



The impact of Interior Design in educational spaces for children with Autism

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Abstract: Many descriptions of autism describe people like as “not wanting contact with others” or “preferring to live alone”, how can interior design intervenes to affect on the autistic behavior? Interior design, as profession, is responsible for creating environments that accommodate the needs of all types of users. Special needs individuals should not be exempt from such accommodation. Without any doubt, autism is one of the most complex disorders Medicine and Psychology have confronted. Interior designers play an important role in creating spaces that may help individuals with Autism better understand their place in the environment with spatial designs sensitive to their needs. Learning environment is important in promoting the development of autistic children. Environments can attract and stimulate their interest when they participate skill enhancing activities. This research gives an overview of the different approaches to designing learning environment and illustrates the environmental factors, special design considerations concerning various space which enhance autistic children's development for a better future of individuals with autism.

Keywords: Autism, Autism Spectrum Disorders, Autism Friendly Design, Sensory design, Educational Spaces for Autism.

I. Introduction

The interior design for buildings of autistic users is a major topic for research. According to the Center for Disease Control and Prevention, one in every 88 children is affected by autism. Autistic behavior is characterized by repetitive behavior, limited communication skills, challenges in social interaction and introversion. Creating an appropriate environment plays a significant role in the overall success of the behavior, education and care of individuals affected by autism. Autism may be a result of a malfunction in sensory perception, so the sensory environment and its relationship to autistic behavior seems to be the key that designing for autism revolves around. “Neuro-Typical” approach and “the Sensory Design Theory” are the two polar opposite approaches to designing for autism.

II. Research problem

The Research problem is related to the lack of research which discuss the impact of interior design on the behavior of autistic patients. Failure to apply the correct interior design criteria in the small number of centers which will reflect negatively on the development of an autistic child's behavior.

III. Research objectives

This research aims to illustrate the impact of interior design elements on autistic behavior, study the interior design criteria and special design considerations for Children with autism care centers to be appropriate therapeutic environment for them, Shed light on this marginalized group of society and give it the attention it deserves. Extend a bridge of communication between patient with autism and the world around him in order to adapt to the community, participate in it for a better quality of life of those individuals.

IV. Methodology

The paper is divided into five sections: the first explains some Fundamental concepts about Autism. The second includes the interior design considerations in buildings for people with Autism. The third section gives an overview about the most recent design approaches for Autism treatment centers and educational spaces. The fourth section explains two cases studies for famous schools for autism. The last sections discuss how to design an ASD friendly learning spaces including Classroom Design, Specialized Therapy Spaces and Outdoor Learning Spaces. The researcher follow the inductive approach through access to the latest scientific literature and websites related to the subject of research and the analytical approach by the study and the analysis of the interior design of some projects for autism.

V. General concepts about Autism

A. What is Autism?

[AW-TIZ-UHM] from Greek "Autos: SELF. Autism is a complex neurobehavioral disorder characterized by impairment in reciprocal social interaction, impairment in communication, and the presence of repetitive and stereotypic patterns of behaviors, interests and activities [1]. In addition, sufferers often struggle with sensory sensitivity to visual, auditory, tactile, proprioceptive, gustatory and olfactory stimuli. Some sufferers may be able to live relatively independently, others will require lifelong continuous support [2]. Autism is regarded as the most severe psychiatric syndrome of early childhood. Because the disease cannot be fully treated, the autistic child becomes the autistic adult, its condition depending on the severity of the syndrome and mostly on the treatment process. Since any person will spend about 75% of his life as an adult, the task of autism treatment is to prepare children to gain independence and to insure integration into society [3]. Autism can be obviously seen when children are three years old. The severity of impairment varies from individual to individual, this can be categorized into three levels: mild autism, moderate autism and severe autism. Autism of each level leads to various behaviors and different levels of sensory perception impairment [4]. Although autism affects the functions of the brain, the specific cause is not known [5]. Autistic Spectrum Disorders (ASD) became the usual name of what we know, generally speaking, as autism. [6]. In 1970 and 1980, the rate of autism was one out of every 2000 children. Now the centers for Disease control and prevention (CDC 2013) estimates the rate is closer to 1 out of every 50 children in the United States [7]

B. Autism Spectrum Disorder(ASD)

Autism is not a single disorder, but a spectrum of closely-related disorders with a shared core of symptoms [8]. Autism Spectrum Disorder (ASD) is an increasingly popular term that refers to a broad definition of autism including the classic form of the disorder as well as closely related disabilities that share many of the core characteristics. Although the classic form of autism can be readily distinguished from other forms of ASD, the terms autism and ASD are often used interchangeably [5]. Autism is a spectrum disorder, meaning that there is a wide degree of variation in the way it affects people. Every child on the autism spectrum has unique abilities, symptoms, and challenges [8].

C. The Autist person (who is the autist)

"Is autistic that person to whom other people become opaque and unpredictable, that person who lives like absent –mentally absent– towards people present, and whose conduct these latter feel incompetent to rule by means of communication" [9].

D. The logo of autism

The logo of Autism is puzzle, because Puzzle indicates the mystery and complexity of Autism; Each puzzle piece indicates the children with Autism waiting to complete the picture and give it a meaning. Each puzzle piece is different and unique but gives a meaning when put together properly in the big picture. It indicates the diversity of the individuals effected with Autism [10].

E. Autism Symptoms

The severity, frequency, and grouping of the following symptoms will determine where (if at all) an individual will fall on the autism spectrum ; Repetitive behaviors (may want to watch the same program over and over again). Unresponsive to commands or questions ("in their own world"). Delayed speech & language development (non-verbal, especially by age 3). Lack of imitation of others or imaginative play. Indifferent to the feelings of others. Hypersensitivity to light & sound (covers ears when music is played or covers eyes when going outside). Self-stimulatory behaviors (e.g., rocking, jumping up and down, hand flapping). Echolalia (Repetition or echoing of a word or phrase just spoken by another person). Unusual emotional responses (inappropriate laughing or crying). Frequent temper tantrums / meltdowns. Responds adversely to physical affection, hugs, kisses, etc. shows no interest in making friends. Does not initiate conversation. Very poor diet (may eat only starches). Frequently walks on tip-toes as a toddler. Socially withdrawn or socially awkward. Shows little expressive language. Clumsiness (falls or trips often). Improper use of pronouns, statements, and questions. Unusual tone or rhythm of speech. Self Injurious Behavior (head banging, scratching/biting self). Frequently makes irrelevant remarks. Difficulty with abstract language and concepts. Be preoccupied with one or only a few narrow interests. Need for sameness (adheres to routines). Severe tantrums when routines are disrupted. Shows an attachment to unusual objects such as car parts, branches, leaves, etc. Fascination with spinning objects or spinning one's self. Very good at rote memory tasks such as repeating lists of items or facts [5].

F. The triad of Autism impairments

People with autism see that the world, is a mass of people, places and events which they struggle to make sense of, and which can cause them considerable anxiety. The characteristics of autism vary from one person to another but are generally divided into three main groups: Difficulty with social communication, Difficulty with social interaction, Difficulty with social imagination. The first impairment means that people with autism have difficulties with both verbal and non-verbal language. Many have a very literal understanding of language, and

think people always mean exactly what they say. The second impairment means that people with autism often have difficulty recognising or understanding other people's emotions and feelings, and expressing their own, which can make it more difficult for them to fit in socially. The third impairment means that people with autism find it hard to: understand and interpret other people's thoughts, feelings and actions, predict what will happen next, understand the concept of danger [11].

G. Three theories explaining Autism

(1) Theory of mind: Consider that people with autism lack a "Theory of Mind", so that they are incapable of assigning mental states (emotions, thoughts, etc.) to other people. This absence of a Theory of Mind would explain social impairments observed in people with ASD and the difficulty to participate in a normal social interaction. (2) Theory of central coherence: considers people with autism would present an impairment of the cerebral mechanism that confers coherence to the wide range of stimuli we receive. (3) Theory of executive functions: considers that people with autism lack control over these executive functions. This impairment would also be the origin of stereotyped and repetitive behaviours, which would not be correctly governed by an executive or supervisory system [4].

VI. Interior Design Parameters in buildings for people with Autism

A. The eighteen 'design parameters' by Khare & Mullick

Children with autism are found in all countries in the world of different cultural expectations, different attitudes to education and disability and very different levels of resources [12]. A study by Khare & Mullick in 2009 identifies eighteen 'design parameters' that defines the enabling environment for autism and acts as a measurable quantity in the study [13]: (1) Provide Physical Structure: organize environment with clear visual and physical boundaries. These will help to create a definite context for each activity in association with a given space. (2) Maximize Visual Structure: organize visual environment by means of concrete visual cues. This would comprise aspects as colour coding, numbers, signs, labels, etc. [9]. (3) Provide Visual Instructions: is a way of giving necessary instructions or sequence of steps to follow an activity, using visual mode [13]. (4) Offer Opportunities for Community Participation refer to involvement in the community activities in every day occupations. (5) Present Opportunities for Parent Participation: involves parents in school activities, thus aiding to address pupils' educational needs. (6) Present Opportunities for Inclusion: provides an environment for children with autism that allows them to interact with their peers. (7) Maximize Future Independence: an environment that supports self help, domestic, vocational and independent living training help children with autism to live with dignity in future. (8) Offer Generous Space Standards: these will help children with autism to face social demands, since they are rather wary about their personal space. (9) Provide Withdrawal Spaces: quiet areas in which pupils with autism can retire to avoid or mitigate the stress they can feel in certain moments, when they are in spaces where socially demanding situations may occur [14]. (10) Maximize Safety: refers to minimizing threats to the pupil within the school buildings due to their own condition, including, in many cases, the misperception of dangers. For safety in educational environment there may be concerns for escapes, sharp edges, non toxic materials etc. (11) Maximize Comprehension: clear arrangement of spaces, direct routes between them, neat zoning, use of simple forms, and uncluttered interiors help children with autism to perceive –and to apprehend– their school environment. (12) Maximize Accessibility: impairments in movement coordination and balance, epilepsy, restricted attention span, and other difficulties demand that the building be physically accessible. (13) Provide Assistance: Majority of the children with autism need aide in regular classroom, for 1:1 teaching, parallel teaching or group teaching, and a good numbers of teaching assistants are present in the teaching spaces with the lead teacher. (14) Maximize durability and minimize maintenance costs: equipment, furnishing, fixtures, fittings, and materials and systems in general should be durable –especially taking into account possible aggressions and misuse by pupils– and require little and inexpensive maintenance. This is possible when architects design easy to clean surfaces, robust finishes, strong furniture and equipments and fittings, those are serviceable and cheap to replace. (15) Minimize Sensory Distractions: interior designer through his design has control over this input and he can design calm and Least Distractible Environment conducive to learning. (16) Provide Sensory Integration: include multisensory stimuli within the environment, providing opportunities to roll, jump, spin, as well as vibrations, music, visual experiences. (17) Provide Flexibility: environment has to be flexible enough to accommodate a wide range of functional skills and different teaching paradigms. (18) Provide Monitoring for Assessment and Planning: it is necessary to control or monitor pupils with the lesser degree of distraction and intrusion, in order to assess them, grant their safety and plan activities, teaching strategies, etc [14], [9], [13]. Environmental factors such as cultural acceptance, early intervention and educational programs have already been shown to substantially improve the quality of life for those on the autism spectrum [15].

B. The eight 'design criteria' by Simon Humphreys

Simon Humphreys, an architect with a wide range of experience in designing for autism, including designing a home for his brother who has autism. Humphreys (2008) sketches a variety of criteria to be considered when designing buildings for people with ASD. (1) Calm, Order and Simplicity. (2) Minimal Detail and Materials. (3)

Proportion .(4) Natural Light . (5) Proxemics: individuals with ASD may need more space for social relationships, and this has to be taken into account in the design process –including classrooms, corridors, halls, dining-rooms.(6) Containment: this concept refers to the need to monitor children with ASD, but, simultaneously, to the opportunity for them to wander ,create a safe place where a child with ASD can walk freely. (7) Observation: as noted before, this will fulfil the need of supervision, but avoiding, at the same time, excessive intrusion in the child's activities or interactions.(8) Acoustics: people with ASD often have to make an enormous effort to differentiate sounds, and are more sensitive than other people to noises. The acoustic properties of materials and constructive elements and systems must be taken into account [9].

Thomas Bewick Autism School by Humphreys

The architect Humphreys designed the Thomas Bewick Autism School in Newcastle, United Kingdom"Fig.1" . The idea was that the Junior and Senior schools are separated by the main communal and administration departments. The classrooms for each school are located off a courtyard, defined by the Golden Spiral. It is this courtyard that provides a constant source of reference when you circulate around the building or exit a classroom. The intention being that you are always connected with this source of reference and able to easily locate yourself at any point within the building therefore providing a source for calm, order and clarity [16].

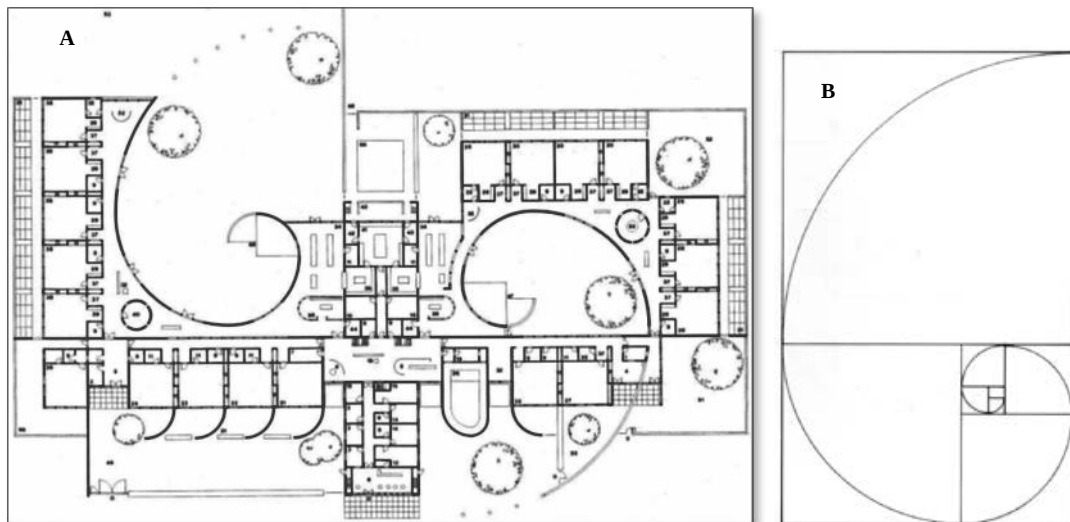


Fig. 1: Fig 1 a shows the plan of Thomas Bewick Autism School by Humphreys . It is an all age specialist provision in Newcastle upon Tyne for children and young people with autism (3-19 years) Fig 1.b: The diagram at the right shows the golden spiral in operation creating a series of rectangles which can be used in plan and section. This proportion can help achieve well balanced spaces.

VII. Recent Design Approaches for Autism Treatment Centers and Educational Spaces

Present design methods for autism treatment centers concentrate either on skill development (Sensory Design Theory) [17] or rigid adaptation to day-to-day circumstances (Neuro-Typical Approach) [18]. In accordance with treatment plans, the two major design approaches have been created, both based on the perception issues of people with autism, and also possessing features almost opposite to one another [19].we must first discuss about Sensory Integration and relation between Autism and Sensory environment.

A. Sensory Integration and Sensory environment

A.1 Definition of Sensory Integration

Autistic children frequently have difficulties with sensory integration which are the senses that are experienced through sight, touch, sound, taste and smell [20].Sensory integration is the organizing of all the information that comes in from the senses. In conclusion , sensory integration is a child-directed, sensory enriched therapy that depends upon a specialized environment. It can be both playful and fun, while being active and flexible. Most therapists consider it to be both an art and a science [21]. Sensory processing refers to our ability to take in information through our senses (touch, movement, smell, taste, vision, and hearing), organize and interpret that information, and make a meaningful response [22].

A.2 Autism and Sensory environment

The key to designing for autism seems to revolve around the sensory environment and its relationship to autistic behavior. The sensory environment has been part of the autism dialogue, this dialogue hypothesizes that autistic behavior may be a result of a malfunction in sensory perception. This malfunction may take the form of hyper-sensitivity or hypo-sensitivity, in its various degrees and across the scope of all the senses, leaving individuals with autism with an altered sensitivity to touch, sound, smell, light, color, texture etc. Sensory Design Theory is based on the concept of the sensory environment as a major role player in the process of perception and behavior development[17]. When designing areas for children on the autism spectrum, it is important to have knowledge and understanding of how they experience the environment and the people and objects within it [23].

B. Two approaches for Autism Treatment Centers and Educational Spaces

B.2 The first Approach :Neuro-Typical Design

The Neuro-Typical Approach is centered on direct integration to different typical urban and public situations .It proposes the immersion of the autistic user in as typical and stimulating an environment as possible, in order to encourage adaptation to the overstimulation so typical of the disorder and to replicate the level of stimulation found in the real world. It would best prepare the autistic user for the generalization of his or her skills, particularly those acquired in a learning environment, to the outside world [17]. It offers High stimulus environment, inadequate for severe autism, focused on adapting to environment. Results are relevant on a long term therapy, limited skill development, and underestimates autistic sensory deficiencies [19].

B.1 The second Approach: Sensory Design

The Sensory Design Theory, which stipulates that favorably altering the sensory environment, can be conducive to positive and constructive autistic behavior, particularly in learning environments [17]. It focuses on creating a controlled sensory environment that makes autistic people feel comfortable, therefore facilitating skill acquirement. It offers Low stimulus environment, adaptable to severe autism and focused on skill acquirement. It may limit integration for less severe cases and requires more effort and well trained therapists but insufficient for real world situations [19].

(a) The Autism ASPECTSS™ Design Index

Dr.Magda Mostafa, associate professor in the Department of Construction and Architectural Engineering at the American university in cairo , created the Autism ASPECTSS™ Design Index, which outlines seven architectural design criteria that allow individuals with autism to focus better and improve their skills [24]. The Autism ASPECTSS Design Index, is a unique tool that assesses architectural environments for people with autism. It was developed with the input of teachers, parents, and caregivers and is now being applied to other projects internationally [25].

(b)The principles of The Autism ASPECTSS™ Design Index

1. Acoustics: are the most influential feature of the sensory environment upon autistic behavior [17]. A sense of calm will encourage better behaviour and a feeling of well-being amongst residents and staff. It influences the choice of materials and so the look and warmth of the building.[26] This calls for the reduction of internal and external noise sources through various means such as cavity walls, sound proofing and sound absorbent materials, spatial configuration to reduce echoes and isolation of sound emitting building systems and avoidance of sound-emitting fixtures such as fluorescent lighting [27]. On the floor , a new type of floor covering was suggested for the ASD specific house based on a Flotex design; a robust and durable product [27].This does not call for the complete soundproofing of spaces. Consequently this would allow for the generalization of skill in non-acoustically managed spaces in the real world [28]. Activities of higher focus, or according to Sensory Design Theory, those taking place in “low stimulus zones”, should be allowed a higher level of acoustical control to keep background noise, echo and reverberation to a minimum [14]. In order to rise the level of integration for people with autism , there needs to be a gradual transition from high controlled environments, towards more stimulating situations that simulate the urban environment scenarios [29].

2. Spatial Sequencing: This criterion is based on the concept of capitalizing on the affinity of individuals with autism to routine and predictability [17]. It calls for the alignment of the sequential organization of space and the daily routine of the users, through a series of smooth transitions from one space to another, in a manner that follows the typical daily schedule of users [28]. Spatial Sequencing requires that areas be organized in a logical order, based on the typical scheduled use of such spaces [17].

3. Escape Space: The objective of such spaces is to provide respite for the autistic user from the overstimulation found in their environment [14]. These spaces should be intimate in scale and can range from the completely physically and visually enclosed to the subtly defined [28].

4. Compartmentalization: The philosophy behind this criterion is to define and limit the sensory environment of each activity, organizing a classroom or even an entire building into compartments [17].This criterion outlines the organization of spaces in a series of mono-functional compartments, allowing for single activities and smaller numbers of users. An architectural opposite of the universal open-plan space, this approach tries to reduce the sensory and social input an autistic user has to deal with to the minimum required to carry out their activity. These compartments can be defined using various means- from complete enclosure using walls and partitions, to moderate enclosure using carefully placed furniture and variances in levels, to a minimalistic definition using perhaps colour, pattern and finishing material to define each space[28].

5. Transition Spaces: Working hand in hand with Spatial Sequencing and Sensory Zoning, this criterion allows for the sensory shift from one activity to another, or one sensory level to another, and helps avoid abrupt changes in function and stimulation. It helps ensure the seamlessness required when circulating from one zone to the next [28].

6. Sensory Zoning: This criterion proposes that when designing for autism, spaces should be organized in accordance to their sensory quality, rather than the typical architectural approach of functional zoning. Grouping spaces according to their allowable stimulus level, spaces are organized into zones of “high-stimulus” and “low

stimulus”[17]. Sensory zoning calls for the grouping of spaces with similar sensory stimulation levels together, into high, moderate and low stimulation zones. Transition spaces should be used between these zones, and circulation should be planned following the daily routine as called for by the spatial sequencing criterion[28].

7. Safety: is even more of a concern for children with autism who may have an altered sense of their environment [17]. Behavioural problems are also frequent in children with ASD, and may lead to aggressive conduct, meaning that the elements in the built environment have to be designed , so safety considerations should be taken with all building systems [30] : material choices, surfaces, bathroom fittings, electrical devices, metaldoor fittings, banisters and railings, exterior carpentry, tiles , protective barriers, furniture, fixtures etc. It is best that most spaces also be visually accessible to allow safe monitoring of children [28]. Using soft surfaces for furniture and floors could lessen this potential for physical injuries . It is recommended avoiding glass surfaces for tables [31].

VIII. The analytical study

A. Applying the Neuro-Typical approach : A case study of the Developmental Learning Center (DLC)

A.1 The project description (DLC)

The Developmental Learning Center (DLC)in Warren, New Jersey (2007)is a unique, specialized learning center providing for the special needs of students with autism and related disorders. At 168,000 square feet, the building construction is designed more traditionally residential than institutional with a ground level entrance, core student level, and an administrative office level, covered walkways, peaked roofs and skylights. The building maintains a student population of 200 – 250 and is divided into three main sections targeted to specific ages: a preschool/primary wing (ages 3-5, 5-8), an intermediate wing (ages 9-13), and a secondary wing (ages 14-21). The facility contains classrooms, learning labs, atrium, health & fitness facilities, cafeteria and diner, kitchen, administrative offices, storage and mechanical/electrical rooms [32].

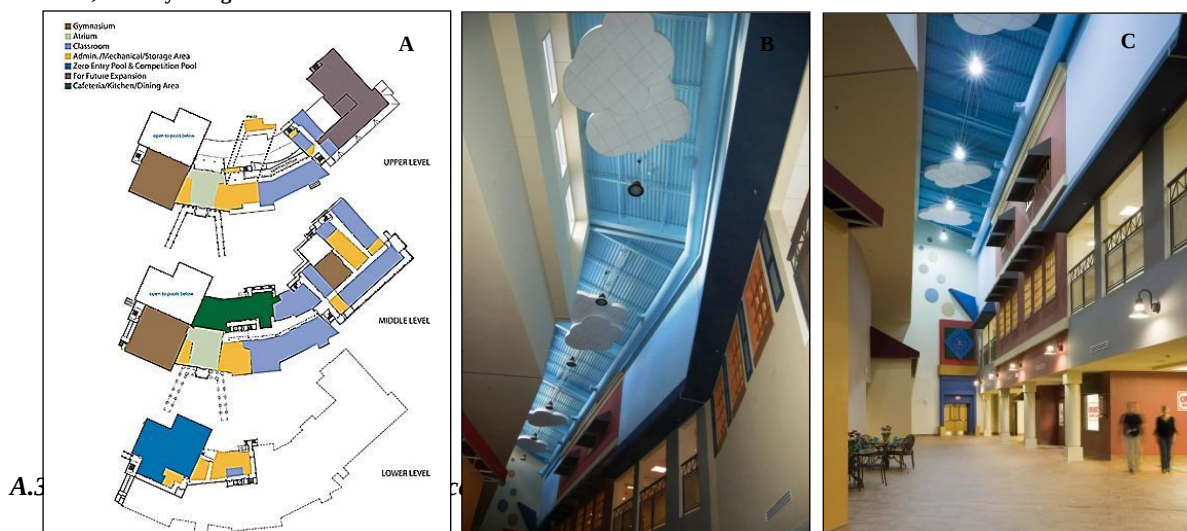
A.2 Architecture and interior design philosophy

USA Architects’ concept for (DLC) “was to replicate the environments and social settings that students would normally travel “off-campus” to experience and so students can learn in ‘real’ world settings if they will ever have a chance to use their acquired skills outside of the classroom[33] "Fig 2", "Fig 3".

Fig . 2: ShowsThe Developmental Learning Center (DLC)in Warren, New Jersey



Fig.3: Fig 3a shows Plans with represented functions, Fig 3b , 3c show The heart of the facility : “Main Street,” the central corridor of the school with its Natural light sources such as skylight. The main corridor is designed as a “replica of a typical American main street.” It includes the Commerce Bank, Warrentown and Berkeley Hardware Store, Carmen’s Barber Shop, Ferratti’s Plant Nursery, Towne Deli Diner, Manufacturing lab, ShopRite, and a mock Apartment complete with living and dining room, kitchen, bedroom, laundry and game rooms.



(a) The layout of the facility: itself was strategic by creating a core level for the students that is simple and easy to navigate. Spaces have logical adjacencies and flexible configurations to minimize travel. Way-finding elements were placed throughout the facility to visually guide children to their proper place [32].

(b) The Vocational Room : of the intermediate wing, through both individual and group instruction, students will learn general vocational trade skills and workplace culture. The goal of the Vocational Room, is to provide students with independent skills needed in workplace environments. These skills incorporate manufacturing tasks and simulated office work like filling off-site work orders from area businesses and establishments.

(c)The school cafeteria: the center features a “diner” environment, Rather than creating the typical school cafeteria ,including the checkerboard touches and several style booths consistent with a real diner. The diner helps make the students more comfortable with a traditional restaurant setting "Fig 4 a".

(d) Two indoor swimming pools: which are developmentally appropriate for both beginner as well as advanced swimmers. The pools provide the natural environment for swimmers to overcome their fear of water while improving their muscle strength and endurance through aquatic therapy[33] "Fig 4 b",

Fig .4: Fig 4a shows the Cafeteria area in the DLC, Fig 4b shows an interior view of the Pool area



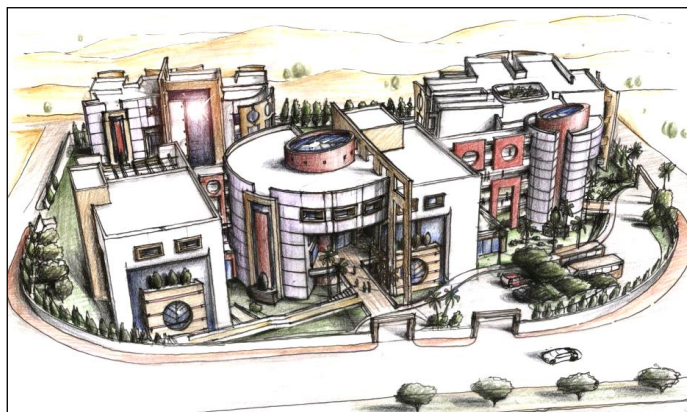
(e) Light and colour: A calming ambient environment by natural and artificial light , acoustic control and thermal comfort, pleasing exterior and interior colors, as well as tactile surfaces and indirect lighting fixtures [32].The center have a highly efficient geothermal heating and cooling system that consumes less fossil fuel and emits less pollution. Its passive solar design incorporates energy-efficient lights, clear-story windows that provide abundant natural daylight, and a general building orientation and angled roofs intended to maximize the advantage of the sun [33].

B. Applying the sensory design theory and Autism aspects design index: A case study of the Advance Special Needs Education Center, Egypt

B.1 The project description

It is the first building to apply 'sensory design theory' to its architecture . Principal architect Ashraf Tawfik translates this evidence based research into a creative and conducive environment for children with autism[34]. The center is located in a newly developed suburb of greater Cairo, Egypt, as part of New Cairo in the Qattameya district "Fig 5". The total plot is approximately 4200 m2 with a permissible footprint of 30% or 1200 m2. The maximum allowable height is 13 m or 3 stories, creating a maximum built-up area 3600 m2 above ground. When completed the center should provide full-time educational services to 70 students, as well as part-time support and supervision to at least 50 others [17]. In addition to classrooms, the design provides therapy areas, a diagnostic centre, sports centre, sensory garden and assisted living residence for up to 20 students [35].

Fig. 5: View of the overall organization of building



B.2 Architecture and interior design philosophy

The 7 principles of the Autism aspects design index were the driving force behind the programming and development of design criteria at all levels: detailed program development; contextual consideration related to site location, surrounding activities and community participation with the center; whole-school issues related to zoning, spatial organization, proxemics etc.; classroom configurations; furniture layouts and finishing specifications

B. 3 The sensory design theory and Autism aspects design index in Whole School Issues

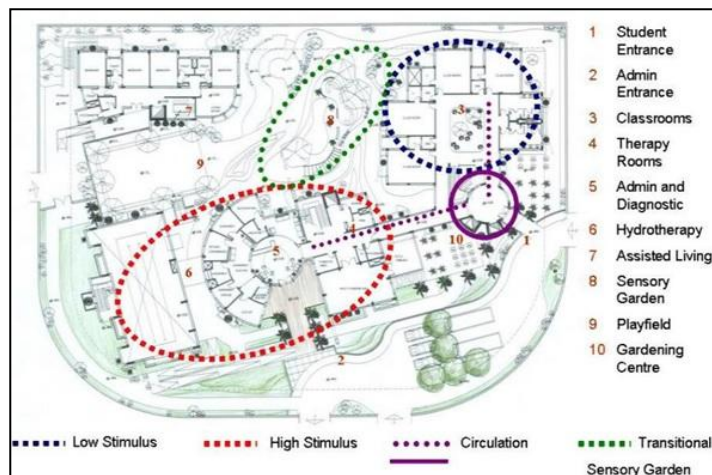
(a) Context and Community

The commercial outlets create an opportunity for student interaction with society. They are kept visually and spatially separate and organized. Natural lighting, natural ventilation are used as much as possible. Noise exposure is kept to a minimum in "high focus" areas: computer stations in the business center or accounting stations in the other outlets. The assembly hall can also be utilized to encourage inclusion: awareness campaigns, parent home program training sessions, parent support groups, teacher training seminars, school organized shows and school assemblies.

(b) zoning

Spatial groupings should follow "autistic" logic and involve sensorial compatible functions. They should be accessed through a one-way circulation system, emphasizing "routine". For example high-stimulus functions like music, art, crafts and psychomotor therapy, requiring a high level of alertness can be grouped together, while low stimulus functions or "high focus" areas like speech therapy, one to one instruction and general classrooms, requiring a high level of concentration, can be grouped together "Fig 6". Services, which are usually high-stimulus, including bathrooms, kitchens, staff-rooms and administration, should be separated from the student areas. Buffer areas such as gardens, free-play, sensory curriculum rooms and some other open spaces may act as transitional areas between the low-stimulus "focus" zones and the high-stimulus "alertness" zones. Transition zones also play a role in easing such shifts [17].

Fig. 6: Entry-level plan and Division of space in sensory zones - The Advance Center for Autism, Qattameya,



(c). Way-finding, Navigation, Circulation and Spatial Sequencing

A "one-way" circulation scheme that builds on the special needs user's affinity to routine is employed throughout this building. Transition zones such as gardens and sensory curriculum rooms may assist when this one-way circulation is not possible. The use of a circular node, in the form of a cylindrical tower, between the two main circulation axes, create a transition zone between the two sensory zones and will aid the student in independent navigation. Visual aids such as color, pattern, written word and signage are employed in circulation areas to assist way finding. Pictorial language displayed, with written language will help develop skills. Various colors and themed symbols are used to indicate different functions in the school. Various textured materials are also used to indicate circulation areas, changes in levels and for the creation of interesting sensory experiences. The lighting used in all circulation spaces is natural with placement that avoids glare and silhouetting. The use of contrasting materials in various elements-floor, wall, ceiling, doors- helps visually define and differentiate, helping to clarify the visual qualities of circulation areas. Overstimulation, however, is avoided [17].

(d) Fire safety and evacuation

The evacuation strategy proposed involves insuring the safe and effective movement of the challenged individual from any point in the building under various fire location scenarios (progressive horizontal evacuation), to a safe spot or refuge. This refuge should be secure and located away from the evacuation flow. An appointed faculty or staff member will meet the individual at this assigned refuge and proceed to evacuate him/her.

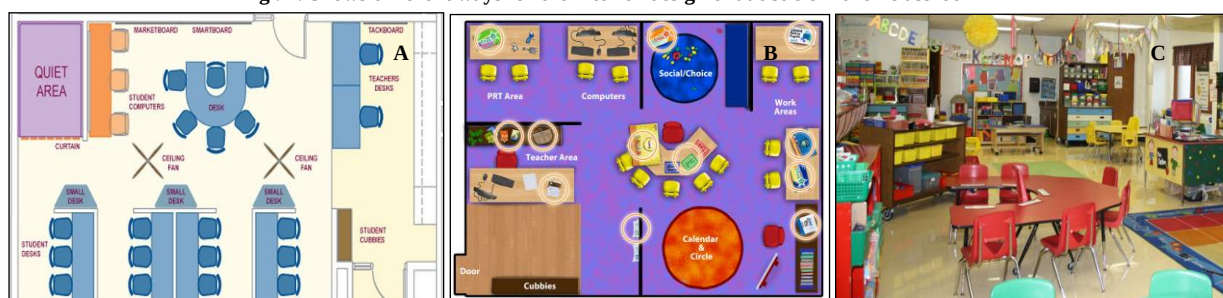
IX. Designing Autism (ASD) friendly learning spaces

Designing learning spaces includes: General Classroom Design , Specialized Therapy Spaces and Outdoor Learning Spaces and also includes what furniture, light and colour must be used.

A. General Classroom Design

The classrooms are located in the low-stimulus area of the school. Each classroom has an average of 7 students with at least 3 teachers and assistants. Acoustically, they are designed to reduce external noise as well as internal echoes. It is designed in a compartmentalized fashion [17]. Each activity is allocated to a “station” which can be physically and visually separated from the remainder of the classroom by low partitions, levels or different flooring materials and colors [14] "Fig 7". These stations are organized in the classroom according to their sensory requirements with high focus functions like fine motor skills, matching, sorting and academics located in well-lit areas allowing alertness without distraction. Natural lighting is introduced with above eye-level sills to allow indirect sunlight in without visual distractions. These windows are north facing to avoid glare and direct light, can only be opened and closed by staff and located so as to encourage cross ventilation [26] . For each activity an optimum and distinct furniture and equipment layout is used consistently [17]. Open areas for floor play are included as provisions for group work. Resources must be organized to avoid distraction to the child. Closed storage cupboards or open shelving with neutral boxes are ideal. Autistic children need a quiet space to control their temper tantrums and which helps them in being calm and organize their behavior [10]. This area must be included and located in the lowest stimulus area of the classroom. It is a small partitioned area where a child may seek refuge whenever over-stimulated or overwhelmed. This space is intimate and partially enclosed to limit the sensory environment the child needs to deal with. It is designed as a sensory neutral space with various items close at hand, like a small Snoezelen sensory curriculum room so that the child can have the space customized according to his or her sensory needs . These items may include cushions of various textures, brushes, sand paper, small tents, blankets, fiber optic lights, music headphones and perhaps aromatherapy oils. This area can also be used at the beginning and end of classes to help children calm down and prepare to be more receptive to the upcoming tasks. Joint observation rooms are made available directly adjacent to the classrooms. These are small rooms with one-way mirrored windows looking directly into the classes, with a/v equipment for taping sessions. These can be used as part of teacher training courses as well as parent awareness and home program training [17]. Avoid air fresheners and perfume because students with autism can be very sensitive to smells . Children with autism pay attention to details and can miss the big picture. Wall charts and posters can distract them. While teaching, professor tries to teach in front of a blank background[35] . Eight design standards and solutions gathered from interviews with people most directly affected by autism - parents, teachers, and therapists, as well as college students and adults with autism: (1)Flexibility , (2) Non-Threatening, (3)Non-Distracting , (4)Predictability , (5) Controllability , (6) Sensory-Motor Attuned , (7)Safety ,(8) Non-Institutional [16]. Keith McAllister identifies the design criteria for ASD friendly classroom as Simple layout : calm , ordered , low stimulus spaces, no confusing large spaces, indirect lightning , no glare , subdued colors; good acoustics , avoiding sudden/ background noise , robust materials , tamper- proof elements [31].

Fig . 7: Shows different ways for the interior design of autistic children classroom



B. Specialized therapy spaces design

A center for autism may provide various specialized spaces for speech, occupational, psychomotor therapy etc..All these spaces, with the exception of speech therapy, are considered the high stimulus functions and should be grouped accordingly in that sensory zone. Each function, is kept acoustically separated from the others using high quality wall systems. Lighting, is natural and indirect, from a source above eye-level to avoid visual distraction. Fluorescent lighting, which emits a low hum and flickers, is avoided. Shared resource and preparation areas, as well as observation rooms are also provided . The speech therapy rooms, being high-focus activities requiring a low-stimulatory environment, should be located as part of the low-stimulus zone. as an acoustical control ,They may be soundproofed rooms.The art therapy area incorporates various activities including painting, printing, sculpture and pottery, these different activities are organized in stations kept partially visually and spatially separate. The vocational workshops incorporate activities like woodwork, bamboo, candle making, tapestry and computers. The workshops are furnished with adjustable stools and tables with durable surfaces [17]. The sensory room "Fig. 8" called “snoezelen” (pronounced SNOO-ze-len), it is

based on Snoeselen, a concept developed in the Netherlands nearly forty years ago. The word Soneselen blends two Dutch verbs: “snuffelen,” which means to seek out or explore, and “doezelen,” which means to relax. The room helps students with autism and other disabilities better regulate the amount of sensory stimulation they experience. The room is filled with special equipment and tools such as a vibrating platform, speakers, an LED projector, a motorized mirror ball, beanbag chairs and bubble tubes, all of which be adjusted by the student to meet his or her needs . Kijeong Jeon, a Chico State University associate professor of art who provided the interior design of a sensory room where used multicolored fiberoptic lighting, lava lamps that change colors, bubble mirrors and a cork floor that absorbs sound. A fountain in the center of the main sensory room creates the sound of rhythmic water dropping, and a “3-D wall”-a multilayered, boxed platform- on which movies can be projected, giving them a kind of broken or underwater effect [38]. “The room lets students ‘listen’ with their bodies and their minds,” said Dr. Geraldine Gibbia, co-founder and Executive Director of The Phoenix Center [37]. The enclosed swimming pool and hydrotherapy can be located at the farthest possible location from the classrooms and the low-stimulus zone. The hydrotherapy is comprised of a sensory pool that activates various jets at different parts of the body to provide tactile stimulation [17].

Fig. 8: Shows the sensory room offers a Multi-Sensory Environment (MSE) for students



C. Outdoor Learning Spaces design

Outdoor spaces are an essential part of any individual’s environmental awareness and can play an essential role in learning [4] . They can enjoy the freedom without the feeling of being obtrusively observed [8]. the small outdoor classroom courtyards may help create the opportunity for small-group social interactions between students and the larger playground area may allow for larger scale interactions [17]. The outdoor area allows the autistic child for a few minutes to perform a sensory readjustment to prepare for the upcoming task. Variety of spaces made available like : A sensory garden ,formal vocational garden and A formal playfield.For the sensory garden , it can be comprised of textured pathways, water-play, ball pools, sand pits and an aromatherapy herbal garden is the core of this space. Water features, a free-standing expression wall painted with blackboard paint allows the students to articulate themselves artistically and various shaded seating alcoves. The formal vocational garden is another essential outdoor learning spaces where students can learn various skills. In addition to gardening, small projects can be carried out including herbal packaging, floral arrangements, organic produce and others. The formal playfield is used for organized sports is also provided [17]. In 2002, Herbert gives the Guidelines for Designing a Therapeutic Garden for Autistic Children: Design for Security, Safety, and Supervision. Provide a “Corner of the World”.Create A Variety of Specialized Spaces. Design Space for Sensory Integration Activities. Stimulate Gross Motor Activities. Stimulate Fine Motor Skills. Provide Spaces with Loose Parts for Manipulation. Provide Activities for Physical Exertion.

Design Spaces for Directed Play Therapy or Self-Help Skills. Provide Visual Cues for Orientation. Design with Special Lighting Conditions in Mind. Provide a Safe and Nurturing Entry.Design for Future Spatial Flexibility. Design to Accommodate all Children. Provide Organizational/Informational Feature. Choose Appropriate Site Furniture. Design for Maximum Nature Interaction. Choose Appropriate and Stimulating Plants. Provide Adequate Storage. Establish Strong Indoor/Outdoor Connection. Create Clear and Unambiguous Layout (Design Intent). Design for Ease of Maintenance [21].

D. Furniture Items

The furniture items used inside a treatment center for autistic need to posses certain characteristics. Because the majority of patients will be less than 7 years old, the objects need to be selected in accordance to their standards. Furthermore, sensory deficiencies will be responsible for other features that furniture items will have. Also, they should be easy to perceive from the other elements present in the room/ building. The shapes should be simple, adapted to the form of therapy and should not contain pieces that can harm the patients. As is the case for walls and floors, the texture needs to be rudimentary, and the color neutral so it will not distract attention. The materials that can be used are diverse, such as wood and textile, though reflective surfaces and glossy metal should be avoided. A specific furniture element required inside treatment centers for people with autism is the refuge space. This can be designed in numerous ways, usually in the shape of an armchair and it is destined to

provide patients with a calm environment when overstimulating episodes appear. This object needs to possess the capacity to adapt to different deficiencies and patient preferences. In relation with the progress of therapy, the furniture elements need to be replaced with day-to-day items in order to encourage the integration to typical household scenarios [29].

E. Lighting

The most important issue raised by school staff was the type and quality of artificial light used [31]. A high proportion of children and adults with autism show marked differences in their sensory profile and that this includes sensitivity and adverse reactions to certain forms of artificial lighting [39]. This range of sensory problems includes an aversion to very bright fluorescent lighting can affect their visual field [27]. Care should be taken to avoid flickering fluorescent lighting as this can be disturbing to people with ASD. Compact fluorescent is acceptable but the specification always needs to be checked to make sure that fittings are fitted with the appropriate diffusers. It is common for children and adults with ASD to sleep with the light on but a lighting level suitable for waking hours may not be suitable at night. Flexibility is the key here so that the lighting level can be reduced [26].

F. Color Perception in Children with Autism

Colour can play an important part in the 'feel' of a building. Suffice it to say that there are neutral colours, calming colours, disturbing and stimulating colours. Careful choices have to be made to ensure a good balance between the common and private spaces [26]. Children with autism appear to be less accurate at color memory, search and chromatic target detection than controls matched on age and non-verbal cognitive ability. One potential explanation is that the difference arises from differences in the anatomical and functional organization of the brain in autism [40]. When selecting color for children's spaces; Researchers have found that autistic children's rods and cones (components of the eye) have changed due to chemical imbalances or neural deficiencies. Colors appear more vibrant to autistic children. Of the autistic children tested, 85% saw colors with greater intensity than non-autistic children. The color red for example, looks fluorescent and vibrates with intensity [20]. Children diagnosed with autism perceive colors differently, they have reported headaches caused by the color of the walls, food that is served, or clothing that people wear. In addition, studies have found that overstimulation caused by the changes in color intensity have produced a negative effect on the behavior of these children, we can use earth tone colors and avoid busy patterns because children with autism often have difficulty processing complex patterns. [31]. Environments with too much stimulus on walls, floors and counter surfaces can wreak havoc in neurologically delayed individual's minds [20]. Interior designer Carolyn Feder encourages parents to paint their autistic child's room in a tranquil hue, such as pale blue, soft green or muted purple [41]. the brain automatically responds to softer colors on a subconscious level. As a result, the relaxing colors help encourage calm emotional responses and appropriate behavior. Pink is a good room color for children, both gender with learning disabilities, like autism. We must opt for a lighter version of the favorite color of autistic child, rather than a bright or vivid hue, to avoid overstimulation. soft neutrals are a good option. Ivory, beige, light mocha, muted teal and soft gray are muted colors that work well in various interior designs, while reducing the amount of visual stimulation. Even though white is a neutral color, avoid stark white paint colors because they aren't soothing and might remind your child of unpleasant doctor's visits. Stay away from busy curtain patterns, colorful wall decorations, and complex furniture designs[41].

X. Conclusion

1. Children with ASD are a significant group of the population, which requires attention from society.
2. The classroom is an important element in school, if comfortable and relaxed, may be the secure starting point for those venturing into the bustle of the wider school environment with their peers.
3. Autistic behavior can be influenced favorably by altering the sensory environment resulting from the physical architectural surroundings (color, texture, ventilation, sense of closure, orientation, acoustics); behavior may be improved, or at least a more conducive environment created, for more efficient skill development.
4. The interior design can affect positively or negatively on the autistic child's psychology. Make the lives of those people better, can assist caretakers, and can even affect the course of the disorder.

XI. Recommendations

1. Raise the society awareness of those marginalized group of autistic children.
2. Supporting research about design/human behavior relationship and also on designing for people with autism, to positively change people's lives through the power of design.
3. Interior designers and researchers must collaborate to document measurable outcomes of their design solutions and share findings with the design industry, building the body of knowledge and advancing educational spaces design for children with ASD.

References

- [1]. Pomana, A, "Design Approach for Autism Treatment Centers," LUMEN TCA 2014 Conference 21-22 ,November 2014, Targoviste .
- [2]. McAllister, Keith, "The ASD Friendly Classroom – Design Complexity, Challenge and Characteristic", available online: <http://www.designresearchsociety.org/docs-procs/DRS2010/PDF/084.pdf>
- [3]. Pomana, A , "Architecture for autism. improving designs for autistic integration," ICAR 2015: Re[search] through architecture", 26-27, March 2015.
- [4]. Noiprawat,N and Sahachaiseri,N ,"The model of environments enhancing autistic children's development ", Procedia Social and Behavioral Sciences 5 (2010),pp. 1257–1261. doi:10.1016/j.sbspro.2010.07.271
- [5]. "Autism symtoms" ,available online: <http://www.autismkey.com/autism-symptoms/>
- [6]. Valdes, A.,Maria , "Architecture for Autism ", Master of Architecture , The savannah college of Art and Design , 2012.
- [7]. Paron-Wildes, A. J. "Interior Design for Autism from from Childhood to Adolescence " ,Wiley , New Jersey, 2014.
- [8]. Smith ,M. and Segal, J. Autism Symptoms and Early Signs, Center for Autism Research & Treatment, available online : www.helpguide.org
- [9]. Sánchez, P. A., Vázquez, F. S., & Serrano, L. A. , "Autism and the built environment". In T. Williams (Ed.), "Autism Spectrum Disorders - From Genes to Environment",pp. 363–380. Croatia: Intech, 2011.
- [10]. Manchala,S , "Center for autistic children : an architectural intervention, department of architecture,school of planning and architecture,vijayawada , 2014.
- [11]. "Autism" available online :<http://www.minddisorders.com/A-Br/Autism.html>
- [12]. Khare, R. & Mullick., " Universally Beneficial Educational Space Design for Children with Autism",available online : <http://www.designingforchildren.net/papers/r-khare-designingforchildren.pdf>
- [13]. Khare, R., and Mullick, A. " Incorporating the Behavioural Dimension in Designing Inclusive Learning Environment for Autism". International Journal of Architectural Research, 3(3), pp.45-64, (2009).
- [14]. Mostafa, M. , An an architecture for autism: Concepts of design intervention for the autistic user, International Journal of Architectural Research, Vol 2, No(1), pp.189–211, 2008.
- [15]. Henry, C. ,"Architecture for Autism: Architects Moving in the Right Direction", Arch Daily, ,available online: <http://www.archdaily.com/197788/architecture-for-autism-architects-moving-in-the-right-direction/>
- [16]. Humphreys, S. "Architecture and autism", available online,http://autismsocietycanada.ca/images/dox/Autism_and_Architecture_
- [17]. Mostafa, M. "Architecture for Autism: Autism ASPECTSS™ in School Design." Archnet-IJAR: International Journal of Architectural Research, vol. 8, issue 1 ,pp.143-158, (2014).
- [18]. Henry, C, " Designing for Autism, the Neuro-Typical Approach", ArchDaily, available online: <http://www.archdaily.com/181402/designing-for-autism-the-neuro-typical-approach> ,
- [19]. Pomana, A, "Architectural Design for Autism , Treatment centers destined to people with autistic spectrum disorders" dissertation,UAUIM Bucuresti, 2014.
- [20]. Denise ,T, "Color & Autism: Seeing Color through Autistic Children's Eyes" ,Aavailable online: <http://colorturners.blogspot.com/2011/03/color-autism.html>
- [21]. Hebert, B. ,"Design Guidelines of a Therapeutic Garden for Autistic Children", MLA thesis dissertation,Department of Landscape Architecture, Louisiana State University(2002).
- [22]. Rudy , L, J., "Sensory Integration, Sensory Processing Disorder and Autism ", available online <http://autism.about.com/od/treatmentoptions/a/whatisspd.htm>
- [23]. Scott, I. ," Designing learning spaces for children on the autism spectrum", Good Autism Practice 10(1): 36–51, 2011.
- [24]. "Autism-Friendly Buildings Deliver Enhanced Learning Environment", available online <http://www.aucegypt.edu/newsatauc/pages/Story.aspx?storyID=1264>
- [25]. Goodyear,S., "Designing Buildings for Children With Autism", available online <http://www.citylab.com/design/2014/04/designing-buildings-children-autism/8960/>
- [26]. Beaver, C. " Designing environments for children and adults with ASD", 2nd World Autism Conference and Exhibition, Cape Town, 22 August 2006.
- [27]. Whitehurst, T. "Evaluation of features specific to an ASD designed living accommodation", Technical report, Sunfield Research Institute , (2007).
- [28]. Mostafa ,M, "An Architecture for Autism, Towards More Inclusive Built Environments for Individuals with Autism Spectrum Disorders", United Nations, Geneva, 11th Session of the CRPD, April, 2014.
- [29]. Pomana ,A., Architectural Design for Autism , Available online <https://architectureforautism.wordpress.com/autism/causes/>
- [30]. Vázquez , F. S. and Torres, A, S "Autism and Architecture", Recent Advances in Autism Spectrum Disorders , Volume II, InTech, 2013, <http://dx.doi.org/10.5772/53679>
- [31]. Williams,M and Vouchilas,G, EdD"Residential Design for Families with Children on the Autism Spectrum" Vol. 1 0 5 , N o . 3 , J F C S, 2013.
- [32]. "Developmental Learning center Warren ", available online <http://www.educationdesignshowcase.com/view.esiml?pid=254>
- [33]. Marion, M. "Bringing The World to the Classroom." EP Magazine, April 2006 p. 32-35. Available online ,www.eparent.com.
- [34]. Sensory perfection, available online, <http://www.worldarchitecturenews.com/project/2010/13547/progressive-architects/advance-special-needs-education-center-in-cairo.html/>
- [35]. Setting Up Your Classroom for a Student with Autism, National Autism resources, available online: <http://www.nationalautismresources.com/classroom-setup-for-autistic-student.html>
- [36]. Vogel, C. L. , " Classroom design for living and learning with autism", Autism Asperger's Digest, 7. 2008, http://www.designshare.com/index.php/articles/classroom_autism/.
- [37]. Students with Autism Find Calm in Sensory Room at The Phoenix Center, available online: <http://www.prweb.com/releases/2014/10/prweb12211386.htm>
- [38]. McGuire , G, "Designing for autism", available online, <http://www.newsreview.com/chico/designing-for-autism/content?oid=914493>
- [39]. "Light sensitivity and autism", The National Autistic Society (NAS), available online on <http://www.autism.org.uk/working-with/leisure-and-environments/architects/light-sensitivity-and-autism.aspx>
- [40]. Franklin, A., Sowden, P., Burley, R., Notman, L., & Alder, E. "Color perception in children with autism". Journal of Autism and Developmental Disorders, 38(10),pp. 1837–1847(2008)..doi:10.1007/s10803-008-0574-6
- [41]. Tucker ,K," The Best Room Colors for Children With Autism", available online, <http://everydaylife.globalpost.com/room-colors-children-autism-10950.html>