2018 Scienceline Publication

Journal of Civil Engineering and Urbanism

Volume 8, Issue 1: 06-11; Jan 25, 2018 ISSN-2252-0430

Operative Guidelines for Sustainable Designing of Child-Oriented Architectural Spaces

Mina Khodadad[1], Seyyed Moein Moosavi Nadoshan[2], Solmaz Khodadad[3], Mohsen Sanei[1]✉

[1]*M.Sc., Dept. of Architecture and Urban Studies, Politecnico di Milano University, Milan, Italy*
[2]*Faculty Member, Dept. of Civil Eng. and Architecture, Shahid Chamran Faculty of Kerman, Technical and Vocational University, Iran*
[3]*M.Sc. Graduate Student, Dept. of Architecture, Islamic Azad University of Tabriz, Tabriz, Iran*
✉Corresponding author's email: mn.sanei@yahoo.com

ABSTRACT: Paying attention to children space has long been important. A large number of researchers have dealt to it, whether in science of psychology and sociology or in the field of architecture. According to the needs of the community and audiences, science of architecture always has seek creative ways to optimize the space for contacts in different fields, such as child-oriented spaces. It has been done with regard to the consideration of human needs and the importance of user's behavior in achieving the goals of sustainable architecture. In addition, according to the theories of psychology, considering the importance of childhood, as one of the most important periods of human life, is so imperative. Therefore, designing a sustainable environment for children is an element, which requires further discussions, and it is necessary to contemplate psychological aspects and behaviors, related to a sustainable approach. In this context, it should be taken into consideration that what the principles of a sustainable design for children are, and, basically, how sustainable environment's definition for the children should be. In this paper, the main effort is to take a step towards sustainable development by raising a discussion of child spaces with a sustainable development approach, and giving a physical dimension to the sustainable development indicators in the areas of children's centers. The research is a descriptive-analytic study, with use of library research method for data collecting, linked with the different categories of sustainability, architecture and psychology. As results, there are some suggested practical solutions to develop physical patterns for designing sustainable children's spaces, each of which could be a field for deeper qualitative and quantitative analysis in future studies.

Key words: Child-Oriented Space, Sustainable Environment, Sustainable Development.

Received 19 Dec. 2017
Accepted 15 Jan. 2018

ORIGINAL ARTICLE

PII: S2252043018000002-8

INTRODUCTION

Children, because of their physical and mental limitations, are more impressible, and instead, they have lower impacts on the environment compared to adults; thus, they are more subordinates of environmental conditions. Barker, founder of "ecological psychology" believes there is a specific relationship between physical aspects of architecture and behavior of physical-behavior stations, which expresses them with the same concepts (Mortazavi, 2001; Young, 1990). In all alive creatures and according to the law of affecting and to be affected in the environment, the tendency to compromise the environment is available, so that child tries to compromise with the environment in which they live (Anbari and Soltanzadeh, 2015).

Sustainable urbanism engages with various aspects of environmental, economic, and social sustainability concerning the urban context (Joss, 2015). [This expression], as a defined term, is application of sustainability and resilient principles to the design, planning, and administration / operation of cities (Sharifi, 2016). Sustainability factors in urban contexts and architecture helps children to understand the importance of environment, energy and resources, and unconsciously, it learns them to take creative steps to conserve resources and their environment. Children obtain information about environment and interact socially as a result of their experiences in the physical environment (Acar, 2013). They are the most sensitive and affected age group of the society. They need to experience social life in their own scale in most sensitive and important years of their lives; that means the period, in which their foundations of personal, physical, mental and social growth forms, until they enter the city. This requires the availability of a childish and intimate space, a space away from the

commotion of the larger world, a place that provides context for children's creativity, a world full of joy with beautiful colors, where the child has the opportunity to express his new ideas, and breed and grow his talents.

In designing of child spaces, child-centered designs have priority. This means that the spaces should be designed for temporary holding of children and this space and all the equipment and facilities should be appropriate for them. A children space should have an exclusive design to meet their needs, particularly in interior design and furniture. Environment is a trainer, and after children's parents, it is their first teacher. Children's pedagogy is transferred through forms, which are made by architecture and their surrounding environment. Sustainable design of children spaces locates in a high degree of importance, because children interact inside and learn from architecture and the space.

During this descriptive-analytic research, which is done by library research method, first, definitions of a child space and sustainability, and the necessity and aims of designing sustainable spaces for children are explained. Then, after describing two study cases, some solutions for designing sustainable children spaces are suggested, as the outcomes of the study. The aim of this study is to offer some practical design features, which are beneficial in order to have more efficient child-oriented spaces.

MATERIALS AND METHODS

Since the aim of this paper is applying the principles of sustainability in the architectural design of children spaces, after reviewing the basic concepts and necessity of this topic through library resources, and analyzing examples of sustainable children's spaces, some results acquired, which led to present executive and easy proposals for designing child spaces.

Child and child space

Child is a Part of the civilized human society and considering children is one of the principles of urbanization. In children space designing, child-oriented approach has priority. This means that the space should be designed for the child's presence. Therefore, children safety during their presence in such spaces should be the main point and guideline in design and construction concepts and standards. Children have an active presence in the environment, as long as all their senses are in balance. For example, noise and air pollution, lack of good physical and mental realm and sense of congestion will prevent children from proper interaction with the environment. In addition, existence of any safety and security threat, which are detrimental for the balance of their mental and environmental power, will prevent their creative talents.

In designing of children space, the aim is to create safety and a sense of belonging to the space. Emphasizing on the exciting environment, creating the necessary conditions for the emotional bond between children in that environment, expanding their social relationships and creating a vibrant environment requires attention to the views of children, as well as quantitative and qualitative criteria and standards related to space.

Sustainability concept

It is not possible to make an exact definition of sustainability in architecture. It is known that this concept, which had been scrutinized with reference to different priorities in every different period, has been discussed under various titles since the 1970s. For instance, while the concept "environmental design" was used in 1970s, "green design" in 1980s, "ecological design" in the late 1980s and in 1990s, the concept "sustainable design" has started to be used since mid-1990s (Arslan, 2008).

Sustainable architecture can be considered as one of contemporary critical events, a subset of sustainable designing, which is a wise reaction against industry era issues and problems (Sanei et al., 2017). Sustainable architecture defines an understanding of environment-friendly architecture under all classifications, and contains some universal consent. In general, it can be argued that in a building, which is a product of sustainable architecture, an environment-conscious architectural code should be used, and therefore, shaping, positioning and constructing practice of the building and its relation to the topography are of great importance. Currently, the buildings could not meet the sustainable environment requirements with reference to both unnecessarily consuming energy and uncontrollable production of wastes. It is known that buildings consume 50% of the energy produced in the world and the other half is consumed in transportation and industry (Cebeci, 2005). According to another study, buildings are responsible for the 40% of carbon dioxide emission in the world (Somali and Ilıcalı, 2009). Sustainable design is an attempt to create maximum comfort of the people with the highest quality of life and create the least damage to the environment (Kiumarsi and Ahmadipoor, 2001).

Necessity of sustainability for children

Moving and playing are two of the child's primary needs. The perception of the environment, space, time and people is dependent on physical activity (Curriculum for Kindergartens, 1999). The goal of "Understanding the role of nature and a clean environment in relation to the physical activities happening there" is the most obvious one in Curriculum for kindergartens. It should be added that children must study how to learn throughout their life, as environmental problems are unpredictable. The children will approach these problems in the future as adults and they will act so independently through learning completely new skills. The consequence of such learning will be an empathetic knowledge (Rifkin, 2009), which

bonds and preserves relationships, emphasizes quality and strives to maintain and increase diversity, respects the legality of life and has the responsibility towards the future in a participative, synergistic and non-aggressive way. This, indeed, is what constitutes lifelong learning and education for sustainable development (Vodopivec, 2011).

In the era of dwindling oil supplies and rising energy costs, the need for low energy lifestyles has never been greater than today (Khodadad and Sanei, 2017). Over the last decades, interest and investments in sustainable energy have increased and, indeed, sustainable energy solutions are increasingly playing important roles in meeting the energy needs of the global community. However, little attention has been paid to the sustainable energy needs of children, despite the fact that sustainable energy solutions can provide major opportunities in terms of improving their health, education, well-being and development (Strohmeier, 2015).

Today, in educational sciences, "environmental sustainability" is one of the main subjects that lesson programs include several studies about. Telling "what sustainability is" only by words is not enough for using the knowledge in practice. Besides, students learn much more by seeing real examples rather than hearing about it. Children's house can be seen as a real example, a 3D textbook written by an architect. Architecture discipline deals with environmental sustainability and defines various sustainability criteria. Environmental sustainability is related with built environment design and designing with the natural environment.

When educators create environments, in which children experience mutually enjoyable, caring and respectful relationships with people and the environment itself, children respond accordingly. When children participate collaboratively in everyday routines, events and experiences and have opportunities to contribute to decisions, they learn to live interdependently. Children's connectedness and different ways of *belonging* with people, country and communities helps them learn ways of *being*, which reflect the values, traditions and practices of their families and communities. Over time, this learning transforms the ways they interact with others (EYLF, 2009).

RESULTS AND DISCUSSION

Aims of designing sustainable spaces for children

- Developing healthy physical and mental activities, and fostering children's abilities to, independently, maintain a healthy and safe life.
- Developing a culture, where sustainable practices are embedded in our daily kindergarten routines and activities.
- Developing a culture that supports children to understand the need for sustainable practices at kindergarten, at home and in the community.
- Developing a culture that encourages every member of our community to reduce, reuse, recycle and rethink.
- Developing a community that understands, recognizes and respects people and their connection to the land (The Sustainable Kindergarten Project – year one, 2013).
- Children develop a sense of belonging to groups and communities and an understanding of the reciprocal rights and responsibilities necessary for active community participation
- Children respond to diversity with respect
- Children become aware of fairness
- Children become socially responsible and show respect for the environment (EYLF, 2009).

The impacts of spaces and design elements on children

Design elements of the physical environment of child care facilities are thought to have important effects on children's behavior (Moore et al., 1995). The physical environments of children have been investigated primarily in terms of spatial understanding (Wohlwill and Heft, 1987). Based on Gibson's (1979) theoretical ideas, we would expect that what the physical environment affords would have an influence on children's perception, learning, and behavior within that environment. Therefore, all affordances within a physical environment affect children's behavior, particularly cooperative behaviors. These affordances include all elements that are used and designed in architectural design of a child space, like differentiation in vertical space, wall colors, and their combination. So it is important to pay attention that what elements are defining in a design and how. For example, colors have important effects in the character of human beings, especially children and create an emotional experience, such as joy, laughter, sadness, grief, comfort, irritability, stillness and excitement. The designers of spaces specific to children cannot be indifferent with valuable and important conclusions in recognizing colors and their impacts on children (Alaghbandrad et al., 2003). For the children inside whom this feature intensified, they prefer vivid and mixed colors that are combined with each other in the right combination, due to their own pure, happy and vibrant spirit. This is the subject, which should be considered in designing, decorating and painting of interior spaces and, also, in appropriate color combinations of open spaces. With different colors, it is possible to illustrate size and weight of a certain object smaller or larger, lighter or heavier. Basically, warm and bright colors cause development of objects and extend

them, while cold and dark colors make objects appear smaller than their size.

Main spaces in a child-oriented designed environment

An environment designed for children should include the following spaces:

1. Natural spaces, such as trees, water and living creatures, which form the most basic and important space for the children.

2. Open spaces and wide spaces, in which children could run freely and release their internal energy.

3. Road spaces, which were children's main playground before the presence of cars. They are places, in which children meet each other, and networks, which connects various spaces together.

4. Spaces for adventure, which are filled with complexity that strengthen children's power of imagination.

5. Hiding spaces, which make children's autonomy grow.

6. Spaces for play structures (playgrounds), which are designed with children's playing and gaming facilities and fascinate them to play, where playing becomes important (Mahdizadeh, 2006).

Examples of sustainable architectural design for children

Two examples of successfully designed children spaces are presented below (Table 1). Related figures are illustrated in article graphical abstract.

Table 1. Sustainable children space examples

Project Title	Project Location & Architect(s)	Important Criteria
Children's Activity & Learning Center	Koh Kood Sub-district, Thailand / 24H-architecture group	- Children communicate with each other through fun activities, in order to increase children's awareness. - Compatible design with bioclimatic aspects. - Structural design of the roof in a cantilever form.
Madison Children's Museum	Madison, USA / The Kubala Washatko Architects	- Building innovative exhibits using natural fabrics and recycled materials. - Tackling indoor air quality and instituting green incentives for employees. - Taking a local approach to an ecological design with a green roof, solar panels and rainwater harvesting.

Suggested solutions for designing sustainable children spaces

- Make diversity in designing of spaces.
- Provide a wide range of play and activity experiences.
- Choose a location near other facilities that children can get to easily.
- Make sure the location and designed places are accessible to both disabled and non-disabled children.
- Develop the project in close co-operation with the local community who use the site, to be loved by the community.
- Design places that allow children of different ages to communicate and play together.
- Use flexible desinging, which allows change and evolution.
- Make the places more inviting to explore, by building some spaces with no predefined function and no sense of where the activity space begins and ends.
- Consider safety regulations with respect to natural disasters and fire.
- Consider safety monitoring of the space for unexpected hazards.
- Cogitate how to minimize vandalism, as you design.
- Use industry standards for playing equipment to ensure children are not exposed to unreasonable risks or unexpected hazards whilst playing.
- Consider safe methods for in-site car transport; e.g. underground routes.
- Design wider hallways and good spatial visibility of people to prevent running collisions.
- Consider safe conditions of the floor or ground surface, as most children's accidents involve falling down.
- Make spaces Ecological, Economic and Healthy by using trees and shrubs in the design.
- Make comfort zones by planting trees in hard surfaces to shade areas of active play.
- Locate the place close to nature, when possible.
- Plant a variety of tree and shrub species for teaching and learning purposes.
- Plant species, which are manageable and sustainable.

- Choose plants which are fast growing, easy to maintain and resilient.
- Choose native plant species, if you want to encourage wildlife.
- Avoid using plants, which are poisonous or uncomfortable to the touch (which have thorns, or leaves with sharp edges) or contain substances that could irritate the skin.
- Use plants and trees for natural ventilation of the environment.
- Consider the conservation, and ideally enhancement of wildlife habitats in and around the space.
- Stimulate the five senses by providing access to music and sound, and different smells made by plants and leaves.
- Provide natural elements for playing, such as sand and water with considering the sustainability of sources.
- Provide natural lighting and ventilation, as much as possible.
- Design proper building envelope.
- Decrease the heat island effect by using outdoor green areas or high-albedo materials.
- Use water recycling methods together with renewable energy production; e.g. solar panels.
- Use rain and recycled water for green area's irrigation.
- Design green and usable roofs or facades; e.g. façade agriculture.
- Design interior green areas, which adds variety and liveliness to the space.
- Consider visual comfort terms (level of light, balance of contrasts, appropriate colors, etc.) in designing.
- Use proper glazing and insulations and not too much insulated places, as it is important to maintain a loose relationship with the outside in order to ensure appropriate immunity and adaptability.
- Consider the position, shape and morphology of the building with respect to sun location and the prevailing directions of the wind.
- Design accurate localization of openings and using suitable types of openings and shading systems, relative to sunlight and wind direction.
- Use appropriate materials in terms of heating capacity.
- Determine drainage flow and avoid planting trees in areas subject to salt runoff.
- Consider using permeable paving on walkways and in parking lots to reduce water runoff and increase ground percolation.
- Use a color or stain for paving to reduce the sun's glare and reflection.
- Strike a balance between areas of hard and soft surfacing.
- Design places, which allow children to manipulate natural and fabricated materials, use tools, and have access to bits and pieces of all kinds.
- Provide suitable solutions for water playing in order to learn the consumption culture.
- Provide suitable solutions for sand playing that fosters construction play, social interactions and experimentation with physical properties.
- Use native, natural, recycled or sustainably sourced materials, instead of synthetic materials wherever possible.
- Avoid constructing with wood that has been treated with chemicals.
- Use appropriate materials, which are resistant against water in walls (washable walls).
- Use granitic sand rather than brick sand or concrete sand, which tends to blow around on dry windy days and can be a safety concern.
- Choose the best surface material for the activities planned – not always the cheapest or easiest surface to maintain. A good choice of surfacing will add activity value to a scheme.
- Use pathways to separate areas in the play space that serve different functions and provide a boundary to areas that should not be entered.
- Provide a variety of path choices to enhance variations for play and exploration.
- Include seating and pull-off points along the path to rest, read or play.
- Create designated paths for tricycle riding and cart pulling.
- Use gates and fences as opportunities for creating a sense of place that speaks to children's imagination and creativity, by defining them as artworks.

CONCLUSION

Sensory impulses, which child receives from his surroundings, are very crucial for his growth progress. Psychologists have discovered the effects of architecture on children's behavior and it is up to architects to integrate these theories with special needs of children in the design process. Needs of infants and children are special. Their rights as members of society, which enables them to expand their social relations, are as significant as impacts of the architecture of buildings, such as homes, hospitals and theaters, on other segments of society. Since education is based on people and the environment, which have impacts on talents of children and their interactions with that environment, speaking about the idea of space, as a factor of education, is not out of discussion.

By designing a sustainable space for children, it is possible to give them information and fundamental concepts of sustainability, through touchable examples, which they know them as their simple experiments. World

needs sustainability a lot and we have to be trained to do our best to get the most benefits out of our resources, while saving them. For this purpose, the awareness of sustainability must be developed, and the experimental-educational form is the most reliable way to achieve this aim.

This paper tried to study the necessity of sustainable design of child-oriented spaces, by reviewing library resources and two case of studies, and as the results, some instructions for designing sustainable children spaces are suggested. It could be recommended for future researchers to analyze, both qualitatively and quantitatively with suitable methods, the impacts of each important suggested implementation in existing examples of children spaces, to have clearer vision of the most effective design solutions.

Authors' Contributions

All authors participated equally in this research.

Competing Interests

Authors declare that they have no competing interests.

REFERENCES

Acar H (2013). Landscape design for children and their environments in urban context. In: Advances in Landscape Architecture. INTECH. 291-324.

Alaghbandrad J, Dashti B, Moradi M (2003). Exposure to violence in adolescents: implication for resilience. Advances in Cognitive Science, 5 (2): 26-36. http://icssjournal.ir/article-1-184-fa.html

Anbari M, Soltanzadeh H (2015). Child-oriented architecture from the perspective of environmental psychology. European Online Journal of Natural and Social Sciences, 3 (3): 137-144.

Cebeci N (2005). Energy saving and architect. Proceedings of 4th Renewable Energies Symposium and Industry Exhibition, Izmir.

Council of Australian Governments COAG. (2009). Belonging, being and becoming, the early years learning framework (EYLF) for Australia. ACT: Australian Government Department of Education and Workplace Relations. https://docs.education.gov.au/system/files/doc/other/belonging_being_and_becoming_the_early_years_learning_framework_for_australia._v5_docx.pdf

Durmuş Arslan Z (2008). Sustainable architecture in Turkey. Architectural Journal, 340:21-30.

Gibson JJ (1979). The ecological approach to visual perception. Houghton Mifflin, 332.

Joss S (2015). Eco-cities and Sustainable Urbanism. In: International Encyclopedia of the Social & Behavioral Sciences, 2nd Edition. Elsevier. 829-837. DOI: 10.1016/B978-0-08-097086-8.74010-4

Khodadad M, Sanei M (2017). Necessity of collaboration between technology and architectural design in order to develop the urban space quality. World Journal of Engineering and Technology, 5: 574-584. DOI: 10.4236/wjet.2017.54049

Kiumarsi V, Ahmadipour F (2001). Intelligent architecture, Master of Architecture Thesis, Shahid Beheshti University, Tehran, Iran.

Mahdizadeh M (2006). A house for children, Master of Architecture Thesis, Tehran University, Tehran, Iran.

Ministry of Education and Sport of Slovenia (1999). Curriculum for Kindergartens. Ministry of Education and Sport (Zavod Republike Slovenije za šolstvo in šport).http://www.mizs.gov.si/fileadmin/mizs.gov.si/pageuploads/podrocje/vrtci/pdf/vrtci_kur.pdf

Moore GT, McCarty AL, Jelin G (1995). Children's village: a safe haven for children of stress and violence. Children's Environments, 1-24.

Mortazavi Sh (2001). Environmental psychology and its applications, Shahid Beheshti University Press.

Rifkin J (2009). The empathic civilization: the race to global consciousness in a world in crisis. Jeremy P. Tarcher/Penguin Group.

Sanei M, Khodadad M, Ghadim FP (2017). Effective instructions in design process of urban public spaces to promote sustainable development. World Journal of Engineering and Technology, 5: 241-253. DOI: 10.4236/wjet.2017.52019

Sharifi A. (2016). From Garden City to Eco-urbanism: the quest for sustainable neighborhood development. Sustainable Cities and Society. 20: 1-16. DOI: 10.1016/j.scs.2015.09.002

Somali B, Ilıcalı E (2009). Assessment of LEED and BREEAM international green building evaluation systems. Proceedings of 9th National Plumbing Engineering Congress, Izmir.

South Australian Government (2013). The sustainable kindergarten project – year one, 2013. South Australian Government, Department for Education and Child Development, Paralowie Kindergarten. http://www.paralowiekgn.sa.edu.au/docs/the_sustainable_kindy_project_year_1.pdf

Strohmeier H (2015). Why sustainable energy matters to children: the critical importance of sustainable energy for children and future generations. UNICEF. https://www.unicef.org/environment/files/UNICEF_Sustainable_Energy_for_Children_2015.pdf

Vodopivec JL (2011). Some aspects of sustainable development in kindergartens in Slovenia. US China Education Review, 12: 967-976.

Wohlwill J, Heft H (1987). The physical environment and the development of the child. In: D. Stokols and I. Altman Eds. Handbook of Environmental Psychology.

Young IM (1990). Justice and the politics of difference. Princeton University Press.