ISSN: 2008-5079 / EISSN: 2538-2365
DOI: 10.22034/AAUD.2019.97361



# Presenting an Analytical Model for Recognizing and Evaluating the Environmental Indicators Influencing the Increase in Social Interactions of Children with Autism in Educational Centers Using Analytic Hierarchy Process

**Abolfazl Karbalaei Hosseini Ghiyasvand[a*]- Mahsa Sattari[b]- Hossein Soltanzadeh[c]- Mojgan Farahbod[d]**

[a] Ph.D. of Architecture, Young Researchers and Elite Club, Qazvin Branch, Islamic Azad University Qazvin, Iran (Corresponding Author).

[b] Ph.D. Student of Occupational Therapist, Department of Occupational Therapy, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran

[c] Associate Professor of Architecture, Faculty of Architecture and Urban Planning, Central Tehran Branch, Islamic Azad University, Tehran, Iran.

[d] Ph.D. Student of Health Management Services, Faculty Member of Curriculum Planning and Research Organization, Education Research Center, Tehran, Iran.

Received 01 February 2017; Revised 05 December 2017; Accepted 30 December 2017; Available Online 21 December 2019

## ABSTRACT

Autism spectrum disorder is a pervasive abnormality in nervous system accompanied by defections in thinking, emotion and feeling, speaking and the ability of communication with others hence leading to the reduction in the interaction level of individuals with autism. In order to create an integrated process for enhancing the social interactions in children with autism, the therapeutic interventions should be conducted by the assistance of proper architectural designing and through considering the role of environmental variables in satisfying the needs of children with autism. Thus, the recognition of the architectural indicators influencing the enhancement of social interactions in the children with autism and evaluation and prioritization of them in architectural designing of these centers seem important. The present article aimed at recognizing and offering an analytical model consisted of environmental indices influencing the enhancement of social interactions in children with autism for prioritizing these indices in designing of educational environments. A descriptive-analytical method was used in this study and the data has been collected in two stages: in the first stage, the study background and theoretical foundations have been compiled using library and documentary research following which the main scales and subscales were identified; then, using the scales found in the first stage, a four-level analytical model was offered comprised of the environmental indices influencing the increase in the social interaction in the children with autism. Afterwards, a questionnaire was prepared using Expert Choice program and it was administered to 15 specialists, including psychologists, occupational therapists and instructors of children with autism. Then, the obtained scales and subscales were rated using analytic hierarchy process and pairwise comparisons. In the end, the autism schools of Qazvin, Zanjan, and Tabriz were selected on which the criteria were evaluated. Finally, the study results indicated that "spatial organization" and "natural elements", with weights equal to 0.42 and 0.32, respectively, had the highest effect inter alia the studied principles and scales on the enhancement on the social interaction level of children with autism in educational environments.

**Keywords:** Autism, Social Interaction, Space Organization, Natural Environmental Elements, Sensory Integration Disorders.

* E_mail: abolfazl.ghiyasvand@qiau.ac.ir

## 1. INTRODUCTION

The autism spectrum disorder is a group of neurodevelopmental syndromes that are phenomenologically caused by multiple genes' inheritance with their specific character being a vast spectrum of damages and losses in social relations and limited and repetitive behaviors. Autism spectrum disorder can be divided into five separate abnormalities: autism, Asperger, childhood disintegrative disorder (CDD), Rett syndrome and not otherwise specified (NOS) syndrome (Sadock & Sadock, 2015, p. 417). Besides being inflicted with defections in socialization and communication, the children with autism have clinical symptoms like attention deficit, challenge with the familiar behaviors and difficulty in sensory processing (Nesa'eiyan, Kazemi, Pishyare, Hashemi Azar, & Farrokhi, 2013, p. 654). Sensory processing refers to the method by which the peripheral and central nervous systems manage the received sensory information (Hatami, 2012, p. 115). In some individuals, sensory processing is not properly done in brain and the sensory information like calls, sounds and motions are incorrectly interpreted every day. These mistakes in information interpretation cause the creation of behavioral problems and malfunctioning in adaptation and response to the environmental stimuli (Nazari & Karaminejad, 2015, p. 39). Upon occurring in one or several sensory systems, the processing problems result in such other abnormalities as behavioral problems, dyspraxia, verbal difficulties, delay in coordinating eyes and hands and high or low sensitivity to foods, sounds and touching that eventually lead to the participation problems (Parham & Maillouz, 2010, p. 373). Sensory processing disorder can lead to the creation of problems in many of the life areas like performing daily life activities, self-confidence and coping skills, playing and social participation (Cosbey, Johnston, & Duun, 2010, p. 463).

The determination of the effect of sensory processing patterns on the various areas of participation enables the psychologists, occupational therapists and architects to reduce the problems resulting from sensory processing by using their special knowledge in their own specific fields and through performing sensory interventions as well as determining proper activities and provide better participation for children in different areas of life. The sensory disorders with which the children with autism are largely engaged create many limitations for them in learning and growth. There is incongruent information about the increase in autism's prevalence during the recent decades. The prevalence rate reported based on the latest statistics by American National Institute of Mental Health (NIH) is eight cases per every 10000 live births. The prevalence rate in the boys is four times more than girls as stated in the reports (Sadock & Sadock, 2015, p. 418).

Based on the studies by Samadi et al. (2012) regarding the children with autism in Iran, the prevalence rate has been reported 6.25 per every 10000 live births (Samadi, Mahmoodizadeh, & McConkey, 2012, pp. 5-12). This statistic is ascending and lack of paying attention to the structure of the educational spaces for these children and overlooking the environmental effects and standards made the present study's authors investigate the effects of the environmental variables on the improvement of disorders in children with autism and offer patterns in proportions to them herein. Recently, interdisciplinary researches in psychology and other fields of studies have been carried out worldwide for these individuals and they showed that the appropriate environments can have a positive effect on the health trend and enhancement of interactions in these individuals. On the other hand, the centers considered for these children are limited and mostly disregard the effect that the architectural and environmental variables can have on the facilitation of the communication considering the sensory sensitivities in these children (Mojahedi, Ghasemi Sichani, Frouzandeh, & Bahramipour, 2014, p. 23). As mentioned in the studies by Mostafa (Mostafa, 2008, pp.189-211; 2014, pp. 143-158) and other researchers (Paron-Wildes, 2013; Beaver, 2010, pp.76-78), controlling the stimuli in the environment plays an important role in preserving the attention and concentration levels in the children with autism. If the architectural spaces are designed based on the foresaid considerations, the children with autism would no longer need to adapt themselves to concentrate and create a personal space and this design process can be effective in the improvement of behavioral disorders of children and consequently, in their interactions and levels of participation. In order to gain a better perception of such a disorder, many definitions and theories have been expressed previously considering the autism mechanisms. The present research paper laid its assumption on the foundation of sensory integration disorder in the children with autism and the role of the architectural environment and space on the improvement of these disorders as also emphasized by researchers like Rimland (1964), Delacato (1974), Anderson (1998), Mostafa (2014) and Kanakri (2017); thus, the present article aimed at the recognition and evaluation of the environmental variables influencing the enhancement of the interactions' level in the children with autism in educational centers and sought to offer an analytical model of the related primary indices in these centers and prioritization of them as well as comparison of the case studies in terms of their adjustment to such indices. Considering the above-presented introduction, the study goals can be proposed as the following:

1) What are the environmental and architectural indices influencing the increase in the interactions' level in children with autism?

2) Do these indices have identical weight and importance in improving the social interaction of children with autism as viewed by the experts?

3) How is the situation of each of the case studies in terms of adjustment to the environmental indices?

The study population included the autism centers in Zanjan, Qazvin and Tabriz. These centers have been selected based on convenience sampling method due to the limited number. The preliminary investigation of these centers showed that the majority of them were not suitable for children with autism in terms of the observation of proper environemntal properties. Some of these centers enjoyed relatively unfavorable statuses in contrast to the global specimens in terms of the spatial arrangement, security properties, spaces' legibility, texture of materials, security, light, color and other environmental variables.

## 2. LITERATURE REVIEW OF THE RESEARCH

In this section, the study literature about the social interaction problems of the children with autism and the important indices of designing special spaces have been investigated so that the primary indicators and their scales were recognized.

### 2.1. Social Interactions in Children with Autism

Difficulty in mutual social interaction is often the most notable aspect of autism. The children with autism may have problems even from very young ages in using and understanding eye contact, facial expressions, cuing and referring, various tones of voice as well as some other issues during communication with other individuals. Many of these children do not exhibit any mutual sensory and social communication and do not spontaneously share their happiness with their parents or cannot readily demonstrate it. The children with autism are not always interested in in their peers but, even if they are found interested, they have problems in finding and keeping friends (Zander, 2005, p. 3). There is this presumption that the behavioral problems of the children with autism spectrum disorders like autoeroticism or avoidance of the social situations is an effort for controlling the incoming sensory information (Baker, Lane, Angley, & Young, 2008, p. 869). These cliché patterns can intensively restric the child's participation in the community and meaningful works (Miller, Vernon, Wu, & Russo, 2014, p. 262).

The ability to take part in meaningful life activities helps the children understand the social roles and cognitive and physical skills required for better growth (Bedell & Dumas, 2004, pp. 65-82; Brown & Gordon, 1987, pp. 828-832).

Some of the individuals with autism spectrum disorder lack many or all of the social competence aspects; a few of them cope with different kinds of defectiveness in social skills and social competence (Jay Contagno, 2014, p. 19). An individual with autism displays severe and long delays in social evolution, particularly in the evolution of interpersonal communication. The shotrtcomings in the social-emotional communication (the ability to get along with others and sharing thoughts and emotions with them) are well evident in minor children with this disorder and they may refrain from starting social interaction or start it in a low level or avoid sharing their emotions along with reduced or absent imitation of the others. The verbal and nonverbal shortages in social communication are differently manifested depending on the individual's age, intellectual level and speaking ability. The shortfalls in the nonverbal behavior such as the uncommon use of eye contact, cuing, facial expression and body orientation are amongst the prevalent social symptoms in these children (Khanjani & Khaknejad, 2016, p. 95).

The children with these inabilities stay away from activities due to the nature of their incompetencies or the issues restricting their normal growth (Panacek & Dunlap, 2003, p. 344). Most of the researches in this regard have concentrated on the children with vivid disabilities such as cerebral palsy, Spina Bifida, acquired brain injury and developmental delay and few studies have dealt with the reduction in social participation in children with non-evident inabilities like autism spectrum disorders, communication disorders, developmental coordination disorder and attention deficit hyperactivity.

### 2.2. Background of the Study

During the recent years, many studies have been conducted regarding the link between architecture and autism and/or designing of autism-friendly environemnts. These studies have shown that the proper architectural designing is effective in improving the children's social interactions and setting the ground for constructing suitable environments for these children. Table (1) has summarized these studies.

**Table 1. Some of the most Important Studies Conducted on the Bond between Architecture and Autism**

| Thinker (Expert)'s Name | | Humphreys (2011) | Mostafa (2008, 2014) | Scott (2009) | Vogal (2008) | Khare & Mullick (2008) | Beaver (2006, 2010) |
|---|---|---|---|---|---|---|---|
| Challenges | Architectural Solutions | School and Educational Space | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Disorder in Imagination: Resistance to change, tendency towards repetitive tasks and limited ability in prediction | Simple and vivid design without details | ■ | ■ | ■ | ■ | | |
| | Use of visual signs (pictorial guides) | | ■ | | | ■ | |
| | Designing intermediary spaces | | | | | | |
| | Use of local activities and index elements | | | | | ■ | |
| Disorder in Communication: Problems in verbal and nonverbal communication as well as in information processing and exhibiting aggressiveness | Avoidance of mess and crowd | | ■ | | | ■ | |
| | Minimization of details | ■ | ■ | ■ | | | |
| | Dedication of separate spaces to activities | | ■ | | | | |
| | Use of pictorial instructions (pictorial guide) in a space | | ■ | | | | |
| | Use of modern technology in designing spaces | | | ■ | | | |
| | Designing spaces for treatment and instruction | | ■ | | | | |
| | Use of neutral backgrounds for preventing distraction | ■ | ■ | | ■ | | ■ |
| Sensory Disorder: Difficulty in processing visual, auditory, deep, atrial and other information | Use of acoustic instruments for controlling the sounds | ■ | | | | | ■ |
| | Use of controlled natural light | | | | | | ■ |
| | No use of fluorescent lamps | | | | | | ■ |
| | Use of smart rooms for experiencing sensory stimulation | | ■ | | | | ■ |
| | Use of controllable heating and chilling systems | | | | | | ■ |
| | Use of soft and proper colors | | | ■ | | | |
| Disorder in Social Interaction: Problem in perceiving the others' affections and emotions and in drawing attention and developing relations | Use of personal spaces in designing | ■ | ■ | | | ■ | ■ |
| | Use of quiet rooms wherein the child can rest when feeling pressure | | ■ | | | ■ | ■ |
| | Designing spaces for interaction with peers, parents and society in the school environment | | | | | ■ | |
| | Offering an array of small and large spaces | | | ■ | | | |
| | Designing vast spaces that can accommodate various games and plays | | | | | | ■ |
| Safety and Behavior: Incorrect understanding of danger, aggressive behavior and misuse of physical elements and equipment | Designing safe physical borders and permitting the movement in a closed space | ■ | | ■ | ■ | ■ | |
| | Use of durable materials with resistance to possible misuses or aggressive behaviors | ■ | | | | ■ | |
| | Designing spaces that maximize the supervision without an emphasis on physical presence | ■ | | | | ■ | |
| | Locking the external doors and windows | | | | | | ■ |
| | Removal of the sharp edges | | | | | ■ | |

According to the studies performed in line with offering proper design solutions for enhancing the social interaction levels in children with autism and based on the investigation of the studied cases, the main indices for designing these spaces can be categorized in four primary sets of space organization, control and secutiry, physical factors of the space and natural environmental elements considering the number of times they are emphasized in the prior research (Table 2). The following section has dealt with a brief introducing of these scales.

## 2.3. Spatial Organization

Corresponding to the study background, the indicator "spatial organization" is composed of three scales, namely "personal spaces and privacy", "spaces' flexibility" and "spaces' predictability". The forthcoming sections have explained each of them in separates.

### 2.3.1. Personal Spaces and Privacy

The personal space required by individuals with autisms differs from that needed by the normal individuals meaning that these individuals need more spaces to be able to establish social relations and this issue has to be taken into account in the designing process, including in the classrooms, corridors, dinning halls and so forth (Jaber, Sanchez, Vazquez, & Seeano, 2011). In other words, the students with autism genrally need more space for movement and dislocation. The presence in the spaces replete with crowds and the limited area is difficult and anxiety-inflicting for them. If the students be able to freely move in the space, they will become happier and feel a sense of freedom (Beaver, 2010, p. 77).

### 2.3.2. Spaces' Flexibility

It is shown in the researches that the cognitive abilities can be extremely increased when the classrooms are divided into various sections with each of them being allocated to a specific activity; for example, the instruction section is constructed physically separate from the other parts and the playground is partitioned into several smaller areas with each serving an independent function (such as study, play, art and so forth). This way, in lieu of a larger place full of distracting factors that allows performing of various activities, these children will be provided with a clearly planned place featuring the capability of controlling the various environmental factors (Woodcock, georgiou, & Jachson, 2013, pp. 1-6). Additionally, it has been proved by Mostafa that physical and visual restriction of the learning environment as well as its adjustment with the needs of children with autism in a special period of time enables them to become more concentrated and memorize the activities. When these children enter such partitioned spaces and see that the equipment, furniture and teacher are always arranged in a special order, everything become predictable for them hence elevates their concentration (Mostafa, 2008, pp.189-211; 2014, pp.143-158).

### 2.3.3. Spaces Predictability

Clear-cut and vivid signs in various spaces are necessary for students with autism who are often dependent on the visual signs. The objective of using such instruments is improving the students' understanding by creating an environment which is predictable and more comprehensible. The visual strategies (use of visual and pictorial signs in the classroom) serve this important goal in three ways:
1) Bring communication to an environment wherein the students are more likely to experience it.
2) Help the students in memorizing the activities and growth and development in their verbal skills and applied communications.
3) Enable students to express their personal experiences (Mojahedi, Ghasemi Sichani, Foruzandeh, & Bahramipour, 2014, p. 51). Therefore, the use of visual aids in various spaces is recommended. Amongst the visual aids, the followings can be pointed out: various methods for supporting the physical environment's arrangement, including how to show the child to sit in a chair, to stand in a particular place, to form a line in a determined place, to go to the next place, to pay attention to a specified thing, to place things in a special place and to do certain activities and to choose from amongst the available options; therefore, when performing interior spatial designing for these children, it seems necessary to consider these signs (Cobt, Xuan, & Rio, 2014, p. 93).

## 2.4. Controlling and Security

Controllability and safety of the spaces are important issues for children with autism because they are unaware of the dangers occuring in their periphery and this is well indicative of the need for supervising and controlling these children; however, in the meanwhile, attentions should be paid to providing them with the opportunity of going out at times allowed by their curriculum and taks; in other words, there should be established balance between their independence and security. To accomplish this goal, the vital issue is constructing a secure space wherein the child with autism can walk around freely (Sanchez, Vazquez, & Seeano, 2011). The concerns about the security of the individuals with autism are increasing mostly as a result of the constant interventions during the recent decades for transferring the individuals with autism from under the shade of institutional care to positions significantly demanding their active presence in the community wherein they would need to cope with the daily life situations experienced by the majority of the normal individuals (OAR, 2014). Thus, it is of a great importance to adopt a clear-cut strategy about

the security in classrooms or other rooms used by these students (Beaver, 2006).

Due to behavioral problems that are prevalent in the majority of the children with autism, they may be found exhibiting aggressive behaviors on certain occasions so all of the elements playing a role in the construction of educational environment should be also taken into consideration in terms of security (Vazquez & Torres, 2013, pp. 148-182). The selection of cases, levels, connecting of the service locations, electrical devices, guardrails, protective barriers, furniture and others should be checked in the environment in terms of security. It is also better if most of these spaces are made with the possibility of visual supervision (Mostafa, 2014, p. 148).

## 2.5. Physical Factors of Space

Light, color, sound, texture and others of the like are amongst the variables that have been taken into account in the majority of the studies according to the special needs of children with autism. These have been examined in the current research paper under the title of "physical factors of space".

### 2.5.1. Light

Lighting is an important factor in designing since it can bring about sublimity in the space or otherwise result in negative effects. The most important subject that is often posited by the instructors of children with autism is the type and quality of the artificial light. The amount of sensitivity and reaction to artificial light sometimes distinguishably differs in the individuals with autism (Anous, 2015, p. 100). In designing lighting systems, it has to be noted that the very extreme reactions by children with autism (especially those who suffer from severe disorders) should be minimized; but, in the meanwhile, the balance and coordination between and with the other cases, including the weak vision of some of the autist students, should be also considered (Beaver, 2006). The transformers in fluorescent lamps produce an audible sound that may be distractive for the students with autism. Although progresses have been made in the structure and performance of the fluorescent lamps' transformers, not all the fluorescent lamps are recommended for installation in the classrooms used by these students; incandescent lamps are mostly suggested to be used in classrooms of children with autism (Long, 2010, p. 116).

### 2.5.2. Color

It is proved in the researches that color influences the human beings' mood and temperaments and therapeutical use of color dates back to a long time ago. In general, light colors are exciting and dark (calm) colors feature tranquilizing effects. However, the effect of special colors on children with autism is not always fixed and it is due to the same reason that it is probably needed to resort to the trial and error for determining a color that can have a favorable influence on a child (White & White, 1987, pp. 223-229). Children with autism seem to be less exact in color memory for the reason that stems from their brains' function (Anous, 2015, p. 100). It is believed that the children with autism perceive 85% of the colors more intensively than normal children (Denise, 2011). However, these children probably respond to some of the colors and patterns different from their normal counterparts. These children's special sensitivities to the colors should be taken into consideration when selecting colors for walls and wallpapers (Cherry, 2012). An environment can destroy the mind of an individual with autism in terms of nervous system by displaying extraneous stimuli on walls, floors and surfaces. Due to the same reason, parents are recommended to design the rooms of their autistic children with calm colors like light blue and green as well as purple. The brain automatically responds to softer colors in a conscious level (Tucker, 2014).

### 2.5.3. Acoustics

Human beings experience various degrees of sensitivity to sounds but autistic children have to make more efforts than others for distinguishing various sounds and they tend to exhibit more sensitivity to the sounds as compared to the other children. The majority of the children with autism live with Hyperacusis meaning that the painful hearing threshold differs for them in comparison to the normal individuals. It is reported by the onlookers that the individuals with autism cover their ears when the sound and noise level goes up (Baugley, 2013, p. 71). The most important aspect of designing for ASD children might be the acoustic status so the buildings designed for them should be able to appropriately respond to this special need of these children (Mostafa, 2008, p. 197). In addition, the acoustic status can influence the materials selection hence the appearance and warmness of the building (Hmphreys, 2011, pp. 9-13). The studies have shown that there is a significant relationship between noise in the autist children-specific educational environments and their behavioral problems within (Kanakri, 2017, pp. 39-44). Environmental control in acoustic terms can have a positive effect on some of the disorders in these children such as attention and response speed (Mostafa, 2014, pp. 143-158).

### 2.5.4. Texture and Materials

As it was mentioned, the existence of tranquility and order is not solely limited to the spatial organization rather it is effective in the method of using the constructional materials, as well (Humphreys, 2011, pp. 9-13). Therefore, it is recommended that use should be made of constructional materials in buildings that expose least details. As for the floor covering materials in the educational centers for

children with autism, it is recommended to use linoleum-made surfaces that can be easily cleaned and dried and are solid and durable.
Care should be exercised so as not to use the floor covering materials that are shiny and highly reflective (Beaver, 2006).

## 2.6. Natural Elements of the Environment

One of the most important factors influencing the autistic children is environment that incorporates natural and artificial spaces and the architects, as environemnt designers, need to be adequately aware of the effect of the natural and artificial environments for these children. Nowadays, bioenvironemntal psychologists have investigated the quality of environment's effect on the various individuals and have identified nature as one of the very important factors in treating various diseases. Amusing and educational environments in the yard for autistic children can help them spend their time in a safe and acceptable environment and can become familiar with the invigorating benefits of the nature based on the educational skills taught in the classroom (Sanchez, Vazquez, & Seeano, 2011). On the other hand, prior studies have proved that the creation of the landscape in the natural environment contributes to the growth in the children's creativity (McCoy & Evans, 2002, pp. 409-426). Moreover, environmental factors can be effective in the sensory disorders of the children with autism (Linehan, 2008). The therapeutic effects of the nature and open spaces have been the source of landscape architects' inspiration for designing healing gardens wherein children can play, learn and become educated (Sach & Vincenta, 2011, p. 3). This natural space can be transformed into a rich therapuetical environment for autistic children (Najib, 2014, p. 129).

**Table 2. Introducing the Main Proposed Scales and Subscales**

| Goal | Principles (W1) | Scales (W2) | Resources |
|---|---|---|---|
| Environmental Indices Influencing the Improvement of Social Interactions in Children with Autism | Spatial Organization | Personal space and privacy | Sanchez, Vazquez, & Seeano, 2011; Beaver, 2006; Beaver, 2010; Woodcock, 2013; McAllister, 2010; Anous, 2015; Tucker, 2014; White & White, 1987; Mostafa, 2008 & 2014; Mostafa, 2014; Kanakri, 2017; Humphrey, 2011; Najib, 2014; McCoy & Evans, 2002; Shibata & Suzuki, 2002; Linehan, 2008 |
| | | Flexibility of Spaces | |
| | | Predictability of Spaces | |
| | Environment's Physical Factor | Color | |
| | | Light | |
| | | Acoustics | |
| | | Texture and Materials | |
| | Control and Security | Limitation | |
| | | Supervision | |
| | | Free of danger | |
| | Natural Elements of the Environment | Play-ability of the natural elements | |
| | | Stimulativeness of the natural elements | |

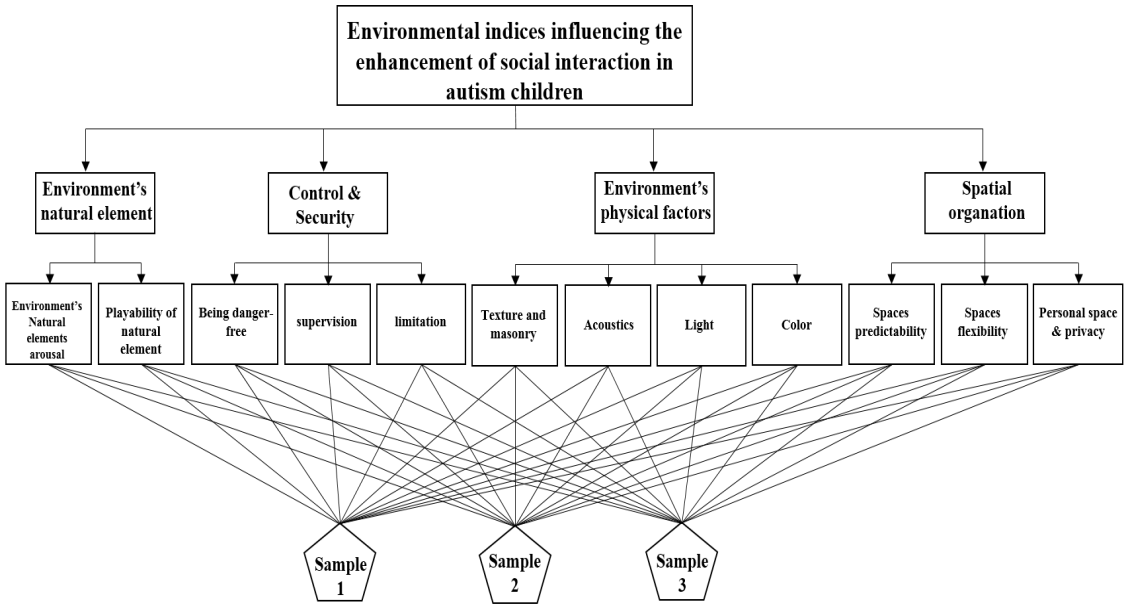


**Fig. 1. The Diagram of the Proposed Analytic Hierarchy Process (AHP)**

## 3. METHODOLOGY

The study method used in the current research paper was of the applied type in terms of the study objectives; it was of a descriptive-analytical type in terms of nature. Two objectives were intended in this article: Firstly, recognition and prioritization of the environmental scales and subscales influencing the enhancement of the social interactions in the children with autism and secondly assessment of these indicators in the study sample volume. In order to analyze the data obtained from the questionnaires and determine the prioritization of the scales and subscales and compare the extent to which these indices have been observed in the studied samples, use was made of analytic hierarchy process (AHP) which is a decision-making technique for solving the multiscale complex problems in the various flexible and quantitative work areas for selecting the options and scales based on their relative performance in respect to one or a larger number of the scales (Boroushaki & Malczewski, 2008, p. 407). The selection of this method has been based on the studied properties, i.e. architectural scales influencing the enhancement of the social interactions in the autistic children as well as the advantages and disadvantages of the other decision-making methods. AHP was used instead of the other rating and decision-making methods for the following reasons:

1) In this method, the quantitative and qualitative scales are used in decision-making and it is the only decision-making model that can measure the consistency of the decision-makers' judgments.

2) Pairwise comparison in AHP method allows the decision-makers extract the weights of the scales and/or the ranks of the options from the pairwise comparison matrices hence a large number of scales can be taken into consideration.

3) AHP helps decision-makers insert the critical aspects of a problem into a hierarchical structure and construct a flexible hierarchical structure according to the problem (Karimi, Mehrdadi, Hashemian, Nabibidhendi, & Tavakkoli Moghaddam, 2011, p. 5).

Figure (1) displays the proposed fuzzy model for the aforementioned goals. In line with this, use was made of the library and documentary researches and investigation of the subject-related background in the first stage to codify the study's theoretical foundation and introduce the main indices. Then, using the obtained information, a four-level model was prepared consisted of the environmental indices influencing the enhancement of the autistic children's level of interaction based on the prior research. In the next stage, a questionnaire was designed using Expert Choice Software and administered to 15 experts, including psychologists, occupational therapists and autistic children's instructors who had sufficient and direct experience regarding these children and had at least worked in this area for five years.

**Table 3. Nine-component Scale for Pairwise Comparison of the Options**

| Definition | Preference Intensity Score |
|---|---|
| Equally preferred | 1 |
| Moderately preferred | 3 |
| Strongly preferred | 5 |
| Very strongly preferred | 7 |
| Extremely preferred | 9 |
| Intermediate preferences (when there are medium states) | 2, 4, 6, 8 |

(Zebardast, 2001, p.17)

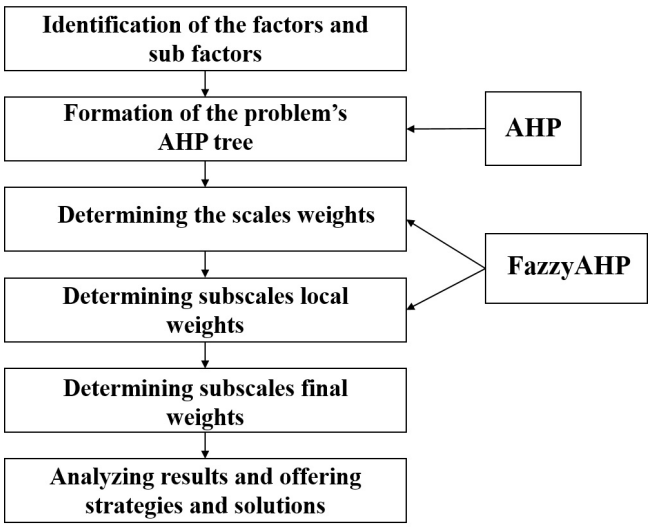


**Fig. 2. Schematic View of the Proposed Analytic Hierarchy Process**

## 4. FINDINGS

The stages of model's application have been explained as the following:

Stage One: The first stage includes the determination of the environmental scales and subscales influencing the enhancement of the interaction levels in the children with autism. These scales have been classified in Figure (1) in the form of a tree.

Stage Two: Formation of analytic hierarchy process based on scales mentioned in the first stage. Hierarchical model has been created in four levels. The model's primary goal, scales related to the enhancement of the interaction level of the children with autism, subscales related to each principle and study samples were placed respectively in the first, second, third and fourth levels.

Stage Three: Determination of the essential priorities according to the goals using the pairwise comparison matrix (W1); the fuzzy scales related to the relative importance for the determination of weights have been given in Table (3). This scale was suggested by Thomas L. Saaty (Zebardast, 2001, p. 15) and has been used herein for solving fuzzy decision-making problem.

Stage Four: Determining the local weight (W2) of the scales and study samples in this stage was a process similar to that in the third stage and aimed at determining the relative importance of the scales according to the upstream principle (the corresponding principle in the higher level of the hierarchy) and the relative weight of the studied samples according to the higher-level subscale (Table 4).

Stage five: Calculation of the samples' final weights (schools "a'', "b" and "c") and evaluation of their statuses: to obtain these values, each level of the options' matrix, given in Table (5), was multiplied by the final weights of the corresponding subscales following which the values of these columns were summed up. The final weights of the options can be observed in the last column of the table. Furthermore, the options' weights can be seen in Diagram (1) in separate for the environmental indicators influencing the interactions in the children with autism. Based on the calculations and analyses, the statuses of the indices influencing the enhancement of the autistic children's interactions can be observed in the studied samples (Table 6).

**Table 4. Hierarchical Diagram with Total Weights**

| Principles (W1) | Scales (W2) | Sample "A" | Sample "B" | Sample "C" |
|---|---|---|---|---|
| 0.42 | 0.42 | 0.625 | 0.238 | 0.136 |
| | 0.28 | 0.333 | 0.333 | 0.33 |
| | 0.30 | 0.250 | 0.500 | 0.250 |
| 0.12 | 0.37 | 0.547 | 0.263 | 0.190 |
| | 0.23 | 0.500 | 0.250 | 0.250 |
| | 0.40 | 0.500 | 0.250 | 0.250 |
| 0.14 | 0.34 | 0.625 | 0.238 | 0.136 |
| | 0.21 | 0.714 | 0.143 | 0.143 |
| | 0.34 | 0.500 | 0.250 | 0.250 |
| | 0.11 | 0.122 | 0.320 | 0.558 |
| 0.32 | 0.76 | 0.333 | 0.333 | 0.333 |
| | 0.24 | 0.333 | 0.333 | 0.333 |

**Table 5. Final Weight of the Three Studied Samples**

| | Spatial Organization (0.42) | Control and Safety (0.12) | Physical Factors (0.14) | Natural Elements (0.32) | Final Weight |
|---|---|---|---|---|---|
| **Sample "a"** | 0.406 | 0.517 | 0.534 | 0.333 | 0.413 |
| **Sample "b"** | 0.342 | 0.255 | 0.236 | 0.333 | 0.313 |
| **Sample "c"** | 0.251 | 0.229 | 0.231 | 0.333 | 0.271 |

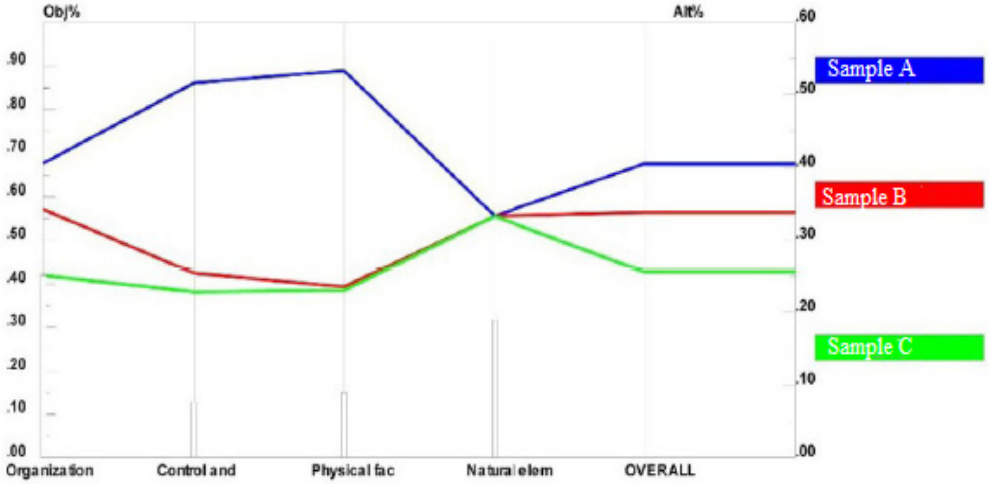


**Chart 1. Efficiency of Investigating the Studied Cases in Terms of the Architectural Indices Influencing the Improvement of the Social Interactions in Autistic Children**

**Table 6. The Statuses of the Indicators Enhancing the Social Interactions' Level in Children with Autism in the Studied Cases**

| Row | Principles | Scale | Sample A | Sample B | Sample C |
|---|---|---|---|---|---|
| 1 | Organization of the Spaces | Personal space and privacy | | * | * |
| | | Spaces' flexibility | * | * | * |
| | | Spaces' predictability | | | * |
| 2 | Control and Security | Limitations | | * | * |
| | | Observation | | * | |
| | | Safety and risk-freeness | * | * | * |
| 3 | Physical Factors | Light | | * | * |
| | | Color | | * | * |
| | | Acoustics | * | * | * |
| | | Texture and masonry | * | * | * |
| 4 | Environment's Natural Elements | Playability of the natural elements | * | * | * |
| | | Stimulativeness of the natural elements | * | * | * |

## 5. CONCLUSION

The present study aimed at recognizing and investigating the environemntal indices influencing the enhancement of the levels of social interactions in the children with autism in educational environments and evaluation of each of these indices in the case studies. In line with this, efforts were seminally made to briefly explore the study backgrounds and theoretical foundations regarding the effect of architectural spaces on the children with autism thereby to identify the primary environmental factors influencing the improvement of the social interactions in autistic children.

The other goal that was dealt with in this article was offering an analytical model for recognizing and categorizing the aforementioned environmental indicators. To achieve this model, use was made of analytic hierarchy process (AHP) in the studied cases. To do so, the indices and scales influencing the enhacement of the interaction levels in autistic children were weighted and prioritized. Then, these scales and indicators were evaluated in the studied cases. According to the study findings, the principles and scales influencing the improvement of social interactions in the children with autism were classified in the proposed AHP model in four principles and 12 scales. The results obtained from Table (4) indicated that "spatial organization" and "use of the environment's natural elements", respectively with weights equal to 0.42 and 0.32, played the most accentuated role inter alia the other attained principles and four variables in enhancing the interactions in these children as viewed by the

experts; and, "physical factors of environment" and "control and security", with weights respectively equal to 0.14 and 0.12, ranked in the next places. These results were consistent with what has been found by Mostafa (2008) and Vogel (2008) who also recommended the interior spaces' organization in adherence to the children's sensory properties as well as the use of open spaces in the schools.

The investigation of the scales, as well, showed that "stimulativeness of the natural elements", "personal space and privacy", "safeness and risk-freeness", "limitation" and "lighting and acoustics" with weights equal to 0.76, 0.42, 0.37 and 0.34, resepctively, were the most important indices of designing the autism specific centers. The aforesaid findings were consistent with the results obtained by Humphrey (2011) who recommended the observation and supevision as well as use of natural light. Table (8) presents the statuses of these indices in the case studies. The table shows the statuses of these indicators in the case studies in separate for each of the principles as well as the final weights of each of the cases. The results indicated that school A, with the final weight equal to 0.413, possessed more appropriate situation in terms of the observance of these principles and indices in comparison to the other specimens. According to the study findings and the amounts of the weights and importance rates of each of the scales, the applied suggestions for designing autism-specific educational center were as explicated in Table (7).

**Table 7. Applied Suggestions for Designing Educational Settings for Children with Autism**

| Row | Principles | Suggestions |
|---|---|---|
| 1 | Spatial Organization | - As pointed out in the prior studies, as well, the spatial arrangement and organization can have a great deal of effect on disorders of these children. The partitioning of the classroom space in the form of flexible spaces, including scientific and sensory sections, places for individual education, tranquility spaces and group instruction or interactive spaces can have positive and significant effects on the attention and concentration and response speed as well as behavioral problems of these children and simultaneously make them feel no spatial restriction that is often felt by these children. Efforts should be made in designing educational settings to avoid sharp corners and curved walls and use circulatory spatial systems instead of corridors. Furthermore, environment can be granted with the required legibility for these children through taking advantage of the pictorial signs on walls and floors.<br>- Use of smart systems like interactive walls and smart systems with sensory stimulation is recommended for these children in the educational spaces. These facilities can influence the sense of environment as well as personal aspects thereby to have a large deal of effect on the perception and recognition hence sensory processing and behavioral problems of these children. |
| 2 | Physical Factors | - In designing educational centers for autistic children, abundant use should be made of natural light. Of course, the light entering the environment should be controlled and it must be uniform. This can be actualized by the means of shades and sandblast glasses. In interior lighting, as well, use can be possibly made of incandescent lamps with warm colors due to these children's sensitivity to vibration and sound of the fluorescent lamps.<br>- According to the high sensitivity of the majority of these children in receiving the sensory stimuli, efforts should be made so that the classroom space be clean of any visual complexities and nerve-stimulating colors and surfaces so it is suggested that the walls' surfaces should be decorated with bright colors and pink and purple tonalities. In addition, the application of crowded and noisy textures and variegated images on the walls and floors should be avoided.<br>- Considering the hyperacusis problem in autistic children, the external and internal sources of the classrooms should be maximally controlled in terms of acoustic pollution. This control can include walls' insulation using rockwool and use of acoustic panels on them, use of parquet on the floor, use of wooden desks and benches for preventing the low frequencies, use of vegetation in the periphery of the educational spaces and so on. |

| | | |
|---|---|---|
| 3 | Environment's Natural Elements | - Environment's natural elements can have an accentuated role in stimulating the sensory systems of the children with autism. The existence of a central partitioning in the autism-specific open spaces considering the various playgrounds such as spaces for playing with sand and natural elements for stimulating the sense of touch, use of vegetation with different colors and odors for stimulating the visual and smelling systems, gardening and collecting parts of the nature for improving the muscular and balance system of the body and playing with domestic animals like horse-riding and others of the like are amongst the cases that can influence the autistic children's sensory processing system. |
| 4 | Control and Security | - According to the fact that the children with autism mostly lack a sense of feeling danger, security issue is of a great importance in designing the educational spaces for these children. In line with this, spatial designing should be in such a way that there are least situations exposing these children to danger. In selecting the furniture, the equipment with sharp corners that the children may climb up them should be avoided. Windows should be placed in a proper height to the ground so that these children have no possibility of exiting them. Additionally, use can be made of vegetation and/or fences and walls devoid of any risk for these children in the precint and spatial limit between the inside and outside. In designing the green spaces, as well, poisonous plants should not be sown within the reach of these children to the maximum possible extent. |

## REFERENCES


- Anderson, J.M. (1998). Sensory Motor Issues in Autism, Therapy Skill Builders. The Psychological Corporation Texas, USA.
- Anous, I.H.I. (2015). The Impact of Interior Design in Educational Spaces for Children with Autism. *American International Journal of Research in Humanities, Arts and Social Science*s. 10(1), 90-101. http://iasir.net/aijrhassissue/aijrhassissue10-1.html
- Baguley, D. (2013). Definitions, Epidemiology and Possible Mechanisms of Hyperacusis. *Audiology Matters,* 21(6), 70-71. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC539655/
- Baker, AE., Lane, A., Angley, MT., & Young, RL. (2008). the relationship between sensory processing patterns and behavioral responsiveness in autistic disorder: a pilot study. *Journal of Autism and Developmental Disorders,* 38(5), 867-875. DOI: 10.1007/s10803-007-0459-0
- Beaver, CH. (2006). Designing Environments for Children and Adults with ASD. *Second World Autism Congress& Exhibition*, Cape Town, South Afric. https://www.autism.org.uk/~/media/nas/documents/working-with/creating-autism-friendly-places/designing_environments_for_children_adults_with_asd.ashx?la=en-gb
- Beaver, CH. (2010). Designing for Autism. *SEN Magazine*, 46, 76-78. Available online: https://senmagazine.co.uk/articles/379-how-can-we-design-autism-friendly-schools.html
- Bedell, GM., & Dumas, HM. (2004). Social Participation of Children and Youth with Acquired Brain Injuries Discharged from Inpatient Rehabilitation: A Follow-up Study. *Brain Injury*, 18(1), 65-82. DOI: 10.1080/0269905031000110517
- Boroushaki, S., & Malczewski, J. (2008). Implementing an Extension of the Analytical Hierarchy Process Using Ordered Weighted Averaging Operators with Fuzzy Quantifiers in ArcGIS. *Computers and Geosciences*, 34, 399-410. Doi.org/10.1016/j.cageo.2007.04.003
- Brown, M., & Gordon, W. (1987). Impairment on activity patterns of children. *Archives of Physical Medicine and Rehabilitation*, 68(12), 828-832. https://www.ncbi.nlm.nih.gov/pubmed/2962558
- Cherry, R. (2012). The Ideal Home for the Autistic Child: Physiological Rationale for Design Strategies. Autism Science Digest, Aavailable Online: https://purposefularchitecture.com/the-ideal-home/
- Cobt, S., Xuan, H., & Rio, Ch. (2014). Setting Up Classroom Spaces that Support Students with Autism Spectrum Disorders. (H. Mojahedi., & M. Hesam, Trsns.). Isfahan: Andishe Guya Publications.
- Cosbey, J., Johnston, S.S., & Dunn, M.L. (2010). Sensory Processing Disorders and Social Participation. American *Journal of Occupational Therapy*, 64, 462-473. Doi: 10.5014/ajot.2010.09076
- Delacato, CH. (1974). The Ultimate Stranger- The Autistic Child. Academic Therapy Publications, Novato, California, USA. https://psycnet.apa.org/record/1975-01338-000
- Denise, T. (2011). Color & Autism: Seeing Color through Autistic Children's Eyes, Available Online: http://color-turners.blogspot.com/2011/03/color-autism.html
- Hatami, R. (2012). Evaluation of Sensory Anxiety Response in Children with ADHD Referring to Tehran Clinics Based on Sensory Questionnaire. MSc Thesis, University of Social Welfare and Rehabilitation Sciences, Tehran.
- Humphreys, S. (2011). Architectural and Autism. *Autism Europe Link*, 55, 9-13. https://www.autismeurope.org/wp-content/uploads/2017/08/LINK-55-EN.pdf
- Jay Cotagno, A. (2014). Group Interventions in the Treatment and Education of Autistic Children (with Emphasis on Social Skills and Competences). (S. Faramarzi., I. Shafiei & F. Ranjbar, Trsns.). Isfahan: Isfahan jihad daneshgahi Publications.
- Kanakri, Sh. (2017). Acoustic Design and Repetitive Speech and Motor Movement in Children with Autism.*Environmental and Ecology Research*, 5(1), 39-44. DOI: 10.13189/eer.2017.050105
- Karimi, A R., Mehrdadi, N., Hashemian, S J., Nabibidhendi, G R., & TavakoliMoghadam, R. (2011). Using AHP for Selecting the Best Wastewater Treatment Process. *Journal of Water & Wastewater*. 21(4), 2-12. http://www.wwjournal.ir/article_1290.html
- Khanjani, Z., & Khaknezhad, Z. (2016). The Effect of Inactive Music Therapy on Symptoms, Communication Deficit, and Social Interaction of Children with Autism Spectrum Disorder. *Journal of Child Mental Health*. 3(3), 97-105. http://childmentalhealth.ir/article-1-105-fa.html
- Khare, R., & Mullich, A. (2008). Educational Space for Children with Autism; Design Development Orocss. Building Comfortable and Liveable Environments for All. International Meeting Georgia tech University Atlanta USA, 15-16. https://www.irbnet.de/daten/iconda/CIB8873.pdf
- Linehan, J. (2008). Landscape for Autism: Guideline and Design of Outdoor Space for Children with Autism Spectrum Disorder. BSc Thesis, Landscape Architecture Program, University of California.
- Long, E. (2010). Classroom Lighting Design for Students with Autism Spectrum Disorder. Ms Thesis, Kansas State University.

- Desgin Research Society Conference, Montreal, Canada, july7-9. https://www.semanticscholar.org/paper/The-ASD-Friendly-Classroom-Design-Complexity%2C-%26-Mcallister/e8b0ec77f2aaa67c41068b737f12d0f8485ddb62
- Mccoy, M., Evans, J., & Gary, W. (2002). The Potential Role of the Physical Environment in Fostering Creativity, *Creativity Research Journal*. 14(3, 4), 409-426. Doi.org/10.1207/S15326934CRJ1434_11
- Miller, A., Vernon, T., Wu, V., & Russo, K. (2014). Social Skill Group Interventions for Adolescents with Autism Spectrum Disorders: A Systematic Review. *Review Journal of Autism and Developmental Disorders*. 1(4), 254-265. DOI: 10.1007/s40489-014-0017-6
- Mojahedi, H., Ghasemi Sichani, M., Frouzande, E., & Bahramipour, M. (2014). Architecture and Autism Design Solutions for Educational Spaces. Isfahan: Khorasgan Branch Azad University.
- Mostafa, M. (2008). An Architecture for Autism: Concepts of Design Intervention for the Autistic User. Archnet-IJAR: *Intenational Journal of Architectural Research*. 2(1), 189-211. DOI: 10.26687/archnet-ijar.v2i1.182
- Mostafa, M. (2014). Architecture for Autism: Autism ASPECTS in School Design. *International Journal of Architectural Research*. 8(1), 143-158. DOI: 10.26687/archnet-ijar.v8i1.314
- Nagib, W. (2014). Toward a Therapeutic and Autism-Friendly Home Environment. A Thesis submitted to the school of Graduate Studies in Partial of the Fulfillment of the Requirment for the Degree Master of Arts, School of Geography and Earth Sciences, Mc Master University, Hamilton, Onatario. https://macsphere.mcmaster.ca/handle/11375/16447
- Nazari, S., & karaminegad, R. (2015). Methods of Accommodation and Modification near Senses Processing Disorder in Children. *Exceptional Education*, 3(131), 39-46. http://exceptionaleducation.ir/article-1-534-fa.html
- Nesaeyan, A., Kazemi, F., Pishyare, E., Hashemi Azar, J., & Farrokhi, N. (2013). Sensory Processing Patterns of Autistic Children from Teachers' Point of View. *Journal of North Khorasan University of Medical Sciences*. 5(3), 653-661. DOI: 10.29252/jnkums.5.3.653
- Organization for Autism Research. (2014). *Life Journey Through Autism: A Guide to Safety*. https://researchautism.org/resources/a-guide-to-safety/
- Panacek, L., & Dunlap, G. (2003). The Social Lives of Children with Emotional and Behavioral Disorders in Self-contained Classrooms: A Descriptive Analysis. *Exceptional Children*. 69(3), 333-48. Doi.org/10.1177/001440290306900305
- Parham, L.D., & Mailloux, Z. (2010). Sensory Integration. In: Case-Smith, J., Allen, AS., & Pratt PN, Editors. *Occupational Therapy for Children*. 5. St, Louis, MO: Elsevier. 356–411. https://scholar.google.com/scholar?hl=en&as_sdt=0,5&cluster=1189418731794651814
- Paron- Wildes, AJ. (2013). *Interior Design for Autism from Childhood to Adolescence*. Wiley E-book Design Shorts.https://books.google.nl/books/about/Interior_Design_for_Autism_from_Childhoo.html?id=smzrAQAAQBAJ&redir_esc=y
- Rimland, B. (1964). *Infantile Autism*. Appleton Century Crofts, New York, USA. https://psycnet.apa.org/record/1964-35017-000
- Sachs, N., & Vincenta T. (2011). Outdoor Environment for Children with Autism and Special Needs. *Implications.* 9(1), 1-8. Retrieved June 5, 2014, Aavailable Online: http://www.informedesign.org/_news/april_v09-p.pdf
- Sadock, B.J., Sadock, V., & Ruiz, P. (2015). *Kaplan & Sadock's Synopsis of Psychiatry: Behavioral Sciences/clinical Psychiatry*. 11, Illustrated, Wolters Kluwer Publition. https://www.amazon.com/Kaplan-Sadocks-Synopsis-Psychiatry-Behavioral/dp/1609139712
- Samadi, S.A., Mahmoodizadeh, A., & McConkey, R. (2012). Anational Study of the Prevalence of Autism among Five-year-old Children in Iran. *The National Autistic Socieety*. 16(1), 5-12. DOI: 10.1177/1362361311407091
- Sanchez, P., Vazquez, F., & Seeano, S.L. (2011). *Autism and the Built Environment, Autism Spectrum Disorders,* From Genes to Environment, prof. Tim Williams(ED), in Tech, Available from: www.intechopen/book/autism, spectrum, disordersfrom, genes to environment/autism and built environment
- Scott, L. (2009). Designing Learning Space for Children on thr Autism Spectrum. *Good Autism Practice*. 10, 36-51.https://www.researchgate.net/publication/233696730_Designing_learning_spaces_for_children_on_the_autism_spectrum
- Shibata, S., & Suzuki, N. (2002). Effects of an Indoor Plant on Creative Task Performance and Mood, Scand g Psychol, 45(5). DOI: 10.1111/j.1467-9450.2004.00419.x
- Tucker, K. (2014). The Best Room Colors for Children with Autism, Available Online: http://everydaylife.globalpost.com/room-colors-children-autism-10950.html
- Vazquez, F.S., & Torres, A.S. (2013). Autism and Architecture, *Recent Advances in Autism Spectrum Disorders.* II(9), 177-186. Doi.org/10.5772/53679

- White, B.B., & White, M.S. (1987). Autism from the Inside. *Med Hypotheses*. 24(3), 223-229. DOI: 10.1016/0306-9877(87)90068-5
- Vogel, C. (2008). Classroom Design for Living & Learning with Autism. Autism Aspergers Digest, may-june. http://www.designshare.com/index.php/articles/classroom_autism/
- Woodcock, A., Georgiou, D., & Jachson, J.A. (2013). Designing a Tailorable Environment for Children with Autistic Spectrum Disorders, *Triannual Ergonomics Conference*, Netherlands, July14. https://pureportal.coventry.ac.uk/en/publications/designing-a-tailorable-environment-for-children-with-autistic-spe
- Zander, E. (2005). *AUTISM FORUM Handikapp & Habilitering*, Box 17519, 118 91 Stockholm 08-690 60 52, www.autismforum.se, Aavailable online: http://habilitering.se/sites/habilitering.se/files/introduktion_om_autism_persiska.pdf
- Zardasht, E. (2001). Application of Hierarchical Analysis Process in Urban and Regional Planning. *Journal of HONAR-HA-YE-ZIBA MEMARI-VA-SHAHRSAZI*. 10, 13-21. https://www.researchgate.net/publication/285851870_The_use_of_hierarchy_analytical_process_in_urban_and_regional_planning

**HOW TO CITE THIS ARTICLE**

Karbalaei Hosseini Ghiyasvand, A., Sattari, M., Soltanzadeh, H., & Farahbod, M. (2019). Presenting an Analytical Model for Recognizing and Evaluating the Environmental Indicators Influencing the Increase in Social Interactions of Children with Autism in Educational Centers Using Analytic Hierarchy Process. *Armanshahr Architecture & Urban Development Journal*. 12(28), 73-87.

DOI:10.22034/AAUD.2019.97361

URL: http://www.armanshahrjournal.com/article_97361.html