AUTISM-FRIENDLY DESIGN STRATEGIES IN DESIGN OF SKILL ACQUISITION CENTRE GUSAU, ZAMFARA STATE

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MAY, 2018

DECLARATION

I hereby declare that this project titled 'AUTISM-FRIENDLY DESIGN STRATEGIES IN DESIGN OF SKILL ACQUISITION CENTRE GUSAU, ZAMFARA STATE' has been prepared by me under the supervision of Dr. H. Sani-Katsina and Prof. M. Abdulkarim. To the best of my knowledge, it has not been presented in a previous application for any degree. All sources of information are duly acknowledged by references.

Nabilah Aliyu YUSUF

_____	_____	_____
Name of Student	Signature	Date

CERTIFICATION

This thesis titled “AUTISM-FRIENDLY DESIGN STRATEGIES IN DESIGN OF SKILL ACQUISITION CENTRE GUSAU, ZAMFARA STATE” by Nabilah Aliyu YUSUF, meets the regulations governing the award of the degree of Master of Science of the Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

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ABSTRACT

Autism is a group of developmental brain disorders, collectively called autism spectrum disorder (ASD). The prevalence of ASD has increased over the past two decades, rising from 2 in 10,000 children in 1990 to 1 in 68 children in 2012, these alarming rates of increase call for attention by all the fields of study and architecture has been ignoring the effect of built environment in their development. The fact that more children are being diagnosed with ASD every day creates the need for livelong support for individuals to transition into adulthood. An aspect of autism which is rarely researched and understood is the remarkable talent found so frequently with this condition. As such; this research aims to identify those talents associated to autistics and propose a skill acquisition centre that is autism-friendly to cater for their sensory needs. This research makes an effort to understand the psychology of individuals with Autism and attempts to provide an appropriate solution for it. This research considered autistic individuals in Northwest Nigeria; which is a region that currently has no facility to cater for the needs of people with autism. Multiple case studies were conducted of both autism centres and skill centres; using field observation and interview as instrument of data collection. Previous studies suggested various autism-friendly design strategies from which a research framework was developed as variables which were assessed in the selected case studies. The results obtained show that anything that impacts attention, auditory input, visual input, movement of autistic individuals also affects their behaviours; the use of design strategies such as acoustics, spatial sequencing, safety, curved walls, proxemics, quiet spaces, lighting and ventilation help to improve their condition. Based on inferences from various case studies and literature studies, a framework was generated from a combination of autism-friendly design strategies and design requirements for skill

acquisition centre which was applied in the proposed design of Autism-friendly skill acquisition centre.

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1.0 INTRODUCTION

1.1 Background to Study

The relationship between people and the environment has long been a research agenda in the field of architecture. The design of space that can be lived, inhabited, or dwelled in without any detrimental effect on both the environment and the inhabitants underlies an architect's work. Sánchez, Vázquez & Serrano, (2011) opined that for decades, architectural practice is carried out considering that there are individuals with different types and degrees of disabilities mainly visual, hearing and motoric impairments, and architects plan and design spaces to be inhabited by those people. However, there are no considerations for individuals with cognitive or mental disabilities such as those with Autism Spectrum Disorder (ASD) instead, they forcefully struggle to grasp and understand the environment around them (ibid).

Autism spectrum disorder (ASD) is a form of brain disorder characterized by impairment in social interaction, communication, and unusual pattern of behaviour. An autistic individual may have an unpleasant reaction to ordinary sensory stimuli such as sight, sound, touch, taste, and smell from their surroundings thus making them extraordinarily sensitive to their environment (Bevan, 2013). As such, living in a world that does not take into account their particular sensory responses can give rise to high levels of anxiety, which in turn may trigger unusual behaviours (Brand & Gaudion, 2012). Therefore, architects can play an important role in making the environment more autism-friendly.

An aspect of autism which is rarely researched and understood is the remarkable talent found so frequently with this condition. Happe & Frith (2009) opined that the existence of extraordinary talent in an autistic person is often referred to as savant

skills, which Howlin *et al.,* (2009) describe as individuals who despite having severe intellectual impairments nevertheless show remarkable skills in a particular area. Although around half of those with autism are of average intelligence or above, they do far worse than they should at school. Though not all autistic people can hold down a job, but the high-functioning among them tend to be clever analysts. Even less gifted autistic people often have an extraordinary capacity to focus and an eye for detail that make them effective workers. Their desire for routine and dislike of change make them dedicative ones, too. They can excel at jobs that require precision and repetition, such as updating databases, stocking shelves, organising libraries or fixing broken cars. Therefore, if exposed to opportunities to acquire and develop skills, they will become useful to themselves, their families and the society. Hence, there is a need for skill acquisition centres for the autistic.

According to the Centres for Disease Control and Prevention (CDC, 2012), the rates of autism have steadily increased with the number of children diagnosed with autism disorder nationwide as 1 in 68. However, the statistics for prevalence in Nigeria is scarce, but a hospital based population study in Nigeria found prevalence of ASD to be 0.08% of children (Bakare & Munir, 2011). This could be attributed to inadequate knowledge and awareness about ASD, inadequate care facilities and inadequate trained personnel leading to late identification and diagnosis.

In Nigeria, ASD is often associated with demonic afflictions or evil spirits so their families go through a tortuous pathway in search of spiritual help. Individuals with ASD and their families are faced with stigma from the society, which makes the autistic individuals to be hidden at home or abandoned on the streets (Okey- Martins, 2007). Due to such rejection, the children never get to be diagnosed and they never get to be helped. Another problem faced in Nigeria is the scarce intervention facilities

for children with ASD and the few available services are very expensive with huge unaffordable cost to most of the parents of affected children. Therefore, there is a need to provide facilities to cater for people with ASD to make them useful to the society.

Autism is one such disorder which is by and far the most challenging developmental disorder which has been overlooked by the architects as a condition that influences building design (Mostafa, 2008). Recent research has shown that the educational environments have a profound effect on learning and performance among autistic individuals (ibid). If classrooms and learning environments are not designed to accommodate students with developmental disabilities, it can be assumed that they will not learn essential skills and may struggle to live in our society (Khare & Mullick, 2009). Hence, there is a need to integrate autism-friendly design strategies in all learning centres for autistic individuals to improve their learning and performance.

1.2 Statement of Problem

The prevalence of ASD has increased over the past two decades, rising from 2 in 10,000 children in 1990 to 1 in 68 children in 2012, these alarming rates of increase call for attention by all the fields and architecture has been ignoring the effect of built environment in their development (Manchala, 2014). The fact that more children are being diagnosed with ASD every day creates the need to provide support for individuals to transition into adulthood. And due the peculiar needs of ASD for better acoustics, lighting, personal space among others, it becomes necessary to create an autism-friendly environment to improve on their condition.

Most researches related to autism lay emphasis on their disabilities without attempt to understand the special talents associated with autism (Happe & Frith, 2009). As such,

the need for skill development in autistic individuals is completely neglected, making them completely hopeless and dependent on their caregivers. But if a skill acquisition centre which is designed purposely for the autistic is provided, it will go a long way in improving their talents.

There is currently no facility to cater for people with autism in north western Nigeria; people with autism in this region are either hidden at home by their parents, or abandoned on the streets as mad people or beggars. They are completely seen as nuisance without attempt to make them useful citizens of the society.

1.3 Aim and Objectives

This study aims at integrating autism-friendly design strategies in the design of a Skill Acquisition Centre to create an enabling environment to acquire useful skills with the following objectives:

i. To articulate how the elements of the built environment affect the behaviours of the autistic individuals
ii. To examine design strategies that have been applied in designs for autistic individuals
iii. To assess the effects of the applied design strategies on the behaviour of autistic individuals within the facilities
iv. To develop a framework for integrating autism-friendly design strategies in skills acquisition centre
v. To design a Skills Acquisition Centre that incorporates design strategies to supports the varying sensory needs of autistic individuals.

1.4 Research Questions

The research will seek to answer the following questions:

i. How do elements of the built environment affect the behaviours of the autistic individuals?
ii. What design strategies have been applied in designing buildings for autistic individuals?
iii. How do the applied design strategies affect the behaviours of the autistic individuals within the facilities?
iv. How can you integrate the design strategies in the design of Skills Acquisition Centre for people with Autism?
v. How can the autism-friendly design strategies be incorporated in the proposed design of skills acquisition centre?

1.5 Justification

People with autism have special talents and are referred to as people with ability in disabilities. It is also believed that every child with autism could develop an identifiable special ability if exposed to opportunities to acquire such skills. Khare & Mullick, (2009) opined that, if learning environments are not designed to accommodate students with developmental disabilities, it can be assumed that they will not learn essential skills and may struggle to live in our society Therefore, there is a need for architects to consider needs of occupants with developmental disabilities while designing spaces for them.

There have been significant efforts in understanding autistic behaviours and the remedies to them. This has also had an impact on the environment and its design

which has greatly influenced the field of architecture over the last few decades. Hence there is a necessity for a behavioural centred design (Manchala, 2014). That should be a design which is appropriate for the peculiar needs of the autistic that will help improve their condition and make them perform better.

Grandin (2009) suggests that Lifelong learning may be of special importance in autism. Thus, training people with autism is of great importance to help unleash their hidden potentials and make them useful members of the society. This research sought to suggest ways to support autistic talents by designing a skill acquisition Centre that is sensitive to their needs. Such facility will enable them to become useful to themselves, their families and the society. They will no longer be seen as nuisance but a great asset to the society.

1.6 Scope

Studying the psychology of autistic is a very vast subject hence; this research is interested in studying their behaviours in educational environments and environments which help them in rehabilitation.

It is interested in autistic individuals of ages 12 and above of both genders across North-Western Nigeria. It will also consider autistic individuals with mild and moderate level of disorder.

1.7 Limitations

The limitation of this study lies in the difficulty to access parents of children with autism and their willingness to participate in the study in order to get first-hand information on their experience with their autistic children. Also, an inadequate record on the number of people with autism in Nigeria poses a limitation to the study.

1.8 Thesis Structure

This study is divided into six chapters as illustrated in the figure 1.1 below.

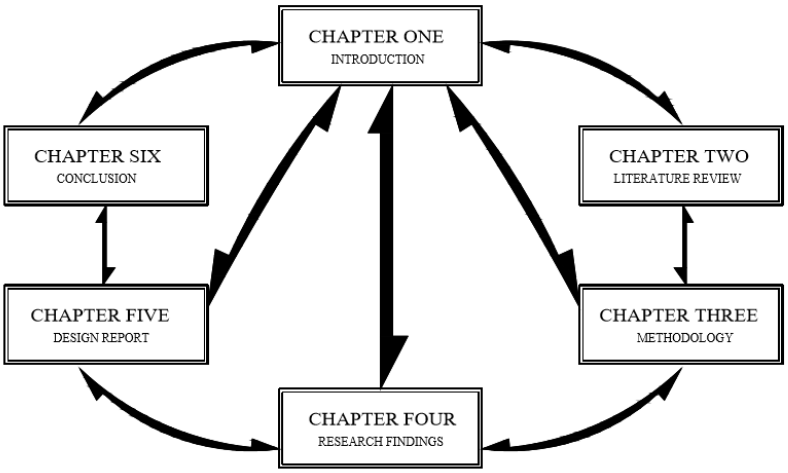


Figure 1.1: Thesis structure

Chapter one consists of background of the study, statement of the problem, aim and objectives of the study, research questions, justification, scope, limitation and thesis structure.

Chapter two consists of literature review under the following sub-topics: Concept of autism and its prevalence, Diagnosis and characteristics of autism, sensory abnormalities in autistic people, autism and the built environment, design strategies for autistic environment, skills associated to autism, skills acquisition and summary.

Chapter three describes research methodology used in the study with the sub-topics; research strategy, research design, population, sample and sampling techniques, case study selection criteria, sources of data collection, instruments for data collection, procedures of data collection, data analysis and presentation and summary.

Chapter four consists of data presentation and analysis. This will present the case study findings and analysis.

Chapter five gives the design report. This will present all the design procedures from preliminary designs, presentation drawings to working drawings.

Chapter six gives a summary of research findings, conclusions, recommendations and contribution to knowledge.

2.0 LITERATURE REVIEW

This chapter presents a review of literature on the relationship between autistic individuals and their built environment. Analyses of previous works by other researchers will be used for investigation and guidance. Previous studies will be reviewed with the aim of collating important architectural contributions. The review of literature will be organized under the following headings: (a) The concept of Autism and Prevalence (b) Diagnosis and Characteristics of Autism (c) Sensory abnormalities and intervention (d) Autism and the built environment. (e) Design Strategies for Autistic Environment (f) Skills associated to Autism (g) Conclusion

2.1 Concept of Autism and Global Prevalence

Autistic disorder was first described by Leo Kanner, Austrian-born American psychiatrist in 1943. In this very first description, Kanner specified a number of aspects common to the 11 children he has studied, which includes; normal physical appearance, difficulties in social interactions, extreme autistic aloneness, resistance to being embraced, impairments in language, obsessive desire for repetition, limited variety of spontaneous activities, strange motoric stereotypies, fear of intense noises, some have excellent rote memory, and symptoms are noticeable during the first three years of life (Kanner, 1943) as cited in (Sánchez, Vázquez &Serrano, 2011). Several months later in 1944, Hans Asperger, without previous knowledge of Kanner's work, published an article entitled 'Autistic psychopathy in childhood', where he studied the cases of several children whose main disorder was the limitation of their social relationships. The cases described by Asperger corresponded to the same symptoms as those depicted by Kanner (Sánchez, Vázquez &Serrano, 2011). However, Kanner's

work covered a wider condition range, which influenced the definition of autism as a group of neurological disorder.

From the mid-1960s and until, approximately, the middle of the 1980s, Autism began to be researched in a further methodical and rigorous way, so as to try to understand its communication and language alteration, as well as associated social relationship impairments, resistance to change. In Africa, however, clinical work on ASDs did not start until three decades after Kanner and Asperger had published their work (Bakare & Munir, 2011). Since that stage, and thanks to those advances in research, autism has come to be considered as a developmental disorder. Hence, it is included among the Pervasive Developmental Disorders (PDDs), which, aside from autistic disorder, comprises others such as Asperger syndrome, Rett syndrome, childhood disintegrative disorder and Pervasive Developmental Disorders-not otherwise specified (or PDD-NOS) (Sánchez, Vázquez &Serrano, 2011). That is the reason why the expression Autistic Spectrum Disorders (ASD) became the usual name for autism.

ASD was once a rare disorder but is now becoming so common that it is reported by the World Health Organization (WHO) as the fastest growing childhood developmental disability in the world (Funmilola, 2014). The prevalence of ASD has increased over the past two decades, rising from 2/10,000 children in 1990 to 1/68 children in 2012 (CDC, 2012; Blumberg, et al., 2013). It is diagnosed about four times more frequently in boys than in girls with prevalence of 1 in 42 boys and 1 in 189 girls (National Autism Association, 2014).

2.2 Characteristics of Autism

There are three cores and defining characteristics of those with the diagnosis of ASD; difficulties with social skills, difficulties with communication, and a restricted repetition of activities and interests.

2.2.1 Difficulties with Social Interaction

Of the three core symptoms that define autistic disorder, impairment in social interaction is central. About forty to fifty per cent of children with autism are either completely nonverbal, or, at the very least, have trouble carrying on two-way conversations (Sachs & Vincenta, 2010). As a result, they have difficulty expressing their needs and are often solitary and detached. To encourage social interaction, Vogel (2008) recommended avoiding large spaces when designing for this population. Therefore, it is necessary to provide spaces which allows and even encourage social interaction, and also taking into account that people with ASD may show particular proxemics (Sánchez *et al.,* 2011). Therefore, they need ample spaces, in which interaction may take place without getting too close to one another.

Another aspect of social interaction is theory of mind; which is the awareness that others have thoughts and emotions that are independent from one's own. Typically developing children begin to have some sense of mental states of others by 4 years of age but, individuals on the autism spectrum have difficulty with theory of mind (Sánchez *et al.,* 2011). Because of this impairment, children with ASDs have difficulties with empathy, sharing, and comforting. Baron-Cohen (2006) coined the term "mind blindedness" when referring to persons with ASDs who demonstrate severe Theory of Mind deficits (as cited in Bevan, 2014).

2.2.2 Difficulties with Communication

People with autism experience language and communication difficulty, they have difficulty interpreting verbal and non-verbal communication, such as understanding the meaning of common gestures, facial expressions or tone of voice (Brand, 2010). In some cases, they might have limited or no ability to talk. The use of visual support for communicating is usually effective for people with ASD and the built environment should be designed to accommodate these forms of communication (Sánchez, Vázquez &Serrano, 2011). This may include pictograms, pictures of objects and people, colour coding among other aids. The built environment should be able to accommodate these forms of visual supports to enhance communication.

2.2.3 Restricted Repetition of Activities or Interests

The other significant area that is part of the fifth edition of Diagnostic and Statistical Manual (DSM-V) criteria involves repetitive, restrictive, and stereotypical behaviours such as hand-flapping, rocking, or head-banging are common in children with autism. They may have a certain order or routine that must be followed in certain circumstances, or they may become fixated on organizing objects (Sachs & Vincenta, 2010). This varies by individual, by age, by circumstance, and by the level of awareness about others. Autistic individuals have difficulty adjusting to changes in daily routines, which can lead to having behavioural problems. People with autism lack control over executive functions; which is an impairment that would limit their ability to carry out activities that require multiple tasks, and showing up to work with all the materials needed, or performing a job that requires multiple job duties. They are better at performing one activity at a time (Sánchez, Vázquez &Serrano, 2011). This impairment could be the origin of stereotyped and repetitive behaviours, as a result of frustration and confusion.

The above characteristics manifest differently in each autistic individual which determines the severity level of the disorder. DSM-V gives the severity levels and supports required as summarized in table 2.1 below.

Table 2.1: Severity levels for autism spectrum disorder

Severity level	Social communication	Restricted, repetitive behaviours
Level 3 (Requiring very substantial support)	Severe deficits in verbal and nonverbal social communication skills Very limited initiation of social interactions, and Minimal response to social overtures from others. Example, a person with few words of intelligible speech who rarely initiates interaction and, when he or she does, makes unusual approaches to meet needs only and responds to only very direct social approaches.	Inflexibility of behaviour, Extreme difficulty coping with change markedly interferes with functioning in all spheres. Great difficulty changing focus or action.
Level 2 (Requiring substantial support)	Marked deficits in verbal and nonverbal social communication skills; Social impairments apparent even with supports in place; Limited initiation of social interactions; Reduced or abnormal responses to social overtures from others. Example, a person who speaks simple sentences, whose interaction is limited to narrow special interests, and how has markedly odd nonverbal communication.	Inflexibility of behaviour, Difficulty coping with change appears frequently enough to be obvious to the casual observer and interfere with functioning in a variety of contexts. Distress and/or difficulty changing focus or action
Level 1 (Requiring Support)	Without supports in place, deficits in social communication cause noticeable impairments. Unsuccessful response to social overtures of others. May appear to have decreased interest in social interactions. Example, a person who is able to speak in full sentences and engages in communication but whose to- and-fro conversation with others fails, whose attempts to make friends are odd and typically unsuccessful.	Inflexibility of behaviour causes significant interference with functioning in one or more contexts. Difficulty switching between activities. Problems of organization

Chaudhuri and Chatterjee, (2014)

2.3 Sensory Abnormalities in Autistic People

In addition to the core diagnostic criteria for autism, many individuals with autism experience different sensory responses to environmental stimulus than non-autistic individuals (APA, 2013). Our senses are conditioned to organize and interact with the world around us but, some individuals on the autism spectrum may actually feel, hear, see, smell, and taste at an extreme level. A study by Kern *et al.,* (2006) suggested a link between the sensory processing disorder (SPD) in autism and the difficulties in their daily life. He presented the cross-sectional study that examined the sensory processing in the individual with autism using the Sensory Profile (SP) which suggested that level of abnormal sensory processing in autism tend to fade out with increasing age. Another study by Crane *et al.,* (2009) focused on the sensory processing difference in high functioning adults with autism. The study adopted a self-report questionnaire to analyse the sensory profiles of each participant. This study suggests that abnormal sensory processing persist across the lifespan of these individuals, but it is contrast with Kern *et al.,* (2007)'s study, which reported that levels of sensory processing abnormality tend to decrease with increasing age.

Sensory abnormalities in autistic people can be classified into hypo-sensitive, and hyper-sensitive to certain sights, sounds, textures, tastes, or smells (Kern *et al.,* 2007; Crane *et al.,* 2009). Hypersensitivity refers to above normal sensitivity and hyposensitivity stands for below normal sensitivity. In a study by Bogdashina (2003), autistic individual's common behaviours were categorized also as hyper and hypo-sensitivities. Each autistic individual can have mixed levels of sensory sensitivities, For instance an autistic individual can be hyper-visual, hypo-auditory, and hypo-

tactile. Table 2.2 below presents examples of typical behaviours by hyper and hypo-sensitivities regarding visual, auditory, and tactile sense.

Table 2.2: Common Autistic Behaviours Categorized by Sensitivity Level

Sensory Issues	Sensitivity	Common Behaviours
Vision	Hypo-sensitive	Attracted to light
		Looks intensely at objects or people
		Moves fingers or objects in front of the eyes
		Fascinated with reflections, bright colour objects
		Runs a hand around the edge of the object
	Hyper-sensitive	Constantly looks at minute particles
		Picks up smallest pieces of dust
		Dislikes dark and bright lights
		Frightened by sharp flashes of light, lightning, etc.
		Looks down most of the time
		Covers or closes eyes at bright light
Sound	Hypo-sensitive	Bangs objects, doors
		Likes vibration
		Likes kitchen, bathroom
		Likes crowds, traffic, etc.
		Tears paper, crumples paper in his hand,
		Attracted by sounds, noises
		Makes loud rhythmic noises
	Hyper-sensitive	Covers ears
		Very light sleeper
		Frightened by animals
		Dislikes thunderstorm, sea, crowds, etc.
		Avoids sounds and noises
		Makes repetitive noises to block out other sounds
Touch	Hypo-sensitive	Likes pressure, tight clothes
		Seeks pressure by crawling under heavy objects
		Hugs tightly
		Enjoys rough and tumble play
		Prone to self-injuries
		Low reaction to pain and temperature
	Hyper –sensitive	Resists being touched
		Cannot tolerate new clothes; avoids wearing shoes
		Overreacts to heat/cold/pain
		Avoids getting ‘messy’
		Dislikes food of certain texture
		Avoids people

Source: Bogdashina (2003) as cited in (Bevan, 2013)

According to Bogdashina (2003), simply changing sensory environment can reduce many challenging behaviours of autistic individuals. For example, adding or removing sensory equipment in the space or alter interior design features can change one’s behaviours (as cited in Bevan, 2013).

2.4 Autism and the Built Environment

Since autistic people are overly sensitive to the environment, special environmental supports can accommodate clients' specific sensory needs (American Psychiatric Association (APA), 2000). The built environment can play an important role in autistic individuals' daily life and their sensory processing. The best way to understand autistic people is learning how each of autistic individuals' senses works (O'Neill & Jones, 1997). Each individual have different patterns of sensory perceptual experiences in environment and it can be difficult to meet the entire individual's sensory need at the same time and surrounding. It is important to consider the different types of materials and finishes which are soothing for autistic individuals to mitigate the sensory impacts on them. Most of the time, overall effects of the sensory built-environment on autistic people's psychological comfort level have been ignored. There is need to think about the diversity of possibilities a space offers to inhabitants (Kinnaer, Baumers, & Heylighen, 2016). This varies dramatically due to the breadth of the autism spectrum and the purpose of the space. Which is why specific guidelines for autism-friendly spaces offers limited value, and the best advice tends to be quite general.

2.4.1 Design Strategies for Autistic Environment

Beaver (2003; 2006; 2010) published on several occasions about the creation of architectural environments suitable for people with ASD. In particular, he explained certain strategies put into play in the development of a residential-educational Centre projected by him, and suggested them as valid approaches for other types of design projects involving users with autism. These strategies are summarized in table 2.3 below:

Table 2.3: Beaver's Design Strategies

S/No	Design Strategies	Remarks
01	Ample spaces	Ample spaces, to allow the development of the children's activities without excessive proximity.
02	Curved walls	The curved walls that seemingly resulted in a more pleasant aspect. The building assessment carried out some time after it was put into use (Whitehurst, 2007) states that these curved surfaces are liked by children and that, occasionally, they help them circulate, since children actually walk in contact with them.
03	Acoustics	Acoustics were taken into account, for instance the use of an acoustic ceiling, use of cleanable carpet on the floor and avoiding too polished materials.
04	Safety	Safety is important when designing showers and toilets, and therefore pipes must not remain exposed, and fittings must be firmly fixed otherwise they could be pulled out of their place. Windows may be a safety problem, and hence Beaver's advice on placing mechanisms to restrict their opening.
05	Under floor heating	Beaver recommends under floor heating or radiant ceiling panels, and cross-ventilation, preferably from bottom to top, by means of stack effect.
06	Lighting	Beaver remarks that they have to be resistant even to abuse. They could be even hidden to sight, thus achieving indirect and diffuse illumination. Specifically reminds us to avoid traditional fluorescent lamps, as people with ASD might be greatly sensitive to the flickering produced by them, even though other people will never notice it. A good option which lighting industry offers us is the use of dimmers to control different illumination scenarios, each of which will generate a different ambience.
07	Quiet rooms	Where a child experiencing too much stress, due to sensory overload, can calm down. This also helps to prevent the undesirable behaviour to expand to other children, as those conducts sometimes have a contagious quality.
08	Sensory rooms and gardens	It is also advisable to provide sensory rooms and gardens, which generate visual, auditory, tactile or olfactory stimuli.
09	Colour palette	Colour palette should be adequately chosen, in order to create environments that provide a warm but not over stimulating atmosphere.

Source: Beaver, (2003; 2006; 2010)

Humphreys (2008) highlighted some simple architectural concepts which, if applied, can help architects in making autism-friendly designs. He drew on his experience in designing a school in Newcastle, United Kingdom. To reduce auditory and visual stimulation and assist people with autism in comprehending the space around them, Humphreys suggested the following principles: maintaining a sense of calm, order, and simplicity in building layout; providing a good level of natural lighting; providing

good quality acoustics, and; minimizing details and materials as summarised in table 2.4 below:

Table 2.4: Humphrey's Design Strategies

S/No	Design Strategies	Remarks
01	Calm, order and simplicity	The sense of calmness and simplicity should exist throughout the building and is not limited to the way in which the plan and sections have been designed, but also applies to the use of materials.
02	Minimal details	Any unnecessary detail should be avoided. Reducing the background visual stimulation to a minimum allows teachers to create the stimulation according to each child's needs.
03	Proportions	The author suggests trying to confer harmonious proportions on buildings and spaces designed for people with autism.
04	Natural light	An extensive use of natural light is important, but dazzling sun, deep shadows or excessive contrast produce visual overstimulation. Skylights and clerestory windows can help in getting diffuse lighting.
05	Proxemics	Autistic individuals may need more space for social relationships
06	Containment	This concept refers to the need to monitor children with ASD as well as the opportunity for them to wander, in a safe place where a child can walk freely.
07	Observation	There is a need for supervision without interfering with the student's activities
08	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.

Source: Humphreys (2008)

Mostafa (2008) developed the Sensory Design Theory after being given the project of designing the first education centre for autism in Egypt. The theory builds on the sensory sensitive approach in that it stipulates that favourably altering the sensory environment can be conducive to positive and constructive autistic behaviour. According to Mostafa (2008), Sensory design theory presents a flexible and adaptable tool which acts as a catalyst for architectural design criteria development for architectural environments based on their sensory qualities, and in response to autistic sensory needs. Mostafa, (2014) developed a set of design principles summarized by the acronym ASPECTSS: Acoustics, Spatial sequencing, Escape spaces,

Compartmentalization, Transition Zones, Sensory Zoning, and Safety as presented in table 2.5 below.

Table 2.5: Mostafa's Design Strategies

S/No	Design Strategies	Remarks
01	Acoustics	This criterion proposes that the acoustical environment be controlled to minimize background noise, echo and reverberation within spaces used by individuals with ASD. The level of such acoustical control should vary according to the level of focus required in the activity at hand within the space, as well as the skill level and the severity of the autism of its users. For example, a gym could handle a higher level of acoustics than a classroom.
02	Spatial Sequencing	This criterion is based on the idea of the affinity of individuals with autism to routine and predictability. The criterion requires that spaces be organized in a logical order based on the typical schedule of such spaces. The organization of spaces should reflect the schedule of the students and how they move throughout the day. There should be minimal disruption between spaces.
03	Escape Spaces	Spaces need to be provided that offer respite for the autistic user from the overstimulation found in their environment. Such spaces may include a small partitioned area or crawl space in a quiet section of a room, or throughout a building in the form of quiet corners. These spaces should provide a neutral sensory environment with minimal stimulation that can be customized by the user to provide the necessary sensory input.
04	Compartmentalization	There needs to be a limit to the sensory input within each space or environment. Each compartment should include a single and clearly defined function and consequent sensory quality. The sensory qualities of each space should be used to define its function and separate it from its neighbouring compartment.
05	Transition zones	The presence of transition zones helps the user recalibrate their senses as they move from one level of stimulus to the next. Zones can take on a variety of forms from a distinct node that indicates a shift in circulation to a full sensory room that allows the user to re-calibrate.
06	Sensory Zoning	Spaces should be organized in accordance with their sensory quality rather than their programmatic function, which is typical in architectural design. Grouping spaces according to their allowable stimulus level, spaces are organized into zones of high stimulus and low stimulus.
07	Safety	Safety is more of a concern for children with autism than their neuro-typical peers, due to the fact that those with autism may have an altered sense of their environment and could easily injure themselves by running into walls to falling down stairs.

Source: Mostafa, (2014)

Pomana (2015) is of the opinion that, architectural designs should take responsibility for all disabled and people with autism should not be forced to adapt to the present surrounding, the same way as the paraplegic persons should not be forced to adapt or walk up the stairs. Designing spaces to suit the autistic will alleviate the challenges of integrating more fully into society caused by an alienating built environment. Although most of the design strategies discussed above have been developed for classroom environment, the ideas can be extrapolated to other environments (Vogel 2008). The summary of the design strategies suggested by the various authors and the framework developed to guide this research are presented in Table 2.6 below.

Table 2.6: Summary of Design Strategies

S/No	Beaver, (2003; 2006; 2010)	Humphreys (2008)	Mostafa, (2014)	Research Framework
01	Acoustics	Acoustics	Acoustics	Acoustics
02	Colour palette	Minimal details	Spatial Sequencing	Spatial sequencing
03	Lighting	Natural light	Compartmentalization	Lighting
04	Safety	Observation	Safety	Safety
05	Sensory rooms and gardens	Proportions	Sensory Zoning	Sensory zoning
06	Curved walls	Calm, order and simplicity	Transition zones	Curved walls
07	Quiet rooms	Containment	Escape Spaces	Quiet room
08	Ample spaces	Proxemics	-	Proxemics
09	Cross ventilation	-	-	Ventilation
10	Under floor heating	-	-	

Source: Author (2017).

2.5 Skills Associated With Autistic Disorder

Of all the features of autism, none is more widely admired than the remarkable talent found so frequently with this condition. Yet special talents are still less researched and less well understood than other features of autism (Happe & Frith, 2009). The existence of such special talents is referred to as savant skills. The history and origins of the savant concept are introduced by Treffert (2009), who illustrates the phenomenon with case material. He originally introduced and differentiated savant skills at different levels of achievement. The very rare 'prodigious savants' are those whose abilities would be staggering in any context; the 'Talented savants' and those with 'splinter skills' show striking abilities relative to their other skills and are relatively more common.

Howlin *et al.,* (2009) provided evidence that savant skills occur in approximately 28.5% of individuals with ASD, which is a much higher prevalence than previous reports. Several authors offer hypotheses for why autism should be associated with talent but, there is currently no explanation as to why people with ASD appear to show striking isolated talents at such a high rate and much more often than any other group (Happe & Frith, 2009). However not every person with ASD has savant skills, but it was hypothesized that each could develop an identifiable special ability if exposed to the opportunities (ibid). More recent experimental studies indicate that savant skills fall within a fairly limited range. The most commonly reported by (Ozonoff, Dawson, and McPartland, n.d) are: Strong visual skills; ability to understand and retain concrete concepts, rules, sequences and patterns; good memory of details or rote facts; long-term memory; computer and technology skills; musical ability; intense concentration especially on a preferred activity; artistic ability;

mathematical ability; ability to decode written language (read) at an early age (but not necessarily comprehend); strong encoding (spelling); honesty; and problem solving ability. A study by Chaudhuri and Chatterjee, (2014) also shows that about 10% of individuals with ASD show unusual abilities, ranging from fragment skills such as the memorization of details (rote memory) to the extraordinarily rare talents of prodigious autistic savants. Many individuals with ASD show superior skills in perception and attention, relative to the general population.

It is sometimes said that genius is 99% practice; Howe et al. (1998) emphasized the overwhelming role of practice in expertise across a range of skills. Often the unique talents of people with autism are a reflection of the focus they place on a particular area, and how much it interests them. There is a strong consensus that one of the deep sources of exceptional skill is the obsessive drive to practice. Therefore, their love for repetition could be an additional advantage to training them to become experts in a particular skill.

2.5.1 Significance of Skill Development to Autistic Individuals

The study by Happe & Frith (2009) established that there is an adaptive value for fostering special interests and talents in autistic individuals, unlike the assumptions that obsessive interests are maladaptive and limiting. Heaton (2009) suggested that untapped potentials special to ASD, makes the task of teaching children with socio-communicative impairments particularly important. However, parents or caregivers often discover an existing talent entirely by accident. Grandin (2009), explained about her own ability to think visually. She raised the interesting possibility that developmental periods of exceptional brain plasticity may be extended in ASD. In her words she said; ‘I felt my brain switched on when I hit fifty’. As such, suggests that Lifelong learning may be of special importance in autism (Grandin, 2009). Thus,

training people with autism is of great importance to help unleash their hidden potentials and make them useful members of the society.

However, the heterogeneity of ASD must be considered in supporting a range of vocational options, while also attending to their core challenges. A 'one-size-fits-all' approach is deemed to be insufficient; instead, the functioning, skills, interests and affinities of the individual with ASD need to be carefully assessed and targeted in seeking complementary vocational opportunities and supports (Happe & Frith, 2009). Studies suggest that supporting an individual with ASD is not solely about charity, but rather reflects recognition of ability and citizenry, and correspondingly furthers a vibrant labour force and community at large.

In conclusion, this literature review began with a brief introduction on the concept of autism as a neurological disorder which comprises others such as Asperger syndrome, Rett syndrome, childhood disintegrative disorder and Pervasive Developmental Disorders-not otherwise specified (or PDD-NOS). Its characteristics are difficulties with social skills, difficulties with communication, and a restricted repetition of activities and interests; with a prevalence rate of 1/68 children in 2012. People with autism experience sensory abnormalities to certain sights, sounds, textures, tastes, or smells. Many elements in the environment, which other people ignore or block out (such as background noise, flickering light, or a bright colour), can be very disturbing to people with autism. As such, people with autism are forced to make an effort to grasp and understand the environment around them because of their difficulty in processing information received through their senses.

The built environment can play an important role in autistic individuals' daily life and their sensory processing; as such there is a need to consider the sensory needs of such

individuals when designing spaces for them. The limited available researches related to architectural design for people with cognitive and sensory impairments, including people with autism were reviewed. Several design strategies were suggested in response to cognitive, social, communication, sensory and behavioural autism-related challenges which can be generalized to other environments.

Studies have shown that people with autism exhibit special skills in a particular area, such skills are referred to as savant skills. The most commonly reported savant skills are mathematical skills, music, art and memory for dates, places, routes or facts. Skills acquisition which is a training process in various skills leading to expertise is of great significance to the autistic. If given the opportunity, they could be a great asset to the society. However, the current provision for skill acquisition facilities in Nigeria does not consider people with cognitive disabilities such as autism in their designs.

3.0 RESEARCH METHODOLOGY

The purpose of this chapter is to introduce the research strategy and the techniques applied in order to evaluate and reveal the design strategies that are conducive to people with Autism Spectrum Disorder. In this research, case studies and interviews were conducted using qualitative approach to examine the reflection of autism friendly design principles in the design of a Skills Acquisition Centre.

3.1 Research Strategy

The research employed qualitative research approach which is a research that uses data that do not indicate ordinal values but descriptive. It usually involves fieldwork with the researcher as the primary instrument for data collection and analysis. Therefore, the researcher must go to the people, setting, site, institution, in order to observe behaviour in its natural setting.

3.2 Research Design

The function of research design is to ensure that the evidence obtained enables one to answer initial research questions as unambiguously as possible. Case study research approach was adopted for the purpose of this thesis research. This form of inquiry was chosen specifically because it focuses on human environments and human experiences within a variety of theoretical frameworks (Hay, 2010). According to Yin (2009), case study is an empirical inquiry that investigates a contemporary phenomenon within its real life context using multiple source of evidence such as interviews, observation, archival records and participant observation to collect evidence. The phenomenon are the challenges of the environment where people with

autism live, with those who are directly involved in modifying this environment to be the unit of analysis.

Oluigbo, (2010) opined that case study in architecture begins with a documentation of the physical characteristics of the case, which should be carried out under the following headings: history and Background; Site planning and Landscaping; Spatial Organization; structure and materials; and building services. The assessment was carried out through visual surveys, observation, and an assessment of the application of these outlined principles of Autistic design under study.

3.3 Population of Study

Population is the aggregate of all the elements that share some common set of characteristics and that comprise the universe of the purpose of the research problem. Population in this study will include Autism Centres and skill acquisition centres in Nigeria and abroad.

3.3.1 Sampling Technique

This research adopted a non-probability sampling; particularly the purposive sampling method which, according to Issa (2004) is a technique that allows the researcher to select certain groups or individuals for their relevance to the subject of investigation; based on his knowledge and understanding of the population. However, for better selection of the cases, certain selection criteria have to be laid down. This method is economical and ensures extensive study of the selected cases.

3.3.2 Case Study Selection Criteria

The cases considered for this study were sampled based on the following criteria;

i. An autism centre located in Nigeria or abroad

ii. A skills acquisition centre for autistic located in Nigeria or abroad

iii. A skills acquisition centre located in Nigeria or abroad

Based on the criteria above, the following cases were selected;

i. Patrick Speech & Language Centre, Lagos; being the first autism centre in Nigeria.

ii. New Struan School, Alloa, Scotland; being a centre for Autism purposely built to address the problems encountered by the autistic within the environment.

iii. Westbrook Regional Vocational Centre (WRVC), United States; being a skill centre located abroad.

iv. Business Apprenticeship Training Centre (BATC), Sabon-gari, Zaria; being a skills centre located in the same geographical zone as the proposed design.

3.4 Sources of Data Collection

Data was collected from primary and secondary sources. Primary data are the original data obtained from the field work carried out by the researcher; which include; interviews, observation, notes and photographs. Secondary data on the other hand, is data collected by other researchers in their respective researches; this includes data from books, manuals, magazines, newspaper, libraries and the internet.

3.4.1 Instruments of Data Collection

For the purpose of this research, the instruments that were used for the collection and documentation of data are;

i. Field Observation

ii. Interview

Field Observation: this requires looking at the physical features of the case being studied and documenting with the aid of photographs and sketches. Also, looking at the pattern of activities as they are carried out and how they affect the users. This will enable validation of certain responses from the interview

Interview: Interview allows for the collection of first-hand data such as detailed and precise information on behaviours of people with autism under certain environmental factors, etc. As Hay (2010) stated, interviews are a great method of acquiring information about events, views and experiences, which obviously differ among people of various classes and levels. This was attained from experienced and knowledgeable personalities in the field being researched.

3.4.2 Procedures of Data Collection

The Procedures of collecting data in the local case study involved; visits to the case study sites, and taking visual analysis of their architectural elements as they relate with the autistic users, buildings were then evaluated based on the outlined variables of study. Caregivers, key staff members and some parents were interviewed to receive information regarding the aim of the study. The foreign case studies however, were obtained from the internet and analysed using the same variables as used in the local case studies.

3.5 Variables of Study

The variables of the study are design considerations adopted from existing literature on autism design (See table 2.6). These variables were used in assessment of the selected case studies in the research. The variables are as follows:

1. Acoustics

2. Spatial sequencing
3. Lighting
4. Safety
5. Sensory zoning
6. Curved walls
7. Quiet room
8. Proxemics
9. Ventilation

3.6 Data Analysis and Presentation

Data collected on the visual survey and observation were analysed based on a descriptive account of the observed features. Brief introduction, account of variables, and assessment on the application of autism friendly design strategies were used to capture a better perspective of the facilities for more effective evaluation. To analyse the content of the interview data collected, a thematic content analysis of the transcripts was applied. Data collected on each case study were analysed and represented in different forms which include:-

- Diagrammatic representation: Proper representation of data was made by the use of sketches and also where drawings/ sketches are not available, data was supported with photographs.
- Photographs: Pictures of the studied cases (autism centres and other relevant buildings) were taken and documented showing their facilities and functional flow.

- Tables: Data collected on this research from the case studies was documented and represented on assessment tables.

In conclusion, this chapter has discussed the qualitative research strategy employed which involves study of phenomena in a real life context. The case study research approach and purposive sampling techniques that will be employed by selecting cases based on their relevance to the research. Both primary and secondary sources of data will be used, and the instruments of data collection to be used are field observation and interview. The design strategies adopted from literature will be used in assessment of selected cases. Data collected will be analysed using thematic analysis and presented in the form of figures, plates and tables. The results obtained using this methodology is presented in chapter four.

4.0 DATA PRESENTATION AND ANALYSIS

Multiple case studies were conducted to understand the existing situation which will help to expose problems as well as solutions inherent in existing buildings to serve as guide in design formation. Architectural case studies take into consideration such aspects as function, structures, site and economy, with a view to identifying the complexities essential in them in order to find ways of incorporating some ideas within the proposed project scope. Four cases studied were conducted which were selected based on the outlined criteria in my methodology in chapter three. The case study areas are as follows: New Struan centre for autism Alloa, Scotland; Patricks Speech and Language Centre, Lagos; Westbrook Regional Vocational Centre (WRVC), United States; and Business Apprenticeship Training Centre (BATC), Sabon-gari, Zaria. This chapter will address the following research objectives:

iii. To study how elements of the built environment affect the behaviours of the autistic individuals

iv. To examine design strategies that have been applied in designs for autistic individuals

v. To assess the effects of the applied design strategies on the behaviour of autistic individuals within the facilities

vi. To develop a framework for integrating autism-friendly design strategies in skills acquisition centre

4.1 Case study one: New Struan School Alloa, Scotland

4.1.1 History and Development

The New Struan School was established in 1977 by a group of parents of autistic children. It started off in a single room with three pupils but, today it is a purpose built school located at Bradbury Campus, 100 Smithfield Loan, Alloa FK10 1NP, Scotland. It was designed by Andrew Lester of Aitken Turnbull Architects, who is also the parent of a young woman with ASD. The school is now the largest provider of autism-specific services in Scotland and a leading authority and advocate for good autism practice. The school helps those diagnosed with autism to lead full and enriched lives and become valuable members of the community they live in. They also seek to share knowledge and expertise with parents, carers and other professionals in order to support the development of skills and strategies needed to provide the best care and support for people with autism. The school offers a large range of services for people with autism including education, day and vocational opportunities, supported living, outreach, respite and specialist transition support. Plate I below shows Approach view of the school.



Plate I: Approach view of New Struan School

The major facilities in the school are: classrooms, multi-sensory room, splash area, library, early learning centre, area for visiting therapists, research centre, autism advisory centre, training facilities and administrative facilities.

4.1.2 Site planning and landscaping

The site of the school consist of the main building with a T-shape plan; outdoor areas with cycle track, play equipment, a ball park and sensory garden that have been designed to offer pupils the opportunity to exercise, to socialize or to simply relax. The perimeter fence is low and aesthetically pleasing; this provides the clear boundary that people with ASD appreciate without appearing to be restrictive. Ample parking areas for staff, taxis and mini-buses ensure smooth and safe arrivals and departures to and from school as shown in the plate II below.



(a)



(b)

Plate II: Outdoor area and parking

4.1.3 Spatial Organization

The New Struan School is a single story building with a T-shape plan designed around one central walkway, the ‘Street’, which runs the entire length of the building. The ‘street’ enables a clear view of the whole school thereby promoting order and independent movement from one area to the next. Seven classrooms are located on

either side of the ‘Street’, as well as the library, Café and dining hall as shown in plate III below.



Plate III: Floor plan of New Struan School, Alloa

4.1.4 Autism-friendly design considerations

Acoustics: The whole area is carpeted, thereby reducing noise and softening the environment as shown in Plate IV below. All the classrooms are sound insulated to a very high standard (150 mm dense concrete masonry wall, with 19 mm thick dense plaster either side).



Plate IV: Carpet flooring

Spatial sequencing: The New Struan School is a single story building with a T-shape plan designed around one central walkway, the 'Street', which runs the entire length of the building. The 'street' enables a clear view of the whole school thereby promoting order and independent movement from one area to the next. Seven classrooms are located on either side of the 'Street', as well as the library, Café and dining hall as shown in Plate III above. An external door leads to a patio area and the gardens beyond.

Lighting: The 'Street' is flooded with natural light from a well-ventilated, glass atrium inducing an immediate sense of well-being. The building is equipped with 'light shelf' and specifically angled ceiling to maximise natural daylight as shown in plate V (a). Artificial lighting is subtle and unobtrusive as shown in plate V (b). Where possible, wall uplighters have been used instead of overhead, fluorescent lights and there is no discernible hum or flicker. Dimmer switches were used to enable pupils and staff to control the levels of artificial light.



(a)



(b)

Plate V: Natural and artificial lighting systems

Safety: High quality, robust and attractive furnishings has resulted in a dramatic decrease in the amount of damage to property.

Quiet rooms: 'Quiet rooms' were provided to offer a sensory-controlled, calming zone or one-to-one teaching area as shown in Plate VI. Pupils utilise these areas during times of stress or overload, thus having some control over their own behaviour.



Plate VI: Quiet room

Curved walls: Curved walls lead the children naturally from one area to the next and reduce the number of sharp angles, obstructive corners and hidden doorways throughout the building. The 'street' enables a clear view of the whole school thereby promoting order and independent movement from one area to the next. 'Caves' of learning curve outwards from the 'Street', facilitating transitions by aiding the children in their Visio-spatial processing and providing natural bays for pupils and staff to utilise for socialising or for respite from the classroom as shown in Plate VII below.



(a)



(b)

Plate VII: Use of curved walls

Sensory zoning: the building is zoned based on the stimulus level of activities. The outdoor areas, with cycle track, play equipment, a ball park and sensory garden have been designed to offer pupils the opportunity to play co-operatively or independently, to exercise, to socialise or to simply relax as shown in the plates VIII below.



(a)



(b)

Plate VIII: Sensory garden and Playground

Proxemics: Classroom lay-out and ample storage has enabled staff to provide an uncluttered and purposeful working environment as shown in plate IX below.



Plate IX: Large classroom with partitioned cubicles

4.2 Case Study Two: Patrick's Speech and Language Centre (PSLC) Lagos

4.2.1 History and development

The Patricks Speech and language centre (PSLC) was the first centre for children with Autism Spectrum Disorders, Asperger Syndrome and other related developmental disabilities in Nigeria. The Centre was established in 2006 by Mrs. Dotun Akande

after many years of frustration searching for an ideal environment for her autistic son. The centre is located at 13B Remi Fani- Kayode Street Ikeja GRA, Lagos. The building was initially designed as a residential building which was later remodelled to meet the needs of autistic children. The centre has facilities to provide services such as behavioural, occupational and speech therapy. The Centre has been at the forefront of increasing awareness about Autism Spectrum Disorders in Nigeria.

The major facilities in the centre are: a reception, educational group classes, one large sensory room, one room partitioned into cubicles for individual Sensory sessions, music and movement room; vocational unit; two rooms partitioned for individual speech therapy sessions; outdoor play areas; parents' room; one large office; kitchenette for staff and parking spaces.

4.2.2 Site planning and landscaping

The site is planned based on a form of sensory zoning. Low stimuli activities like the classrooms and therapy rooms are located in the main building while the music and vocational room which is a high stimulus area is completely detached from the main building. The main building connects to the vocational room through landscaped area adjacent to the playground as shown in figure 4.1 below. The landscape of the site consists of shrubs, few trees and grasses.

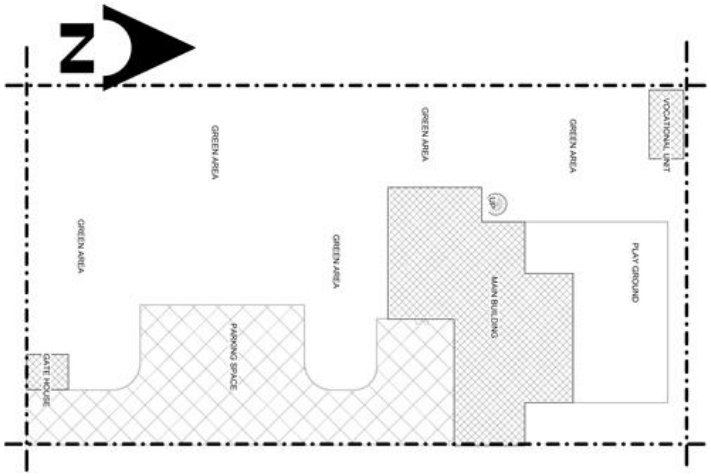


Figure 4.1: Site Plan of Patrick's Speech and Language Centre (PSLC), Lagos

Source: Author (2016)

4.2.3 Spatial organization

The building has two-storeys with the ground floor consisting of a reception, two group classes, parent's room, toilets, kitchenette for staff and an office. The individual therapy session rooms and sensory room are located on the first floor as shown in Figures 4.2 below (a) Ground floor plan and (b) First floor plan.



(a) (b)

Figure 4.2: Floor plans of Patrick's Speech and Language Centre (PSLC), Lagos

Source: Author (2016).

4.2.4 Autism-friendly design considerations

Acoustics: The materials used in the building consisted of sandcrete block walls with plaster finish, terrazzo floor finish in certain areas like the reception, office and

corridors and Poly Vinyl tiles in the classroom and rugged floors for the sensory room and, the use of rugs in the sensory room was use to minimize sound. The ceilings where made of white patterned suspended ceiling and POP ceiling in some spaces.

Spatial sequencing: The building has most of its public areas located on the ground floor towards the front of the building with the more private areas on the upper floor. The ground floor consist of the reception, two group classes, parents room, toilets, kitchenette for staff and an office. Towards the rear of the building are the vocational unit and music room as well as another group class. The classrooms are arranged sequentially based on age to create a sense of routine and order. The individual therapy session rooms and vocational units are completely separated from the group classes and are located together on one side of the building on the upper floor as shown in figure 1 above.

Lighting: A mix of both natural and artificial lighting was used. The transparent glazing for the windows provided access for natural lighting with most windows covered with venetian blinds to avoid direct sunlight and prevent distractions during sessions. Energy saving bulbs was used to provide artificial lighting.

Quiet rooms: No provision was made for an area where the children can use as an area to calm down during meltdown within the classrooms; instead the children were taken to another class that is not in use at the time of the incident to calm them down.

Sensory zoning: Though the centre was not originally designed as an autism centre, a form of sensory zoning was applied in the centre. High stimulus functions like music, arts and crafts are grouped together, while low stimulus functions like classroom and individual therapy sessions are also grouped separately.

Proxemics: there was adequate provision of space of each individual to prevent them from barging on one another in the course of their interaction. Hence, they feel safe and comfortable.

Safety: Terrazzo flooring was used to prevent the children from slipping and the outdoor play area is enclosed with a white picket fence so that the children can still have a sense of freedom in the outdoor areas while being closely observed by their caregivers. The floors are even, no sudden change in levels to avoid the children tripping. The windows in the therapy rooms on the upper floor were covered in clear plastic instead of glass to avoid breakage.

4.3 Westbrook Regional Vocational Center (WRVC), United States

4.3.1 History and development

Westbrook Regional Vocational Centre is located at 125 Stroud water St, Westbrook, ME 04092, United States. WRVC provides many opportunities for students to succeed while offering a very safe and welcoming environment where students feel a sense of belonging and pride. It is accredited by New England Schools and Colleges (NEASC) and offers career and technical education opportunities to students. In addition, eighty five per cent of the programs are aligned with State or national certifications and/or licenses. WRVC offers 14 different programs which include:

a. Automotive Technology
b. Building Trades
c. Business Education
d. Commercial Truck Driving A & B

e. Computer Repair and Networking

f. Culinary Arts

g. Drafting

h. Early Childhood Occupations Education

i. Electricity

j. Emergency Medical Technician - Basic (EMT-B)

k. Heavy Equipment Operations

l. Marketing

m. Medical Occupations

n. Public Safety

o. Web Page Design

4.3.2 Site planning and landscaping

The site comprises of various units of buildings arranged in a clustered form as shown plate X below



Plate X: Site Plan of Westbrook Regional Vocational Centre (WRVC), United States

4.3.3 Spatial organization

The spaces are arranged based on hierarchy and zoned based on noise level produced from each activity. Plate XI below shows the façade of the building from different views.



(a) (b)

Plate XI: Elevation views of the centre

4.4 Case Study Three: Business Apprenticeship Training Centre (BATC) Sabongari, Zaria.

4.4.1 History and development

Business Apprenticeship Training Centre is a governmental body established in 1972. It is located at Sabongari along Maje street Zaria, Kaduna State. It offers certificates in eight trades; comprising of six conventional trades and two non-conventional trades. The conventional trades consist of motor mechanics; electrical and installation; carpentry and joinery; welding and fabrication; plumbing and pipe fitting, radio and television repairs; with training duration of three years. The non-conventional trades consist of tailoring and knotting, which lasts for one year. The basic entry requirement is a minimum of primary school leaving certificate.

The major facilities in the centre are: an administrative block comprising of principal's office, vice principals' office and a staff room, classrooms, workshops and parking spaces.

4.4.2 Site planning and landscaping

The Centre comprises of Administrative unit and training unit. The administrative unit consists of three buildings arranged in a cluster form. The training unit consists of two blocks of workshops and a single block of classrooms which are arranged linearly in the west-east direction as shown in plate XII below. The administrative units has significant number of trees, shrubs and grasses while the training unit has very few landscape elements which include shrubs and scanty grasses.



Plate XII: Satellite image of Business Apprenticeship Training Centre (BATC), Zaria

4.4.3 Spatial organization

The administrative block consists of offices of the principal, vice principals staff room and toilets arranged in a row accessed from a veranda. The block on the left houses classrooms for Radio and television repairs; plumbing and pipe fitting; and tailoring and knitting while the third block in the administrative unit houses classrooms for

basic general training. The workshops at the training unit comprises of 2 working stations and 2 offices each accessed from verandas on both front and back while the last block comprises of three classrooms. Plates XIII and XIV below show the administrative blocks, classrooms and workshops nrespectively.



(a) (b)

Plate XIII: Administrative block and Block of Classrooms



(a) (b)

Plate XIV: Block of classrooms and Workshops

4.5 Addressing the Research Objectives

4.5.1 Research objective one

To study how the built environment affect the behaviours of the autistic individuals

From literature, it was established that autistic individuals are overly sensitive to the environment because they feel, hear, see, smell, and taste at an extreme level. They can be categorised into 2 types; Hypo sensitive (under sensitive) and Hyper sensitive

(over sensitive). Basically elements that affect their auditory, visual and tactile senses make them exhibit some abnormal behaviour in order to block out the unwanted stimuli received.

The interviewees at the autism centre identified and ranked a list of behaviours that can be attributed to an inadequately designed learning environment. Distraction is the first most common environmental-related behaviour identified. Depending on the type of sensory sensitivity exhibited by the child, environmental factors such as noise, bright light, cluttering, room temperature, or smell can be the cause of distraction. Restlessness, or the inability to sit and focus, is the second most common behaviour identified by the interviewees. Repetitive behaviour, such as repetitive language or movements, is the third commonly cited behaviour. Other identified behaviours triggered by sensory input include elopement, clumsiness, self-injury, aggression and avoidance.

Parents of autistic children interviewed also pointed out that their children's behaviours are affected by noise, visual sensitivity, light sensitivity, temperature, smell and colour.

- **Noise:** The majority of the respondents reported that autistic individuals were sensitive to noise. With regard to noise sources, some of the children on the spectrum were disturbed by external noise, especially traffic and rain, and some children were disturbed by noise generated from within the building from other occupants and appliances.
- **Visual sensitivity:** Disturbance by indoor sights was reported by most of the respondents such as reflective surfaces and untidiness. Disturbance caused by

outdoor activities such as wind, falling leaves, rain was reported by some of the respondents.

- **Light sensitivity:** Sensitivity to light was the third most commonly reported sensitivity by the respondents. Sunlight was the greatest source of disturbance followed by flickering from fluorescent light.
- **Temperature:** Sensitivity to heat and cold were reported by all the respondents. The majority of the children on spectrum were more sensitive to heat.
- **Smell:** Sensitivity to smell was less common with only few of the respondents citing it as a problem. Some of the respondents reported sensitivity to indoor odour, while others reported disturbance caused by outdoor smells.
- **Colours:** Surprisingly only one of the respondents said their child was sensitive to specific colours.

After analysing of the literature and interviews with the caregivers/parents, the following are the precautions that should be taken while designing spaces for the autistic to cater for their sensitivities;

SIGHT: Our sight helps us to define objects, people, colours, contrast and spatial boundaries but, children with an ASD may experience these differently. The hypo sensitive ones perceive objects quite darker and hence it is advised to use as many mild colours as possible so that their sight sensitivity can be improved. While hyper sensitive ones find it easier and more pleasurable to focus on one detail rather than the whole object. Henceforth, it is advised to give simple details on the walls, windows, doors etc. Lighting, visual character, colour and materials are the architectural

elements which are to be carefully studied while designing spaces for the autistic to cater for their visual sensitivity.

- **Lighting:** Various theories have emerged concerning how to cater for lighting for autistics. For example, some are of the opinion that daylight and ventilation should be limited while others contradict the fact. However, majority of them agree in reducing the usage of fluorescent light as the individuals affected with autism are vulnerable to sub visible flicker of the bulb which leads to headaches, eye strain and increased repetitive behaviour. Schools for autistic children use day lighting which according to eminent psychologists helps them in their cognitive abilities and improves overall health. The provision of day lighting should be the least distracting and maximize the usage of incandescent lighting. Graded lighting with various intensities in one particular room helps them to get exposed to various types of lighting.
- **Colour and Texture:** The perception of colours by autistic children differs from the neurotypicals due to the defect in their sight. Using subtle colours in the background and contrast colours as the main activity will draw their attention. Fascination to spiral and the like patterns makes them sit at one place. The usage of glazed or polished tiles should be minimized; matt finished tiled can be altered with textured tiles for them to distinguish between the textures. If carpets are being used then one can use both hard and soft material.
- **Visual Character:** A very simple and clutter free spaces must be designed as children under this spectrum can be easily distracted by confusing designs and shapes. Spaces should be organized and compartmentalised according to their

activities. Too small spaces can be suffocating where as too large spaces can be very distracting. One solution can be creating areas that are organised and free flow areas. One can create an un-distracting and functional area by thinking about the activities that happen in that room. Bookshelves, walls, furniture, soft furnishings and variety in flooring materials can all be used to create a calm, structured environment, and to help autistic children recognise the activities of a room.

HEARING: this is one of major impairment in children with ASD thereby affecting their communication and the ability to balance them to an extent. Hypo sensitive ones mostly have only one ear functioning and therefore they sometimes do not recognize certain sounds. Children under this sensitivity enjoy loud noises and crowded places. Incorporating large open spaces helps in their social interaction and can help them in distinguishing between the sounds. While hyper sensitive ones have ability to magnify the noise and listen to every detail. Hence it becomes very difficult for them to concentrate on one particular thing. A secluded space should be provided away from the noisy spaces for the children to aid them in learning. Acoustics is the main architectural elements which should to be carefully considered to cater for their hearing while designing spaces for the autistic.

- **Acoustics:** People with autism struggle to differentiate various sounds and are more sensitive to it. Any building must respond to this in terms of impact of sound and reverberation time. This can be achieved by using opaque materials in roof to reduce the impact of rain, use of mass wall construction with acoustical materials. Areas that have fewer auditory distractions can help improve attention while lessening verbal stimulations or outbursts. Noise and echo treatment should be used in all classrooms, especially speech rooms to

increase attention span. Likewise, all the classrooms should have the option of being acoustically modified; so autistic children are gradually placed from spaces that have total acoustic treatment to non-treated rooms in order to endure the external world.

TOUCH: This is a very important sensory activity for the autistic individuals to distinguish between various objects and react accordingly. Hypo sensitive ones have ability to withstand high pain and are known for self-injury and are attracted to heavy objects. While hyper sensitive ones are touch sensitive, they only like certain types of material and expect the surrounding to possess the same. Materials and elements should be carefully selected.

- **Materials and Elements:** Complexity in the detail of the building causes visual distractions and sometimes obsession. By using limited variety of materials and reducing hard edges, visual distractions can be limited. Quality of spaces can be enhanced by carefully selecting the materials and adaptable furnishings that foster their development and learning. Sensory elements that are soft, such as beanbag chairs, stuffed couches, swings, carpeting, and water have an advantage and proved to be beneficial for autistic children. Hence there is a necessity to provide such sensory opportunities at a school for their exploration.

SMELL: Autistic persons are highly responsive to various types of smell. The hypo sensitive ones are non-responsive to any type of smells be it their own body odour; sometimes they lick the object to identify it. While the hyper sensitive ones, are highly responsive to every odour; this sensory activity overpowers their other senses.

Toilets, kitchen and similar spaces are usually places far from their learning spaces. The following should be considered in designing for them.

- **Spatial sequencing:** Rooms that develop odours like toilets and kitchen must be placed away from the therapy rooms to reduce distractions. If it becomes inevitable to place such room beside therapy room then the orientation of the room and wind direction must be considered and placed such that the air from the toilet/kitchen does not pass through the classroom.
- **Quiet space:** Autistic children require more personal space than normal children and this should be considered when designing classrooms, halls and anything that will contain social interactions. In places were educational activities are done there should be space large enough for one caretaker and one student.

4.5.2 Research objective two

To examine design strategies that has been applied in designs for autistic individuals

From literature, several architects who have designed for people with autism have described the design strategies which they have implemented in their designs to make them conducive for autistic people. The design strategies have been summarized in table 2.5 and a framework was generated to guide this research. Two case studies of autism centres were conducted to determine the level of applicability of the autism-friendly design strategies and the effect on the users as summarized in table 4.1 below.

Table 4.1: Summary of Findings at Autism Centres

S/N	Design Strategies	Considerations	Case Study one (New Struan School, Alloa)	Case Study two (PSLC, Lagos)
1	Acoustics Consideration	Walling	Sandcrete blocks, Wooden partitions	Sandcrete block walls with plaster finish
		Flooring	The whole area is carpeted	Terrazzo, Poly Vinyl tiles and carpeted floors
		Ceiling	Use of POP and PVC ceiling	Suspended POP ceiling
2	Spatial sequencing	Functional flow of activities	designed around one central walkway, which runs the entire length of the building	Classrooms are arranged sequentially based on age
		Proportion of space	Spaces were well proportioned	Spaces are proportioned based on functions
3	Lighting	Natural lighting	Use of glass atrium, light shelf and angled ceiling to maximise natural daylight	Use of transparent glazed windows
		Artificial lighting	Dimmer switches were used	Use of Energy saving bulbs
4	Safety	Use of safe Materials	Use of high quality materials	Use of Terrazzo flooring, clear plastic instead of glass to avoid breakage
		Use of sturdy fittings	Robust and attractive furnishings	Sturdy fittings were used
		Ease of circulation	The street provides easy circulation	No sudden change in levels
		Use of smooth texture	Walls had smooth surfaces	Walls have smooth surface to avoid self-injury
6	Sensory zoning	Grouping of activities based on stimulus level experienced	Zoned based on the stimulus level of activities	High stimulus and low stimulus functions are grouped separately.
7	Proxemics	Provision of adequate spaces	Adequate space was provided for each individual	Adequate space was provided for each individual
8	Retreat spaces	Quiet spaces to calm down	Quiet rooms were provided to offer a sensory-controlled, calming zone.	No provision was made for quiet space
9	compartmentalization	Clear demarcation of activities	Clearly delineated areas for specific activities	Activities are separated into distinct parts
		Provision of compartment to minimize distractions	Cubicles were provided in classrooms to enable one-to-one teaching	Cubicles were provided for individual therapy sessions
10	Curved walls	Provision of curved walls within the centre	Curved wall were used especially at corners to aid circulation and reduce self-injury from sharp edges	No curved wall used

Source: Author, (2017).

4.5.3 Research objective three

To assess the effects of the applied design strategies on the behaviour of autistic individuals within the facilities

From Table 4.1 above, the two cases studied have made considerable attempt to make their buildings autism-friendly. Acoustics considerations used in both buildings reduced to a great extent the impact of noise on the autistic individuals as stated by the administrators.

The wide ‘street’, with its curved walls and clear view of the whole school in New Struan School, facilitated the smooth passage of traffic into and out of school thus enabling many pupils to independently make these important, daily transitions without confusion or fear of crowding. PSLC however, has a large reception area to welcome the both pupils and visitors but a narrow corridor leads to the various functions.

Both buildings provided clear delineation and purpose of each area of the classrooms which resulted in increased independence and focus for the pupils. Classroom lay-out and ample storage in New Struan School has enabled staff to provide an uncluttered and purposeful working environment. However, PSLC has more clustered classroom layout due to inadequate storage facilities.

New Struan School has increased areas for pupils to utilize during times of stress or overload has enabled pupils to request time in a favoured space, thus having some control over their own behaviour. This was not provided in PSLC, Lagos since the building was not purposely built for people with autism.

The space, light, colours and fabric of the whole building induce an aura of calm and a sense of well-being. Use of high quality resources and furnishings, has resulted in a dramatic decrease in the amount of damage to property.

The library, Café, dining hall and seated areas in the ‘street’ have greatly supported the social curriculum, enabling pupils and staff to meet with their peers and colleagues from other classes, in a planned or spontaneous manner. This is in contrast to the compact planning of PSLC, Lagos which does not have such provision for the staff and pupils.

Providing a quiet space where children can escape from overwhelming sensory input or uncomfortable social situations, is a good strategy for families to adopt. This space should be different from the therapy space.

4.5.4 Research objective four

To develop a framework for integrating autism-friendly design strategies in skills acquisition Centre.

Findings from the two case studies of skill acquisition centres conducted to determine the design requirements to make a skill centre conducive for learning. The design requirements are as follows;

1. Acoustics
2. Spatial organization
3. Lighting
4. Safety
5. Zoning
6. Ventilation

7. Circulation

And since, people with autism are very sensitive to their environment; a framework for integrating autism-friendly design strategies in design of Skill Acquisition Centre for the Autistic was developed by a combination of autism-friendly design strategies and design requirements for skill acquisition Centre as summarized in Table 4.2 below.

Table 4.2: Integration of autism-friendly design strategies in Design of Skill Acquisition Centre

S/No	Autism-friendly Design Strategies	Design Considerations for Skill Acquisition Centre	Framework for Integration
01	Acoustics	Acoustics	Acoustics
02	Spatial Sequencing	Spatial organization	Spatial organization
03	Lighting	Lighting	Lighting
04	Safety	Safety	Safety
05	Sensory zoning	Zoning	Sensory Zoning
06	Curved walls	-	Curved walls
07	Quiet spaces	-	Quiet spaces
08	Proxemics	-	Proxemics
09	Ventilation	Ventilation	Ventilation
10		Circulation	Circulation

Source: Author (2017)

In conclusion, this chapter addressed how to integrate autism-friendly design strategies in design of skill acquisition centre by addressing the research objectives as: to study how the built environment affect the behaviours of the autistic individuals; to understand design strategies that have been applied in designs for autistic individuals; to generate a framework for integrating autism-friendly design strategies in skill acquisition centre. Findings show that elements that affect auditory, visual and tactile senses make autistic individuals exhibit some abnormal behaviour in order to block out the unwanted stimuli received. Case studies conducted shows that applying the

autism-friendly design strategies help improve behaviour of autistic individuals and encourage better performance. Findings from case studies are summarised as follows;

1. The building should have a simple layout which reflects order, calmness, and clarity and have good signage and transition space.
2. Autistic children may show different sensitivities to spaces: some will be frightened by large, open spaces and wish to withdraw to smaller spaces, while others will not like enclosed spaces. Providing a mix of larger spaces with smaller ones to withdraw to when anxious can help.
3. Designing low sensory-stimulus environments reduces sensory overload, stress and anxiety i.e., by proper positioning of spaces like toilets and kitchen away from the classroom and therapy areas, using non flickering lighting fixtures, providing good acoustics etc.
4. Classrooms can be arranged so that teachers may employ different teaching methods, with spaces for individual work or screened personal workspaces.
5. Robust materials should be used where there are children with severe disabilities and safety precautions for doors, windows, glass, plaster and piped or wired services are required.
6. There is a need to balance security and independence and to find the right mix between tough materials and special equipment.
7. The designed space must provide lots of level difference which helps in enhancing their fine motor skills and also allows the management to be vigilant.

A framework was generated from a combination of autism-friendly design strategies and design considerations for skill acquisition centres as; acoustics, spatial organization, lighting, safety, sensory zoning, curved walls, quiet spaces, proxemics,

ventilation and circulation which will be applied in the proposed design. The general design processes and incorporation of research findings will be presented in chapter five.

5.0 DESIGN REPORT

This chapter presents a report on how the research findings were incorporated in design of the proposed Skill Acquisition Centre. This chapter will help to address the research objective five which is; to design a Skill Acquisition Centre that incorporates design strategies to supports the varying sensory needs of autistic individuals. The report will include both preliminaries and the actual design proposal. The report will be organized under the following headings: (a) Introduction of study area (b) Site selection criteria (c) Site analysis (d) Brief development. (e) Concept development (f) Design Considerations (g) Schedule of Accommodation (h) Proposed Design and (i) Conclusion.

5.1 Introduction of Study Area

The Skill Acquisition Centre will be located in Zamfara state. Zamfara State is a state in north-western Nigeria and its capital is Gusau. The state was created on 1st of October, 1996 by Gen. Sani Abacha. It was carved out of the old Sokoto state. Zamfara is located in the savannah region of Nigeria on latitude 12.16° north of the equator and longitude 6.66° east of the Greenwich meridian. The total area of zamfara is 39,762 square kilometres. Zamfara is bounded by Sokoto State on the North, Niger and Kaduna States on the South, Kebbi State on the West, and Katsina State on the East as shown in the figure 5.1 below.



Figure 5.1: Location of Zamfara State on map of Nigeria

5.2 Site Selection Criteria

The following factors were considered as criteria for the selection of site for the proposed Skill Acquisition Centre, Gusau:

i. Land use Compliance: Current and projected zoning and land use should be compatible with the use of the site for a school or rehabilitation.

ii. Accessibility: Ideally, the site should be easily accessible during all times of the year regardless of weather and temperature effects on paths, walks or roads. It should be easily accessible to both vehicular and pedestrian users. Access to the site from minor arterials and collectors is more compatible than access from high speed or high volume road

iii. Site Topography: the site should be fairly level with some topographic relief that can provide opportunities for learning area development.

iv. Noise: Incompatible noise such as from air traffic, vehicle traffic, industrial uses, etc. is detrimental to educational delivery especially those with autism since they have higher sensitivity. Sound decibel level is below 65db sustained and 75db peak. The existing buildings in the immediate environment should not have detrimental effect on the proposed facility.

v. Site Soil Condition: the soil should be well graded and stable with high soil bearing pressure.

vi. Proximity to Basic Services: the site should be close to existing and reliable basic building services such as electricity, water supply, and waste/sewer system.

vii. Expansion potential: The site should be large enough for future expansion.

viii. Site Drainage: the site should have good drainage for easy to development and maintenance. Good drainage reduces the chance of water collecting around a facility which could cause decay leading to structural damage.

5.2.1 Selecting a site

Three different sites were selected based on their land-use compliance for the proposed centre. The three sites are as follows:

Site A: The site is located in Gusau at Samaru district. It has latitude of 12° 9'6.29"N and longitude of 6°40'44.34"E and it is access through Samaru road off Zaria road as shown in plate XV.



Plate XV: Google image of Site A

Source: www.googlemap.com. (October, 2017)

Site B: The site is located in Gusau at Tudun wada area. It has latitude of 12°11'23.31"N and longitude of 6°41'4.82"E. the site boundary is shown in plate XVI.



Plate XVI: Google image of Site B

Source: www.googlemap.com. (October, 2017)

Site C: The site is located in Gusau at Samaru district. It has latitude of 12° 8'6.10"N and longitude of 6°40'40.25"E and it is accessed through Samaru road off Zaria road as shown in plate XVII.



Plate XVII: Google image of Site C

Source: www.googlemap.com. (October, 2017)

Table 5.1: Comparison of Site Potentials

S/N	CRITERIA	SITE A	SITE B	SITE C	REMARKS
01	Land-use Compliance	3	2	3	Site A is allocated for rehabilitation while Site C is allocated for health care
02	Accessibility	3	3	3	All sites are easily accessible from the adjacent roads
03	Site topography	2	1	2	Site A & C are located at a more remote region of the city compared to site B.
04	Noise	1	1	2	Adjacent buildings to site C are institutional and Sparsely distributed while site A & B are close to clustered residential layout.
05	Soil Condition	2	2	3	All sites have good soil conditions, but site C has a better soil condition than sites A & B
06	Proximity to Services	2	2	3	Site C is close to water treatment plant
07	Expansion potential	3	2	2	Site B has more expansion potential than Site A&C as shown in the total square area.
08	Site Drainage	2	2	3	Site C was selected
	Total	17	15	21	
Rating Scale: Satisfactory- 3; Moderately satisfactory- 2; Not Satisfactory- 1					

Source: Author (2017)

5.3 Site Analysis

A general site inventory was conducted in order to identify the site features and potentials which will influence the final design proposal. These include climatic analysis, analysis of physical features present on the site, services, adjacent facilities and sources of noise.

5.3.1 Climate of the region

Both macro and micro climate of the region will be analysed; the former considers the state at large while the later analyses the climatic factors affecting the specific site. The climate of Zamfara is located in the guinea savannah which is characterized by two distinct weather conditions; wet and dry seasons this seasons are influenced by two types of air masses; the dry and dusty north-east trade winds blowing from the Sahara desert brings dry season (Harmatan) while the cool and wet south-west trade winds from the Atlantic brings rainfall.

a. Temperature: Gusau records an average temperature of 26°C with the hottest months being March and April reaching 37°C. The average diurnal range is about 14.1°C which is the difference between the average high and average low temperatures. The proposed site experiences same temperature conditions as there is scanty vegetation cover which could modify the micro-climate of the site. Temperature was considered in the proposed design by ensuring proper orientation of buildings, use of shading devices, use of bright coloured building finishes and use of landscape elements to reduce urban heat gain. Figure 5.2 below shows the varying temperature readings throughout the year.

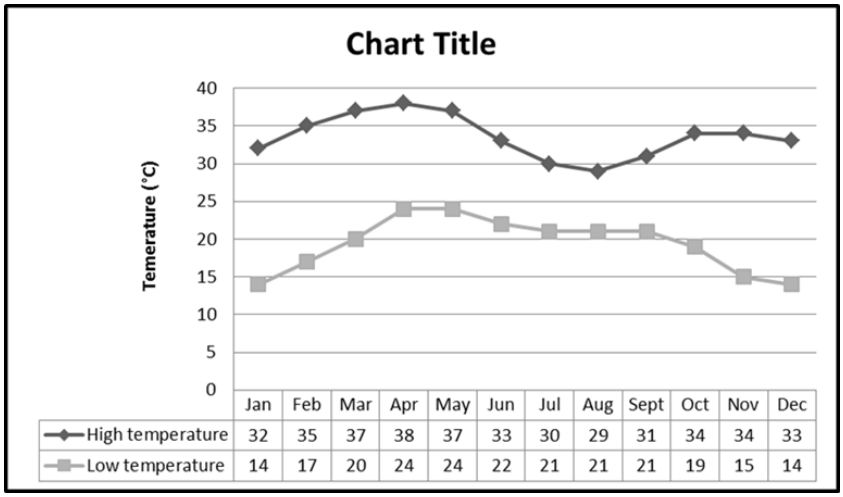


Figure 5.2: High and Low Temperature averages recorded in Gusau.

Source: http://www.climatedata.eu

b. Relative Humidity: At the start of the dry season, relative humidity falls from 68% in October to 36% in November with the stabilization of the easterly winds. It further falls to 35% in January and 20% in February. Mean relative humidity reaches its maximum value of 80% in the month of August as shown in figure 5.3 below. The site humidity is slightly higher than other parts of the state due to the presence a water body close to the site. There is the need for effective natural ventilation strategies and proper damp-proofing to reduce the rise of ground moisture.

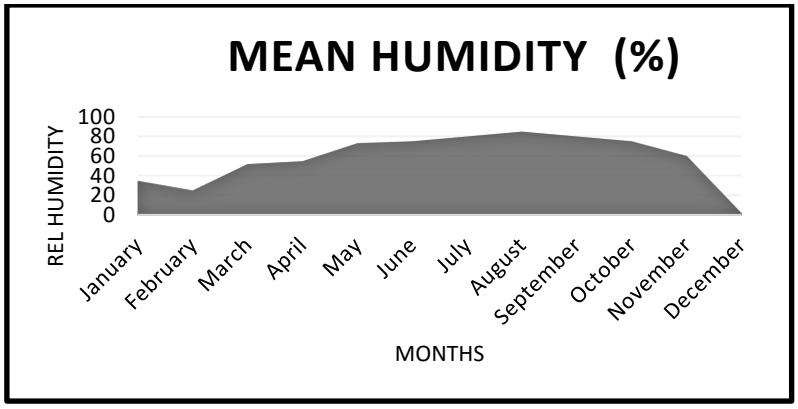


Figure 5.3: Monthly mean humidity in Gusau

Source: http://www.climatedata.eu\

c. **Rainfall:** Rainfall starts in mid-March lasting for about six months till the end of October with its peak in August. The annual average precipitation within the region is 868 mm. The frequency and amount of rainfall over the site is the same with that of the city. There is a need to provide durable roof structure to discharge rain water, proper site drainage to prevent flooding, use of shading devices and water-proof exterior finishes. Figure 5.4 below shows the monthly precipitation recorded within the state.

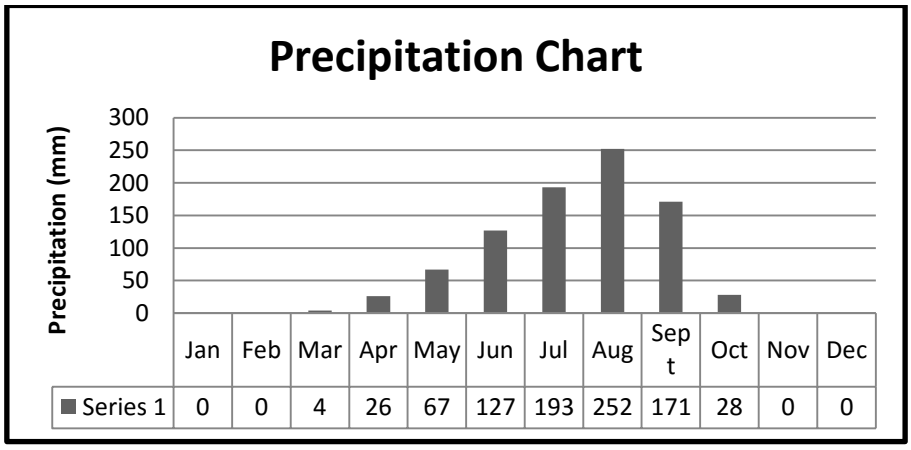


Figure 5.4: Monthly precipitation in Gusau

Source: http://www.climatedata.eu

d. **Wind Pressure:** The predominant seasonal winds are the Tropical Continental Air Mass (North-east trade winds) which is cold, dry and dusty prevails in the dry season (Harmatan Season); and the Tropical Maritime Air Mass (South-west trade winds) which is moist and cool prevails during the wet season (Rainy Season). Higher speeds are sometimes recorded during harmattan period. The average wind pressure in a year is represented in figure 5.5 below. Micro winds are occasionally generated by local air currents. To withstand the effect of wind pressure; the building should be structurally stable, building orientation should obey the Giovani's angle of tilt to prevent draught within the interior and trees should be

planted to serve as wind breakers. SE must have lowest height structure so as to have an unobstructed wind flow.

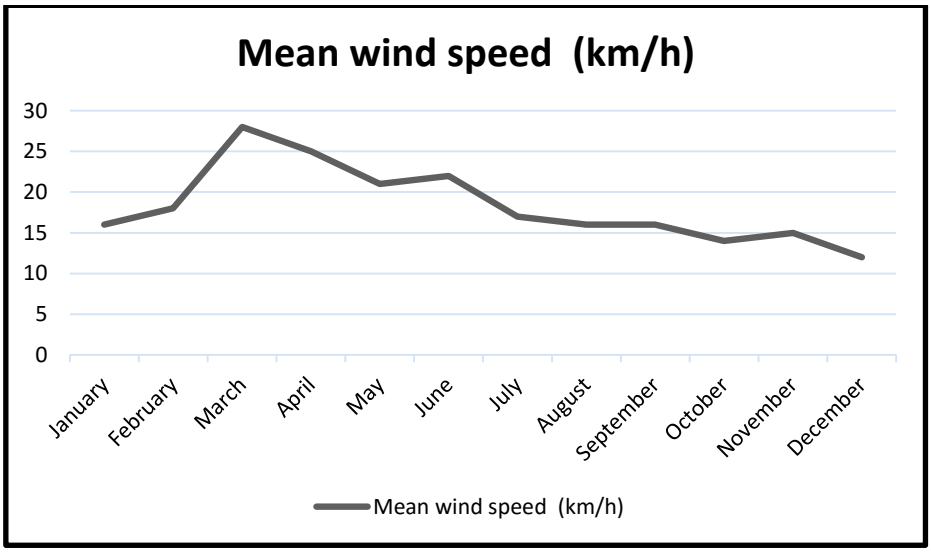


Figure 5.5: Mean wind speed in Gusau

Source: http://www.climatedata.eu

e. Sunshine: Gusau being in the northern part of Nigeria has its sun movement from east through south to the west. As the sun moves over to west its intensity witnesses a reduction till it finally sets. The site is impacted by direct solar radiation due to the sparse vegetation cover of the site. Therefore, soft landscaping should be employed to reduce the impact of solar radiation at the outdoor environment. Building should be properly oriented with the shorter axis facing west-east. Shading devices will also reduce solar heat gain. South, West and Southwest are the hottest sides, least number of openings must be provided; if inevitable solariums can be provided to trap the heat from entering into the building. North side provides glare free lighting which is an apt position for classrooms and sensory rooms.

Inferences made from the site analysis, are summarised in Table 5.2 below.

Table 5.2: inferences from Site Analysis

S/No	Climatic elements	Findings	Design Solutions
01	Temperature	An average temperature of 26°C with the hottest months being March and April reaching 37°C	• Proper building orientation • Ensuring effective natural ventilation strategies • Use of shading device • Use of bright coloured building finishes • Use of soft landscape elements
02	Relative Humidity	Mean relative humidity reaches its maximum value of 80%	• Ensuring effective natural ventilation strategies • Proper damp-proofing of building
03	Rainfall	Annual average rainfall of 868 mm	• Use of durable roof structure • Proper site drainage • Use of shading devices • Use of water-proof exterior finishes
04	Wind Pressure	Average Wind speed of 20km/h	• Planting trees as buffers • Proper building orientation
05	Sunshine	Impacted by direct solar radiation due to the sparse vegetation cover of the site	• Use of soft landscaping elements. • Proper building orientation • Use of shading device

Source: Author (2017)

5.3.2 Site Features

a. Vegetation: the site vegetation is characterized by sparse trees and grasses. The vegetation of the State consists of Sudan and Northern Guinea Savannah. The Sudan Savannah occurs in the western, northern and eastern parts of the State. Like in other parts of the country where this biome occurs, it is structurally characterized by woodlands, where grasses occur either totally or mixed with other herbaceous or shrubby plants. They are green in the rainy season with fresh leaves, but become dry during the dry season. To the southern part of the state, is found the Northern Guinea Savannah. This vegetation type is largely found in the safe Gusau and Anka LGAs. As far as possible the trees should be retained;

farming can be encouraged, as a part of their vocational training, sensory garden can be created by retaining some part of the trees.

b. **Topography:** The site is gently sloped towards a water body located north west of the site with an approximate change of altitude of 4000mm from the first contour to the last on the site. One of the major inferences from the interviews with the psychologist is that if there are level differences it is better as it improves their fine motor skills. This way there is also proper vigilance on the children. Since the land is relatively flat, level differences must be created while designing the buildings.

c. **Soil Condition:** The soil is generally shallow and sandy in nature which is easily eroded but with an underlying strong rock basement, hence the need for low maintenance planting to improve moisture retention.

d. **Services:** Water will be supplied to the site from the water board which is located about a kilometre away from the site or from the stream adjacent to it. Power will be connected from the national grid of Power Holdings Company of Nigeria (PHCN). The site is easily accessible from the two roads bounding the site.

e. **Adjacent Facilities:** The view north of the site, is an access road and a large undeveloped plot adjacent to the road; the west side of the site is also an access road with some scattered settlements adjacent to the road; south of the site are plots of land and east of the site is an expanse of land for future expansion of the facility. Since the surroundings are farmlands there will unobstructed flow of wind into the site.

5.3.3 Site Zoning

The major origin of noise is from the neighbouring community, and from moving vehicles on the main roads. Trees are to be planted close to these sources to buffer this effect. The facilities will also be zoned based on noise-levels generated by each function to eliminate distracting noises which are offensive to the autistic.

5.4 Brief Development

Autism awareness has steadily increased in most part of Nigeria. Researches have shown that people with ASD have special talents which could be improved by training them to become useful citizens in the society. However, Nigeria is faced with the problem of scarce intervention facilities for people with ASD and the few available services are very expensive with huge unaffordable cost to most of the parents of affected children. As such, a Non-Governmental Organization (NGO) has commissioned the design of a skill acquisition Centre in Gusau to provide vocational facilities for autistic individuals in the north western region of Nigeria. The centre will provide both boarding and day facilities for about 100 students with a curriculum focusing on self-care, social living and independence.

The Centre will comprise of the following facilities to cater for administration, autism management, skill acquisition and accommodation.

i. Reception: a reception and waiting area with display facilities is required for visitors adjoining the main offices.
ii. Parents' room: this is a room provided for parents' counselling and meetings.
iii. Principal's Office: this is the office of an administration officer who will be in charge of admissions and relating directly to parents.

iv. Director's office: separate office should be provided for the executive head of the centre.

v. Asst. Director's office: separate office should be provided for the deputy head of the centre.

vi. Secretary's office: this is a room provided for the secretary who could serve both the director and assistant director. The room also serves as waiting area for visitors.

vii. Records room: a room for storing confidential documents of students.

viii. Account office: a room where payments are made and documented.

ix. Diagnosis room: this is a room where specialists can diagnose the severity of autism disorder in a child prior to being admitted into the centre. The diagnosis results will determine the type of therapy and level of support required by each student.

x. Behavioural Therapy room: this is a room where treatments that help change potentially self-destructing behaviours are carried out.

xi. Occupational Therapy room: a room where assessments and treatments are carried out to develop or maintain the daily living and working skills.

xii. Speech Therapy room: a room for evaluation and treatment of communication disorder.

xiii. Staff room: where staff preparation and resource facilities are provided. It is largely social in character and should be adaptable for meetings and staff conferences.

xiv. Training room: a room for staff trainings and seminars to be delivered by specialist to help acquaint them on how to help their autistic students.

xv. Sensory room: this is a therapeutic space specially designed and utilized to promote self-organization and positive change.

xvi. Workshops: these are spaces for vocational skill acquisition comprising various trades from which each student could identify their preference.

xvii. Stores: storage spaces for workshop materials.

xviii. Quiet rooms: is a room where someone who is displaying difficult behaviour can be taken for a period of calming down. These quiet rooms need to be located so that there is always one reasonably near at hand.

xix. Dormitory rooms: these are rooms to be provided as boarding facility to accommodate the autistic users.

xx. Parent- child wing: This area in an early intervention zone where the parent of the child below 3 years is trained to understand the complication of the disorder. Parents are also taught to understand the behavioural and cultural aspects of the children. This way the intervention not only happens in the centre but also at home.

xxi. Multipurpose Hall: this is an auditorium which can serve various purposes such as Autism awareness seminars, trainings, workshops, meetings and so on. The hall can also be rented out for other educational functions.

xxii. Sports facilities: this will include outdoor sports such as football, basketball, tennis, cycling, etc., as well as indoor sports.

xxiii. Assembly hall: this is a hall where the students are gathered at the start of the day's activities

xxiv. Research units: this comprises of various units of research, where trained personnel can be carrying out continuous research on how to manage autism,

what therapies to be done, what new method of teaching can be adopted as well as possible treatment of autism.

5.5 Concept Development.

The conceptual framework adopted for this proposal is formed out in two categories namely:

- The site planning concept and
- The building site concept

5.5.1 Site planning Concept

Positioning of major elements of the design on site are motivated by the need to zone appropriately functions, utilize efficiently available land in relation to existing site constraints and relate to various micro elements which make up the structure for perfect interaction. Hence functions have been grouped into noisy, semi-quiet and quiet zones. The site was organised such that facilities are grouped into activity core in which function emerge from each other and with the landscape creating a sense of continuity of the whole; this is a systematic response to stimulus and gives room for high coordination within the centre.

5.5.2 Building design Concept

The design concept for the proposed skill Centre has its roots in the autism-friendly design strategies which includes; acoustics, spatial organization, lighting, safety, sensory zoning, curved walls, quiet spaces, proxemics, ventilation and circulation. More specifically, the concept is developed from the logo of autism. The logo of Autism is a puzzle, which according to Manchala (2014) indicates the mystery,

diversity and complexity of autism; reflecting this attribute in the design is crucial as people with Autism are very difficult to interpret and understanding their interpretation of space is a challenge. There is need to design the centre such that the different blocks go hand-in-hand with one another to make it a better place for them to live and learn. The puzzle concept was modified into a courtyard system to create visual connectivity because of their social impairment because, it will help unite the diversified spectrum of autism and provide a meaningful platform for their betterment. Figure 5.6 below shows the transformation of (A) the autism logo to (B) the courtyard system.

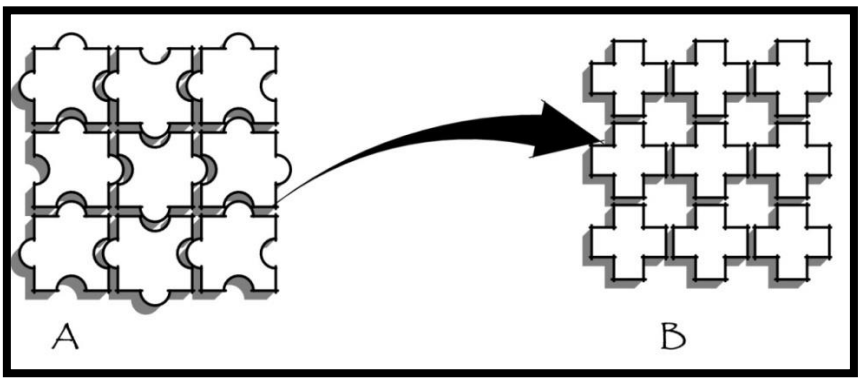


Figure 5.6: Concept generation

Shape and form of the building were based on the behavioural aspects, sensory stimulations and psychology of the children based on the literature study and case study. The whole facility was designed to follow the pattern of the contour lines existing on the site. This gives allowed optimal utilization of natural lighting and ventilation since the contour lines run from east to west of the site as shown in figure 5.7 below. This also allows for courtyards amidst all the blocks as small gathering space rather than large intimidating gathering space.

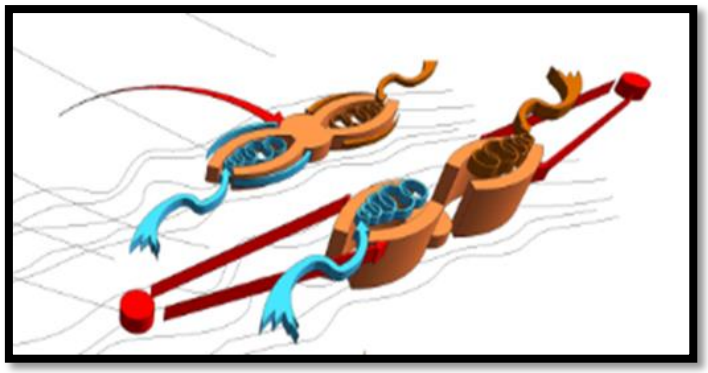


Figure 5.7: Schematic sketch of the concept

5.6 Schedule of Accommodation

The size of spaces required within the Centre have been estimated based on space requirement standards in architectural books and space analysis as summarized in tables 5.3a, 5.3b, 5.3c, and 5.3d Below.

Table 5.3a: Schedule of Accommodation

Sections	S/N	Functions	Space requirement	Space Area	No. of units	Total area
		GROUND FLOOR				
ADMINISTRATIVE UNIT	01	Reception/waiting	-	44m^2	1	44m^2
	03	Occupational therapy	1.5-3.0m^2/child	100m^2	1	100m^2
	04	Staff dining	2.0m^2/person	54m^2	1	54m^2
	05	Student Dining	2.0m^2/person	120m^2	1	120m^2
	06	Outdoor eating area	2.0m^2/person	30m^2	1	30m^2
	07	Kitchen	35-45m^2	40m^2	1	40m^2
	08	Dry store		10m^2	1	10m^2
	09	Wet store		10m^2	1	10m^2
	10	Servery		20m^2	1	20m^2

Table 5.3b: Schedule of Accommodation

Sections	S/N	Functions	Space requirement	Space Area	No. of units	Total area
	11	Changing room	-	$20m^2$	1	$20m^2$
	12	Pantry	-	$12m^2$	1	$12m^2$
	13	Conveniences	-	$5m^2$	8	$40m^2$
BASIC EDUCATION	14	Entrance hall	-	$24m^2$	1	$48m^2$
	15	Assembly hall	$80\text{-}85m^2$	$84m^2$	1	$84m^2$
	16	Library	$50\text{-}65m^2$	$60m^2$	1	$60m^2$
	17	Staff office	$20\text{-}25m^2$	$24m^2$	1	$24m^2$
	18	Quiet room	$20\text{-}25m^2$	$24m^2$	1	$24m^2$
	19	Small size classroom	$1.5\text{-}3.0m^2$/child	$42m^2$	2	$84m^2$
	20	Big size classroom	$1.5\text{-}3.0m^2$/child	$60m^2$	2	$120m^2$
	21	Store	-	$20m^2$	1	$20m^2$
	22	Multipurpose hall	-	$240m^2$	1	$240m^2$
	23	Toilets	-	$5m^2$	8	$40m^2$
WORKSHOPS	24	Entrance hall	-	$48m^2$	1	$48m^2$
	25	Staff office	$20\text{-}25m^2$	$24m^2$	1	$24m^2$
	26	Exhibition hall	$60\text{-}85m^2$	$84m^2$	1	$84m^2$
	27	Sickbay	-	$40m^2$	1	$40m^2$
	28	Quiet room	$15\text{-}25m^2$	$24m^2$	1	$24m^2$
	29	Computer room	$60\text{-}65m^2$	$80m^2$	1	$80m^2$
	30	Music room	$80\text{-}85m^2$	$80m^2$	1	$80m^2$
	31	Painting/craft room	$80\text{-}85m^2$	$90m^2$	1	$90m^2$
	32	Carpentry	$60\text{-}65m^2$	$60m^2$	1	$60m^2$
	33	Metal work	$60\text{-}65m^2$	$60m^2$	1	$60m^2$
	34	Tailoring/knitting	$45\text{-}50m^2$	$45m^2$	1	$45m^2$
	35	Electronics repairs	$45\text{-}50m^2$	$48m^2$	1	$48m^2$
	36	Video games	$45\text{-}50m^2$	$48m^2$	1	$48m^2$

Table 5.3c: Schedule of Accommodation

Sections	S/N	Functions	Space requirement	Space Area	No. of units	Total area
	37	Toilets	-	$5m^2$	6	$30m^2$
HOSTELS	38	Entrance hall	-	$30m^2$	1	$30m^2$
	39	Common room	-	$50m^2$	2	$48m^2$
	40	Caregivers' room	-	$60m^2$	1	$24m^2$
	41	Small size rooms	3.0-5.0m^2/child	$70m^2$	1	$30m^2$
	42	Big size rooms	3.0-5.0m^2/child	$100m^2$	1	$24m^2$
	43	Laundry rooms	-	$30m^2$	1	$35m^2$
	44	Toilets/baths	-	$5m^2$	16	$80m^2$
		FIRST FLOOR				
THERAPIES	45	Records/accounts	15-25m^2	$30m^2$	1	$30m^2$
	46	Diagnostic rooms	1.5-3.0m^2/child	$24m^2$	2	$48m^2$
	47	Waiting area	-	$24m^2$	1	$24m^2$
	48	Behavioural therapy	1.5-3.0m^2/child	$30m^2$	1	$30m^2$
	49	Quiet room	15-25m2	$24m^2$	1	$24m^2$
	50	Sensory integration	1.5-3.0m^2/child	$35m^2$	1	$35m^2$
	51	Speech therapy	1.5-3.0m2/child	$30m^2$	2	$60m^2$
	52	Cognitive B. therapy	1.5-3.0m^2/child	$35m^2$	1	$35m^2$
	53	Conveniences	-	$5m^2$	6	$30m^2$
		SECOND FLOOR				
PARENT/CHILD UNIT	54	Offices	25-30m^2	$30m^2$	2	$60m^2$
	55	Staffrooms	40-60m^2	$50m^2$	2	$100m^2$
	56	Parent training room	-	$66m^2$	1	$66m^2$
	57	Parent-child training	-	$66m^2$	1	$66m^2$

Table 5.3d: Schedule of Accommodation

Sections	S/N	Functions	Space requirement	Space Area	No. of units	Total area
	58	Quiet room	15-25m^2	25m^2	1	25m^2
	59	conveniences	-	5m^2	6	30m^2
		THIRD FLOOR				
RESEARCH UNIT	60	Medical research	-	80m^2	1	80m^2
	61	Special education	-	50m^2	1	50m^2
	62	Cognitive behavioural mgt.	-	30m^2	1	30m^2
	63	Applied behavioural analysis	-	40m^2	1	40m^2
	64	Conveniences	-	5m^2	6	30m^2
		FOURTH FLOOR				
MANAGEMENT UNIT	65	Offices	20-25m^2	25m^2	4	100m^2
	66	Director	35-40m^2	40m^2	1	40m^2
	67	Asst Director	30-35m^2	35m^2	1	35m^2
	68	Secretary	20-25m^2	24m^2	2	48m^2
	69	Conference room	50-65m^2	60m^2	1	60m^2
	70	Conveniences	-	5m^2	6	30m^2

Source: Author (2017)

5.7 Incorporating Autism-friendly Design Strategies in Proposed Design

Based on the concept, case study and literature study, the following are parameters to be followed in the design for the centre. The framework developed for the design of Autism-friendly skill acquisition Centre was considered in the proposed design as summarised in Table 5.4 below.

Table 5.4 Framework for Autism-friendly Skill Centre Design

S/No	Variables	Sub-variables	Application
01	Acoustics	Distance from source of noise	Planting trees as buffers from source of noise
		Wall	Wall insulation Textured wall finish
		Ceiling	Use of Acoustic ceiling panels
		Floor	Carpet flooring to absorb sound
02	Spatial organization	Sequential flow of spaces	Spaces provided based on daily sequence of activities
03	Lighting	Natural lighting	Use of large translucent windows
		Artificial lighting	Use of Concealed lighting fittings
04	Safety	Design	visually accessible spaces to allow safe monitoring from staff
		Use of materials	Avoiding hard materials
		Furniture and fixtures	Anchoring large unstable furnishings and fixtures
05	Sensory Zoning	High, medium and low stimulus zones	Grouping spaces with similar sensory stimulation levels together
06	Curved walls	Use of curved forms	Curved walls especially at corners within circulation spaces
07	Quiet spaces	Provision of Sensory neutral space to escape sensory overload	Small and defined rooms for calming down from sensory overload Courtyards also provide neutral environment to calm down
08	Proxemics	Space allocation	Provision of large space to allow personalization
09	Ventilation	Window openings	Large windows on at least two walls were provided to achieve cross ventilation
		Roof vents	Lattice roof was used with vents to keep the roof ventilated.
10	Circulation	Vehicular traffic	A motorable access was provided separate from pedestrian walkway
		Pedestrian traffic	2m wide walkways border exterior walls of the structure.

Source: Author (2017)

The framework for integrating autism-friendly design strategies in design of skill acquisition centre from Table 5.4 above are further explained as follows:

i. Acoustics: acoustics was ranked as the most influential feature of the sensory environment on autistic behaviour. This requires reduction of internal and external noise sources through various means. This criterion according to Mostafa (2014), does not call for the complete soundproofing of spaces. Rather, it suggests the provision of spaces with reduced noise, at various levels, to allow individuals with ASD to accommodate themselves to different background noise levels, and to mitigate their reliance on this accommodation. Consequently this would allow for the generalization of skill in non-acoustically managed spaces in the real world (ibid). Acoustic considerations in the proposed design are as follows;

   - The building was placed at appropriate distance from road to reduce the noise from traffic and trees were planted to serve as buffers
   - Double walling system with insulating material in between was used on external walls to reduce sound transfer from exterior to interior.
   - Carpet flooring was used to reduce the impact of foot traffic and absorb sound as shown in Plate XVIII.
   - Textured finishes of deeply raked brick facing were used to break up sound waves and reduce noise reverberations
   - Ceilings with sound absorbent backings were used to prevent reverberated sound. The boards are fixed with gaps of about 10mm between them to allow sound travel through the gaps, which is then absorbed by an acoustic blanket behind.



Plate XVIII: Carpet flooring and acoustic ceiling

ii. Spatial organization: Spaces should be allowed to change to the users' needs and to allow the students and teachers to rearrange or subdivide the spaces as needed since we can't satisfy all users at once. There is good evidence that flexible spaces are helpful for those with ASD. A study by Hirasawa, Fujiwara & Yamane (2009), reported that an individual with ASD exhibited less repetitive behaviour when classrooms and care settings were reorganized. Finishing, materials and spatial organization should be able to be manipulated not only by the staff but also by students. This criterion was applied as follows;

- Sequential organization of space was done based on a manner that follows the typical daily routine of the users, and allows for smooth and un-obstructive flow of traffic.
- Open floor plan were created that can be partitioned to the individual needs of the teacher or student and would allow multiple arrangements in rooms.

iii. Lighting: Lighting can do more than just light a building; it can change the mood and even colour of a space. Lighting also needs to be controllable because different activities require different amounts of light. Natural light should be provided in all rooms and used as much as possible as it improves academic

performance, relaxes students, permits better concentration, and reduces hyperactivity in children (Leestma, 2015). Individuals with autism are very vulnerable to the sub-visible flicker from fluorescent lighting, which can cause headaches, eyestrain, and increased repetitive behaviour (ibid). Therefore, it should be avoided. Lighting was considered as follows;

- Natural light was maximised through the use of large windows as shown in plate XIX
- Concealed lighting fittings were used because they are less visible and do not create flickering sounds. The lights are equipped with dimmers to allow greater control over the lighting



Plate XIX: Use of large windows for lighting

iv. Safety: Children with autism occasionally have an altered sense of spatial orientation and depth perception, making them prone to injury. They are also prone to displaying aggressive behaviours and tantrums making them dangerous to themselves and others. Safety considerations were taken with all building

systems, material choices, surfaces, protective barriers, furniture, and fixtures as follows. Implementations in the proposed design;

- Soft surfaces such as rubber and carpet were used to reduce injuries.
- Hard materials such as metal furniture and fixtures were avoided
- Anchoring large unstable furnishings and providing resilient surfaces to reduce risk.
- Spaces were also made visually accessible to allow safe monitoring from staff.

v. Sensory Zoning: Typical zoning in the built environment requires grouping of spaces with similar functional requirements together, but when designing for the autistic a slightly different approach is called for, requiring the organization of spaces in accordance to their sensory levels and qualities (Mostafa, 2014). Zoning was done by grouping spaces with similar sensory stimulation levels together, into high, moderate and low stimulation zones with transition zones in between them.

vi. Curved walls: lots of curved walls were used especially at corners within circulation spaces to prevent self-injury from sharp edges as shown in figure 5.8 below. Whitehurst (2007), states that curved surfaces are liked by children with autism and that, occasionally, they help them circulate by walking in contact with them.

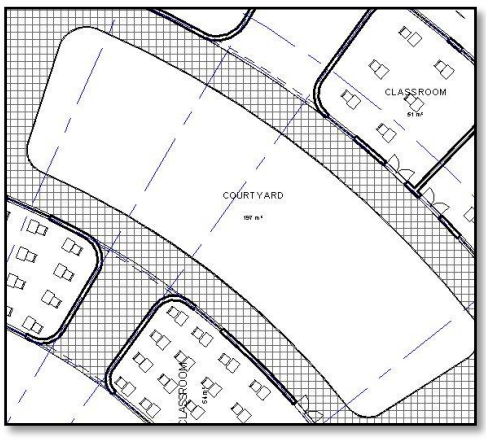


Figure 5.8: Use of curved walls especially at corners

vii. Proxemics: Those with ASD also have different needs for personal space or proxemics (Sanchez *et al.*, 2011). For architecture, the provision of space is a first principle that shapes floors, walls and ceilings. The number of people in a space and enclosure sets limits for inhabitants' personal space and their perception of safety and control. Therefore, larger spaces offer meaningful options for people with ASD in achieving comfort. As such, adequate space was provided to each individual to avoid collision with one another and to achieve comfort as shown in figure 5.9 below.

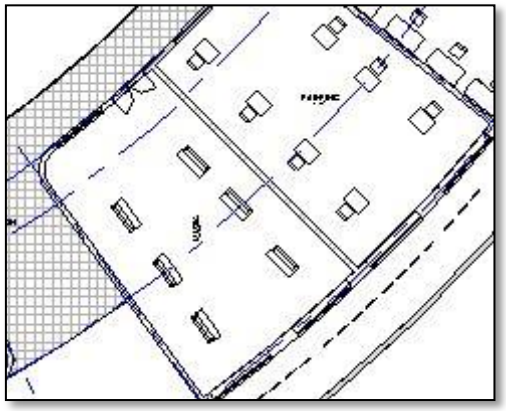


Figure 5.9: Large space provided to allow personalization

viii. Quiet spaces: Students need spaces that provide areas of respite from the over stimulation in their environments. Having such spaces has been shown to have a huge positive effect on students in a learning environment because the class and other students can often overwhelm the sensory input of an autistic individual through the stimuli that accompanies a classroom setting (Leestma, 2015). Implementation in the proposed design;

- Small, defined and discrete sensory neutral environments were provided throughout the buildings that are easily accessible to autistic users as shown in figure 5.10. These spaces are intimate in scale, their objective is to provide a sensory refuge for autistic users to escape sensory overload resulting from the physical and social environment.

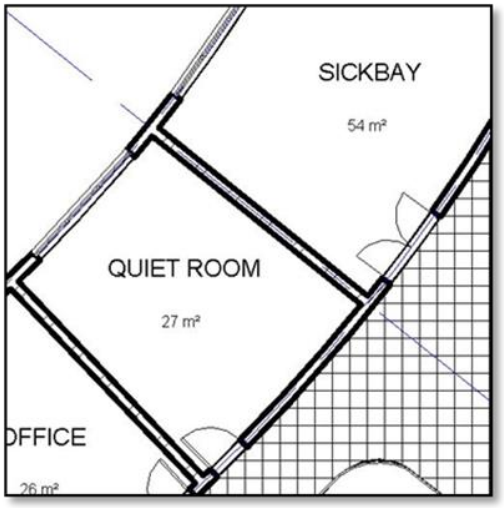


Figure 5.10: Location of quiet room next to sickbay

- Walking paths and courtyards also create soothing outdoor environments which help to calm students down. The courtyard as shown in figure 5.11 can also allow the children to exercise while calming down.

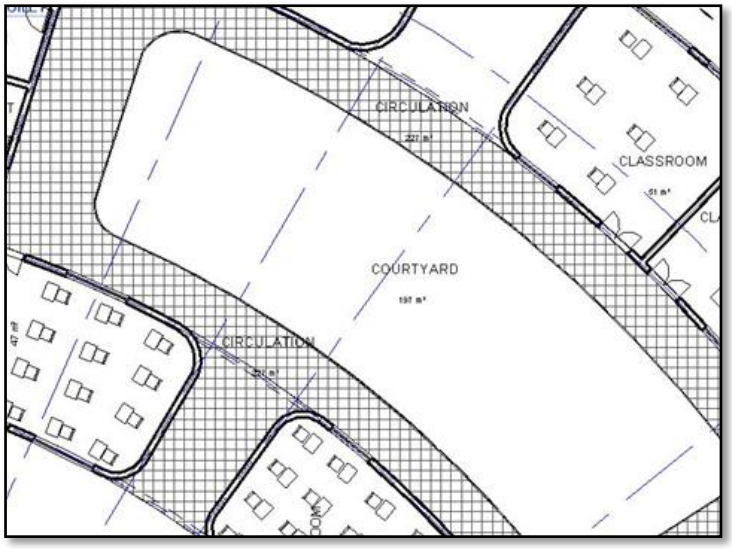


Figure 5.11: Courtyard also serving as quiet space

ix. Ventilation: natural ventilation was maximized through the use of large window openings on a minimum of two walls to achieve cross ventilation. This provides the ideal ventilation and also has the benefit of introducing natural light on two sides of the room. The roofing system employed also allows free flow of air through the trusses to keep the roof ventilated at all times and hence, heat will not be transferred into the building. Double walling system with insulating material in between was used on external walls to reduce heat gain into the building. The use of soft landscaping elements helps to modify the microclimate and keep the environment cool at all times. The glazing panels opted for are reflective glass on the exterior façade of the building which have fixed and operable panels. This allow for considerable reduction in heat gain into the building. Figure 5.12 below shows the features incorporated the proposed design.

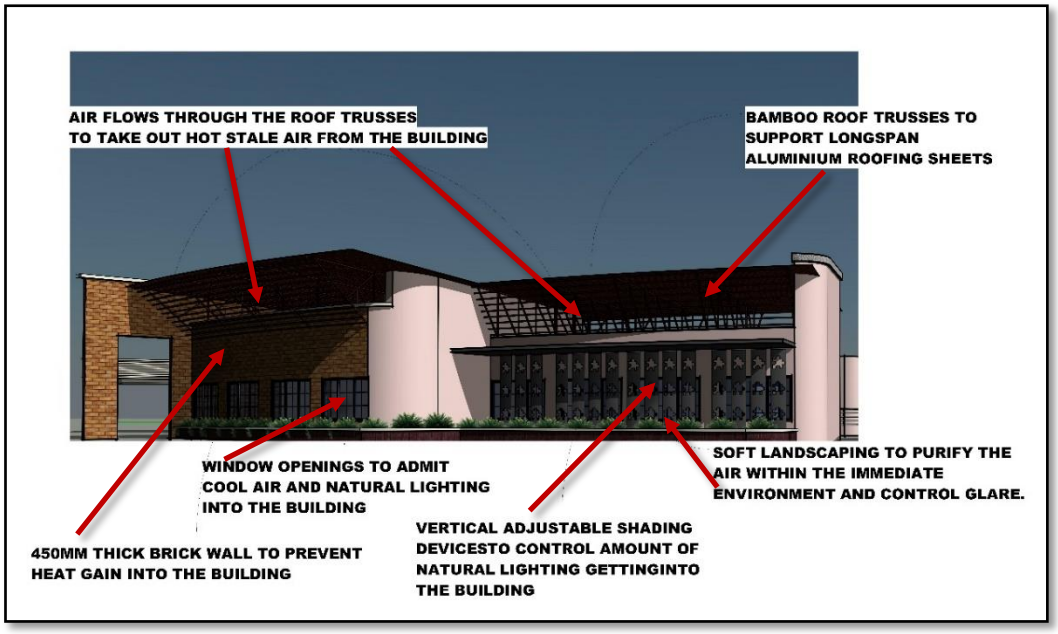


Figure 5.12: Features used to achieve proper ventilation

x. Circulation: circulation was planned following the daily routine as required by the spatial sequencing criterion. Conscious design efforts were made to separate pedestrian and vehicular traffic. The inclusion of a ramp system in the entire building signifies the application of fluidity in the building. Circulation forms an important aspect of the design and can be achieved through the following ways:

- Vehicular traffic: Access to the site is tapped from the south-western axis of the site fanning out into the parking lots provided for visitors and staff. Service access also provided from the same axis of the site.
- Pedestrian traffic: Walkways form an integral aspect of the external and internal circulation scheme. 2m wide walkways border exterior walls of the structure. Also, walkways link the building to the parking lots and ancillary spaces such as the artificial pool and outdoor sitting.

Special systems of conveyance were adopted for vertical and horizontal transportation circulation which includes:

- Lifts: Hydraulic lifts have been opted for, because they are more durable and are not electrically operated.
- Stairs: Located strategically within service core. Stairs are provided in every necessary location in the building sited based on building code statutes and fire regulations.

5.8 Other Design Considerations

The site is located in Gusau which is in north-western Nigeria as such; design and construction should adhere to the North-western Building Code Congress International guidelines as well as the Nigerians with Disabilities Act guidelines. The following factors were also considered.

1. Sustainability: This was considered by designing for minimum energy use and water use, choosing locally sourced, or other low environmental impact materials.
2. Accessibility: The building was made accessible to all users including ambulant disabled adults and wheelchair users. Citing of entrances, walking distances from different functions, provision of disabled parking, as should colour and contrast in the interior design scheme. The implications of sloping sites, changes of level and designs with more than one floor level need careful consideration at the outset. Lifts and chair lifts are expensive to install and maintain, and prone to abuse.

3. Maintenance: considerations were made on the maintenance implications of all specifications to help minimize running costs and ensure long-term viability of the centre. Robust, high-quality materials and products were specified; fixtures and fittings that may cause maintenance difficulties for the management group were avoided.
4. Flexibility: spaces were designed to be as flexible as possible for use both in the short term to cater for current requirements, and in the longer term, as needs will change with time. Initial structural design was made to easily accommodate internal reorganization and allow future extension of space.
5. Means of escape: Care in planning and signposting the means of escape in case of fire is especially important. Escape staircases were provided in case of fire emergency.
6. Water supply: The centre will be equipped with water supply from the Zamfara State Water Board plant which is a few kilometres from the site and a borehole water supply will also be proposed for the centre as an alternative source.
7. Power supply: Power shall be tapped from the Power Holding Company of Nigeria (PHCN)'s national grid. However, the design shall also cater for its own power needs. There is provision for a power substation, with power generating sets and synchronization panel, to cater for power failure.
8. Refuse disposal: Waste bin will be provided in every room and along circulation route. Small incinerator will be provided at a remote part of the site, waste treatment plant, to manage all refuse generated on site.

9. Waste water and sewage disposal: Waste water from water closets will be drained through the central sewer line to the sewage treatment plant for treatment and subsequently disposed.
10. Fire fighting system: Fire hydrants for easy water collection by fire fighters, fire extinguisher and smoke detectors will be provided in the centre, but proficient professional will be involved in determining the number and location of the fire fighting systems.
11. Storm water drainage: The slope of the site being relatively steep will encourage natural drainage of storm water off the site. But drainage channels will be provided to take care of water run-off from roof.

5.9 Materials and Construction Methods Used

To allow ease of construction, without the over-dependence of foreign expertise, the design of the facilities has been simplified to considerable state. A combination of Stabilized Earth Bricks, steel and concrete has been used; for the available construction technology in Nigeria. Reinforced Concrete, Steel, Aluminium and glass are the dominant building materials used for the construction of the facility.

1. Stabilized Earth Blocks: These blocks are made using compacted soil, cement serving as stabilizer. They are about 2-3 times better than conventional brick or concrete masonry in terms of thermal quality, strength, water absorption and they provide good finish.
2. Reinforced Concrete: The high structural strength of concrete (especially when reinforced with steel) makes it the ‘perfect’ material for the structural

system. The fluidity of reinforced concrete makes it a good construction material for curved, slanted walls.

3. Steel: Steel offers many advantages, primarily high strength and ductility. It is also durable if protected from corrosion. Relatively, the higher yield stress of steel allows for smaller sections and its lower weight reduces foundation requirement.
4. Finishes: because the centre comprises of different functions housed separately; for each separate function, the materials to selected for the internal finishing will be based on initial and long term cost, durability, maintenance, comfort, safety (non-slippery), thermal conductivity, reflectance (shine) and appearance.

5.9.1 Construction methods

Framing system should be used during the construction of the centre. All the building component should be produced insitu. Except for some materials like blocks, steel channels, roofing sheets and other components which production practicality on site will be difficult, hence should be produce in factory.

In conclusion, this chapter discussed on the application of autism-friendly design strategies in proposed skill acquisition centre. It started with an introduction of the study area and the proposed site was selected based on outlined site selection criteria which are; land use compliance, accessibility, site topography, noise, site soil condition, proximity to basic services, expansion potential and site drainage.

An inventory of the selected site was taken to analyse the site features, climate and adjacent activities as they will affect the proposed design for the autistic. A brief was developed stating the client, proposed number of users and functional requirements to

cater for administration, therapy, education and accommodation of the users. This was followed by a concept development, stating the philosophy behind the design form chosen. The concept was developed from the logo of autism which is a puzzle.

The puzzle is said to indicate the mystery, diversity and complexity of Autism. The design concept was adopted such that it will allow for symmetry, harmony, repetition and incorporation of the courtyard system. The framework developed for the design of Autism-friendly skill acquisition Centre were the basic design considerations for the proposed design. Each strategy was discussed based on how it was incorporated in the proposed skill centre and their possible impact on the autistic users. Based on the research findings, a general summary, conclusion, recommendation and the major contributions to knowledge will be provided in chapter six.

6.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter presents highlights of the major findings and inferences drawn from the findings based on the data presented and analysed. It will give some recommendations, listing out ways to solve the identified problems and the major contributions to knowledge. The chapter will be organized under the following headings (a) Summary (b) Conclusion (c) Recommendation (d) Contribution to knowledge

6.1 Summary

This research was established on how to integrate autism-friendly design strategies in the design of skill acquisition centre. Autism is a form of cognitive or mental disabilities characterized by impairment in social interaction, communication, and unusual pattern of behaviour. It is a disorder which makes the autistic individuals very sensitive to the environment, of which living in a world that does not take into account their particular sensory responses may trigger unusual behaviours. The prevalence rate of autism is steadily increasing nationwide however; Nigeria is faced with the problem of low awareness, inadequate care facilities and inadequate trained personnel to identify and diagnose the disorder. Most people associate it with demonic afflictions and are forced to hide such individuals at home or abandon them on the streets. The problem being that too much emphasis is laid on their autism disabilities without attempt to understand the special talents associated with the disorder. As such, the need for skill development in autistic individuals is completely neglected, making them completely hopeless and dependent on their caregivers. Therefore, there is a need to provide facilities to cater for people with ASD to make them useful to themselves, families and the society at large. Qualitative research

strategy was adopted using case study research approach. A purposive sampling technique was employed to select two autism centres and two skill centres. Both primary and secondary sources of data were used, and the instruments of data collection used were field observation and interview. Parents and staff at autism centres were interviewed. The design strategies adopted from literature were used in assessment of selected cases.

The following points summarize the major research findings:

a. The interviewees at the autism centre explained that Distraction is the first most common behaviour attributed to an inadequately designed learning environment, followed by restlessness, repetitive behaviour, elopement, clumsiness, self-injury, aggression and avoidance.
b. Literature established that the sensory abnormalities in autistic individuals determine their reactions to elements of the built environment. Such elements like noise, light, colour, texture, smell and movement of autistic individuals affects their behaviours in an attempt to block out the unwanted stimuli received. Most parents interviewed also noted that sensitivity to noise was the most common sensory problem among children with autism, followed by visual sensitivity, sensitivity to lighting, temperature, and colours.
c. Assessments from case study show that acoustics consideration creates a sense of calmness within the building; proper spatial organisation reduces confusion and distraction; compartmentalization increases independences and reduces distraction, zoning of activities, provision of transition space and avoiding flickering lights also creates a sense of calmness within the building; provision of ample user space storage provide an uncluttered and purposeful working environment, provision of quiet spaces to be used during stress enabled users

to have control over their own behaviour; and using soft colours also impacts positively on behaviour of autistic individuals.

d. Findings show that people with autism have great talents which could be developed to make them useful citizens of a society.
e. A framework was generated from a combination of autism-friendly design strategies and design considerations for skill acquisition centres as; acoustics, spatial organization, lighting, safety, sensory zoning, curved walls, quiet spaces, proxemics, ventilation and circulation which were applied in the proposed design.

6.2 Conclusion

The following are the conclusions drawn based on the findings of the study:

a. Distraction, restlessness, repetitive behaviour, elopement, clumsiness, self-injury, aggression and avoidance are behaviours attributed to an inadequately designed learning environment.
b. Environmental elements that affect behaviours of autistic individuals include; noise, lighting, colour, texture, temperature, smell and colours.
c. Application of the autism-friendly design strategies in buildings creates a calm and comfortable environment for all users.
d. Autistics are extremely talented people whose minds can be developed over time and they can be taught a lot of things to make them useful to themselves and the society.
e. Autism-friendly design strategies can be integrated in skill acquisition centre design by considering; acoustics, spatial organization, lighting, safety, sensory zoning, curved walls, quiet spaces, proxemics, ventilation and circulation.

6.3 Recommendations

Based on the findings and conclusions drawn, the study recommends the following:

a. Architects should consider the ways different people perceive space and carry out research to determine the best design approach for such individuals.
b. Given the growing prevalence of autism, building codes should be further updated to consider the needs of people with cognitive disabilities such as autism.
c. Job opportunities should be provided for people with autism and other special children by creating awareness and educating these children along with the rest of the society.
d. Future studies should consider a wider scope such as: the gender of the child with autism; the child's diagnosis on the spectrum (Asperger's Syndrome, ADD-NOS) and other degrees of severity as they affect the autism-related challenges in the environment.
e. Also, there is need to establish a range of values for the design strategies appropriate to make an environment autism-friendly such as: lighting level, acoustic U-value, ventilation, etc.

6.4 Contribution to Knowledge

The key contributions of this research are

i. The study contributes by generating a framework for integrating autism-friendly design strategies in skill acquisition centre design.

ii. It also contributes by demonstrating the framework in the proposed design for autism-friendly skill acquisition centre.

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APPENDICES

Appendix 1: Research Guide

Research Objectives	Research Questions	Information Required	Where to obtain	How to obtain
To study how the built environment affect the behaviours of the autistic individuals	How does the built environment affect the behaviours of the autistic individuals?	What is ASD?	Books, Journals	Literature review
		What are the characteristics of ASD?	Books, Journals	Literature review
		How can people with autism be diagnosed?	Books, Journals	Literature review
		How do people with autism behave in the built environment?	Books, Journals Caregivers/parents Staff	Literature review Interview
To review design strategies that have been applied in designs for autistic individuals	What design strategies have been applied in designs for autistic individuals?	What design strategies are used to make a building suitable for the autistic?	Books, Journals	Literature review
			Caregivers/parents Staff	Interview
			Field work	Physical observation
	What design requirements have not been applied in designs for autistic individuals?	What other considerations are required in autistic environment?	Caregivers/parents, Staff	Interview
To review the significance of skill acquisition to autistic individuals	What is the relevance of skill acquisition to autistic individuals?	What forms of Skills should be taught in the Skills centre for the autistic?	Books, Journals Caregivers/parents, Staff	Literature review Interview
To design a Skills Acquisition Centre that incorporates design strategies to supports the varying sensory needs of autistic individuals.	How can you integrate the design strategies in the design of Skills Acquisition Centre for people with Autism?	What are the basic principles of designing a skill acquisition centre?	Books	Literature review
		How to integrate design strategies for autistic individuals in skill acquisition centre design		

Appendix 2: Assessment table for Case Study

S/N	Variables	Considerations	Available		Remark
			Yes	No	
1	Acoustics Consideration	Walling			
		Flooring			
		Ceiling			
2	Spatial sequencing	Functional flow of activities			
		Proportion of space			
3	Lighting	Day lighting			
		Artificial lighting			
4	Safety	Use of safe Materials			
		Use of sturdy fittings			
		Ease of circulation			
		Use of smooth texture			
6	Sensory zoning	Grouping of activities based on stimulus level experienced			
7	Proxemics	Provision of ample spaces			
8	Retreat spaces	Quiet spaces to calm down			
9	compartmentalization	Clear demarcation of activities			
		Provision of compartment to minimize distractions			
10	Curved walls	Use of curved walls in both interior and exterior			

Appendix 3: Interview Guide

Introduction

Name: Nabilah Aliyu Yusuf

Course of study: M.Sc Architecture

Institution: Ahmadu Bello University, Zaria

Thesis Topic: Autism-friendly design strategies for Skill Acquisition Centre Gusau, Zamfara State

Staff at Autism Centre

Basic Information

a. Name of the organization
b. Location

Background

a. When was the organization established?
b. The number of student intake initially?
c. What were the facilities provided?

Facilities at the institution

a. No. of classrooms, therapy rooms, treatment rooms and sensory rooms.
b. Architecturally, are the rooms according to the requirement?
c. Provision of playground, soft landscape areas?
d. How many children are admitted in the institution? Do the rooms cater for all?
e. Is the therapy supervised by a doctor? If yes, then is there a separate room with all the facilities?

f. Are the parents involved in their intervention? If yes, what are the facilities for parents?

Behavioural Aspects

a. How do the children react to various elements like colours, texture, lighting, sound and environmental features?
b. Are the children obsessed with any object or space? If yes, why?
c. In your opinion, what features of the environment have strong impact on the behaviours of the autistic children within the centre?
d. Are the facilities provided sufficient for the child? If yes, how were they helpful? If no, what other facility do they need?
e. What forms of vocational skills do you teach the children within the centre?
f. What recommendations would you provide to an architect who is designing a skill acquisition centre with a focus on people with autism?

Caregivers/Parents

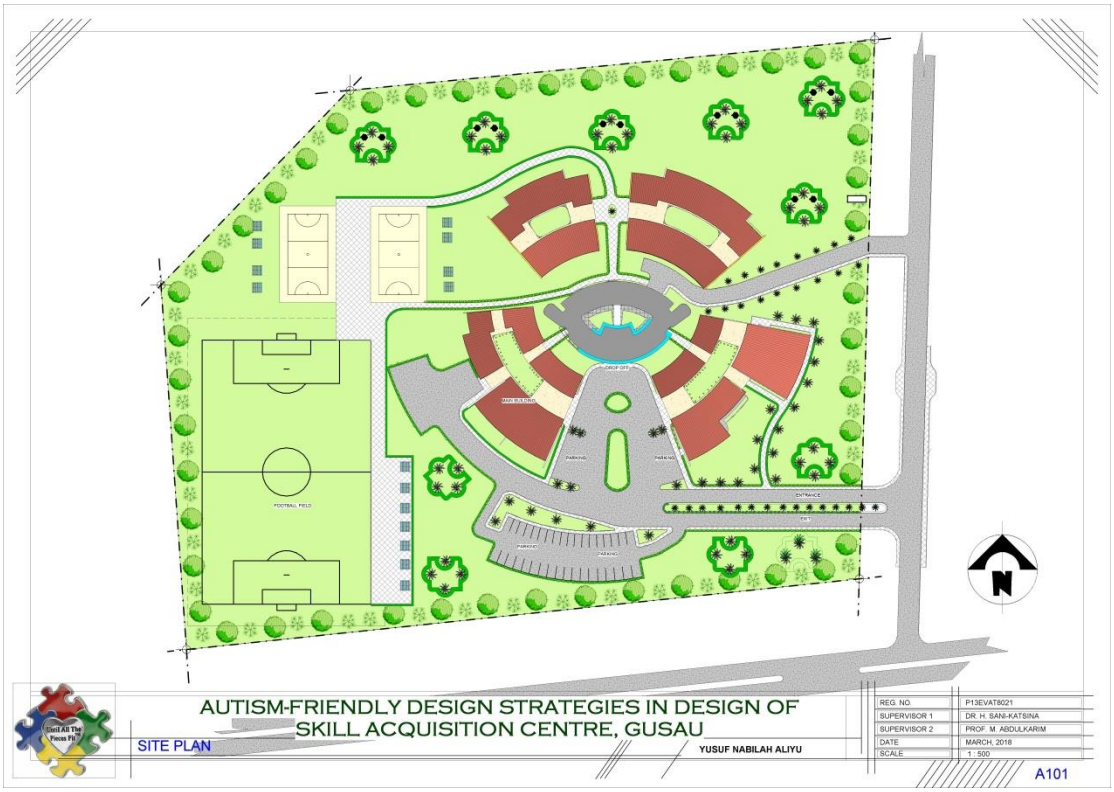
1. What can you say about your child in terms of observing outbreaks, temper tantrums, social interaction etc.
2. In your experience, what features of the environment (such as noise, light, organisation of space, etc.) affect your child's behaviour?
3. What do you think is required in autistic environment to improve their quality of life?
4. Have you noticed any particular activity that your child picks so much interest in?
5. What do you think about a skill acquisition centre?
6. Can you send your child to learn a skill if given the opportunity?
7. What sort of arrangement will you like for your child?

8. If a skill acquisition centre is created for the autistic, in your opinion will it encourage your child develop his/her skills?

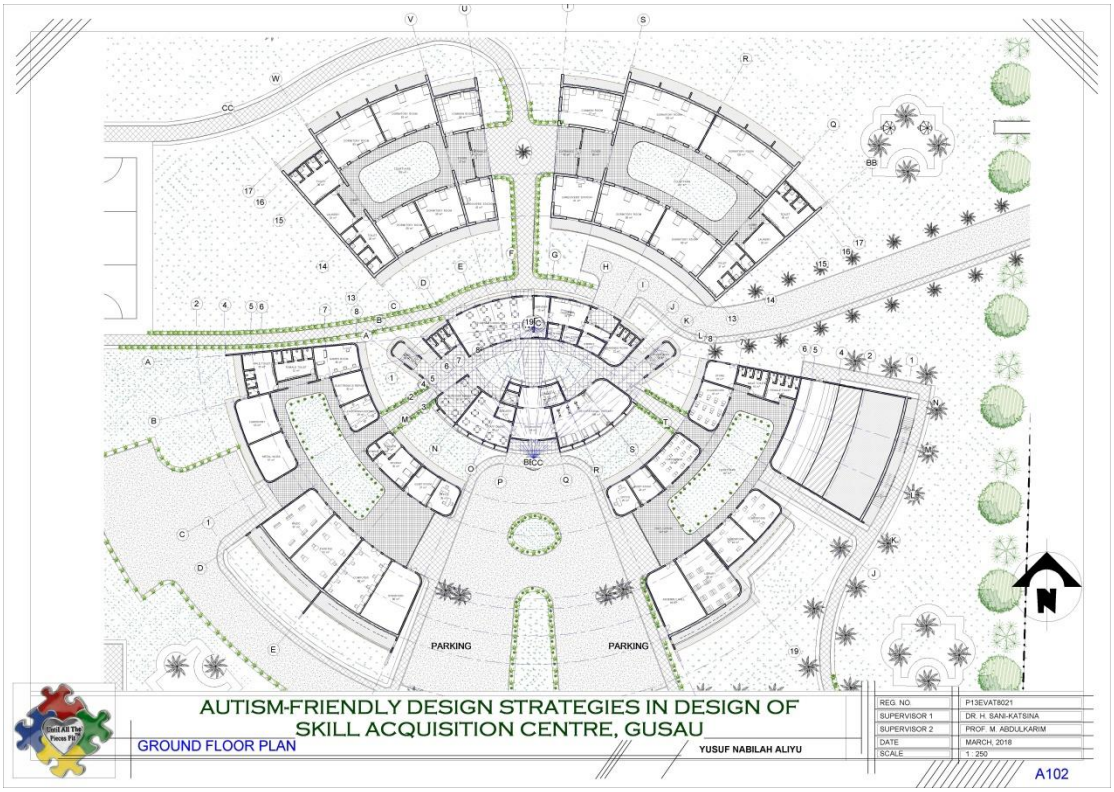
Appendix 4: Interview Response Analysis

Questions	Respondents	Responses	Themes	Subthemes
How do the children react to various elements like colours, texture, lighting, sound and environmental features?				
Are the children obsessed with any object or space? If yes, why?				
In your opinion, what features of the environment have strong impact on the behaviours of the autistic children within the centre?				
What forms of vocational skills do you teach the children within the centre?				
What recommendations would you provide to an architect who is designing a skill acquisition centre with a focus on people with autism?				
What can you say about your child in terms of observing outbreaks, temper tantrums, social interaction etc.				

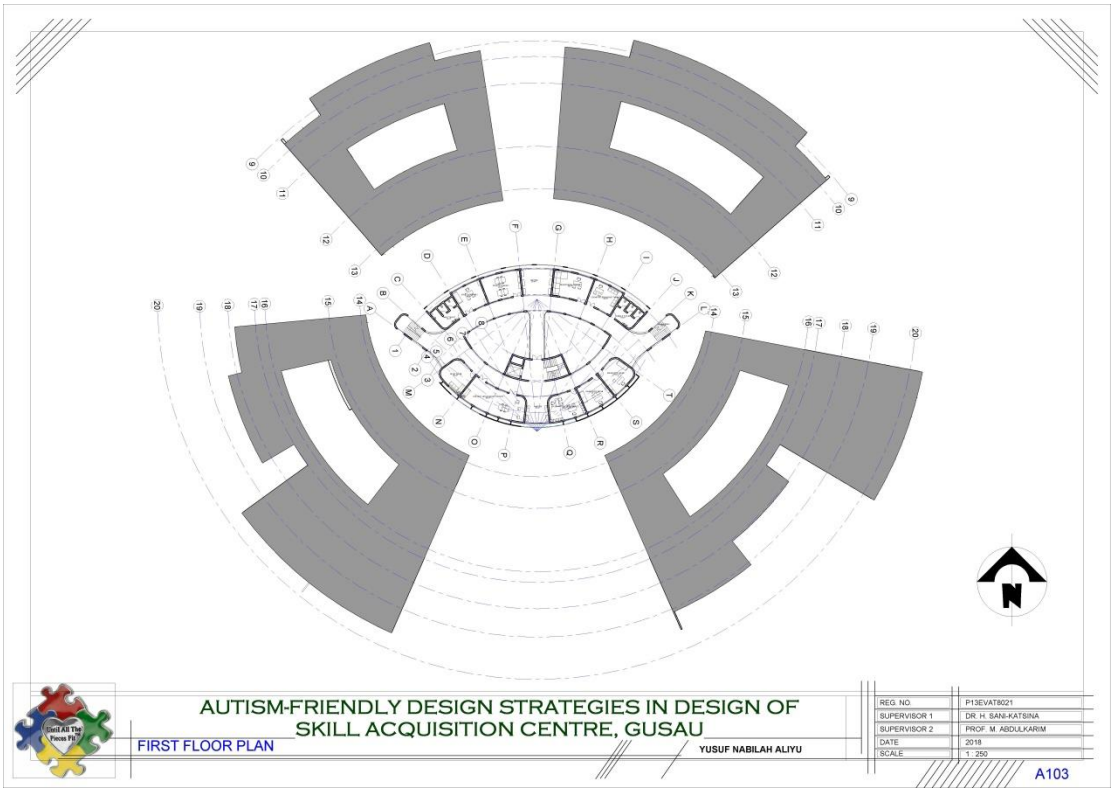
In your experience, what features of the environment (such as noise, light, organisation of space, etc.) affect your child's behaviour?	
What do you think is required in autistic environment to improve their quality of life?	
Have you noticed any particular activity that your child picks so much interest in?	
What do you think about a skill acquisition centre?	
Can you send your child to learn a skill if given the opportunity?	
What sort of arrangement will you like for your child?	
If a skill acquisition centre is created for the autistic, in your opinion will it encourage your child develop his/her skills?	



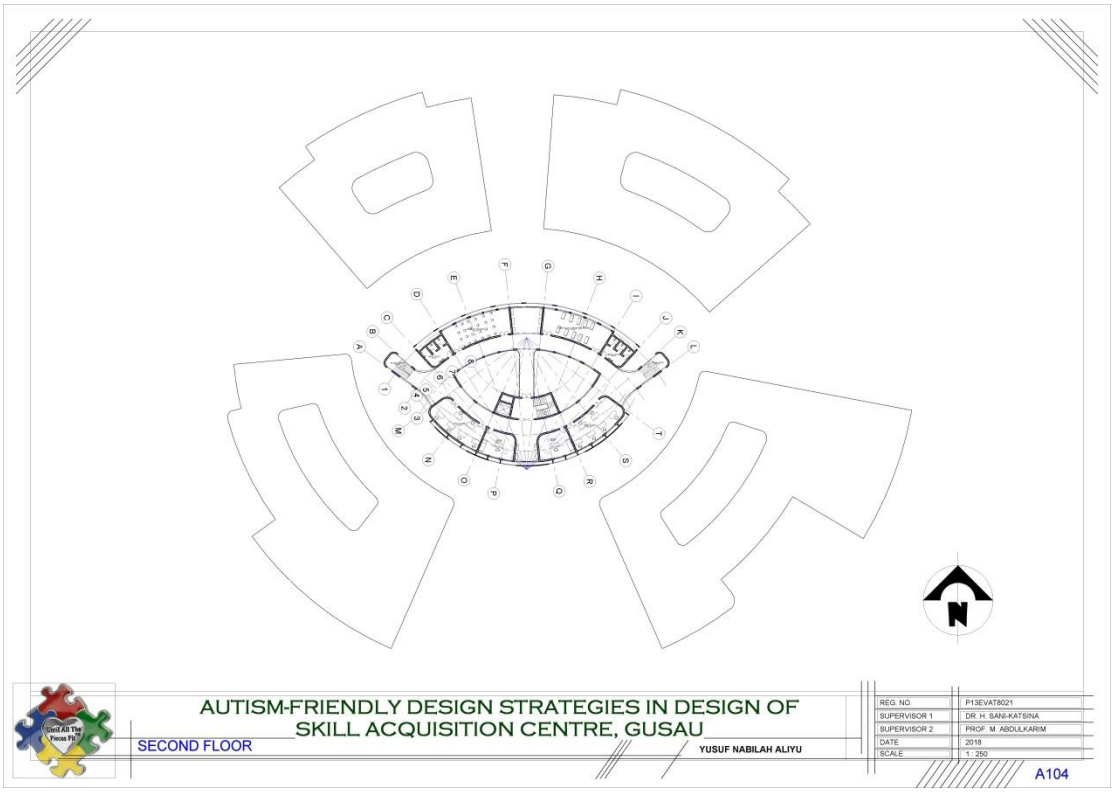
Appendix 5: Site Plan



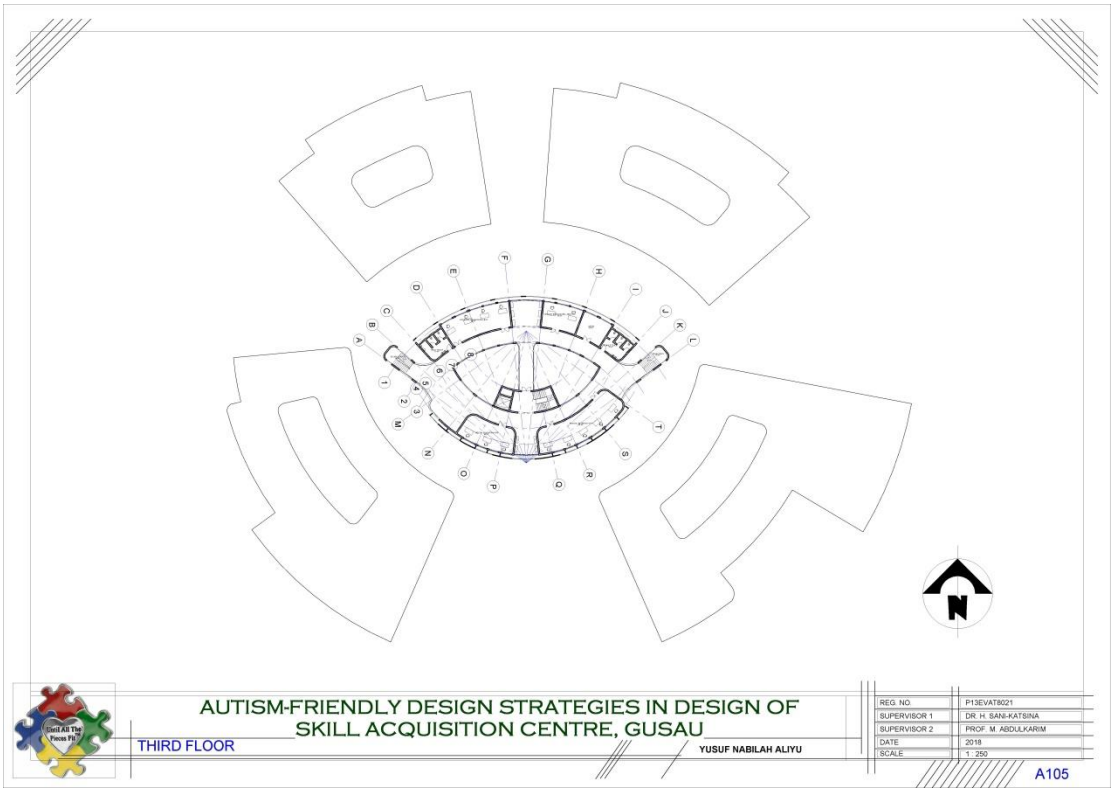
Appendix 6: Ground Floor plan



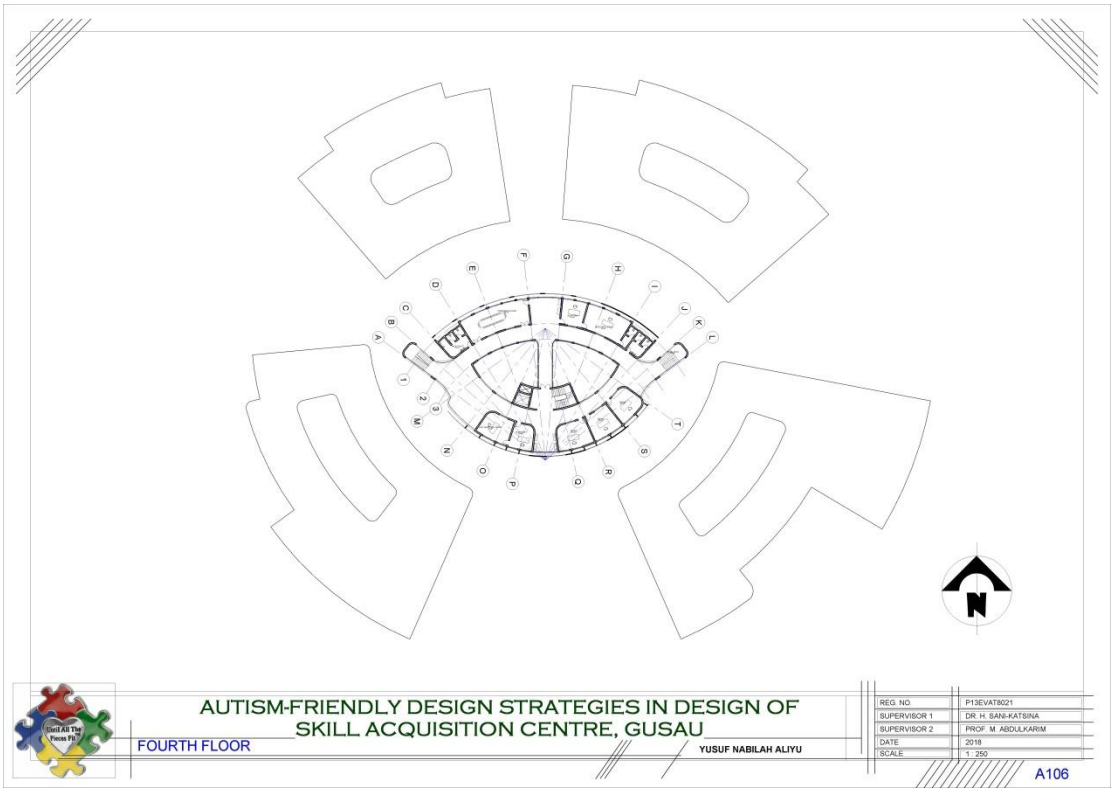
Appendix 7: First Floor Plan



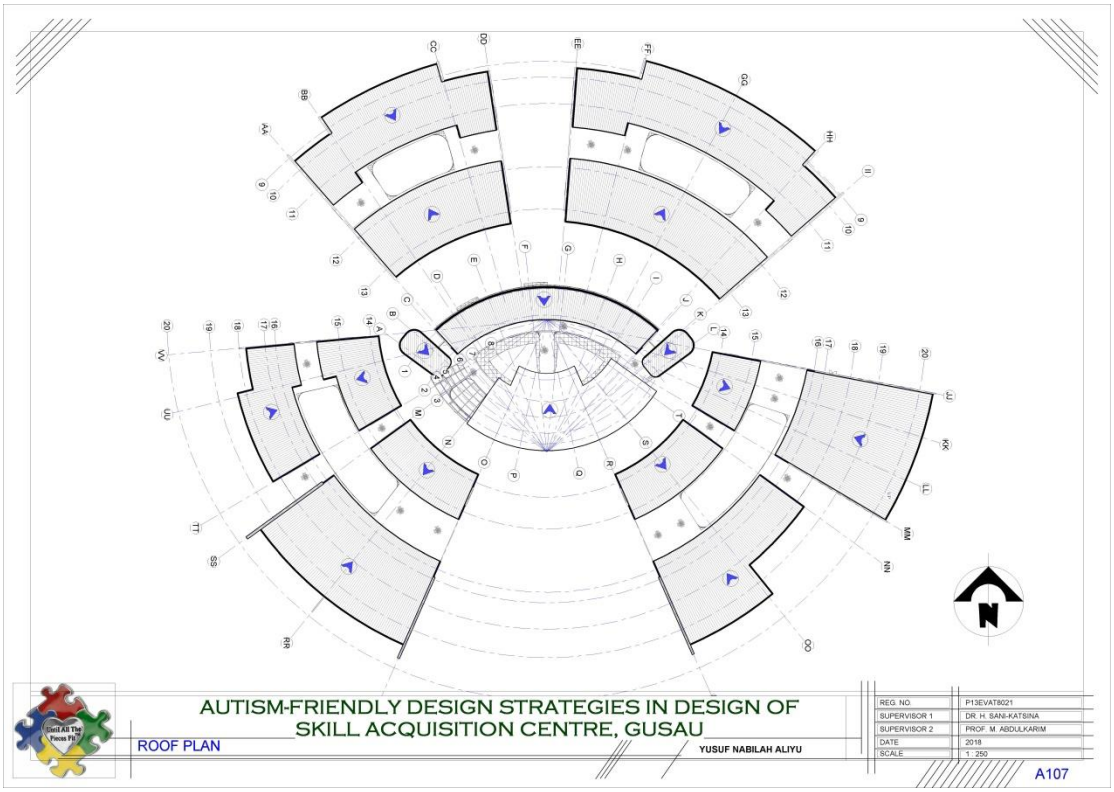
Appendix 8: Second Floor Plan



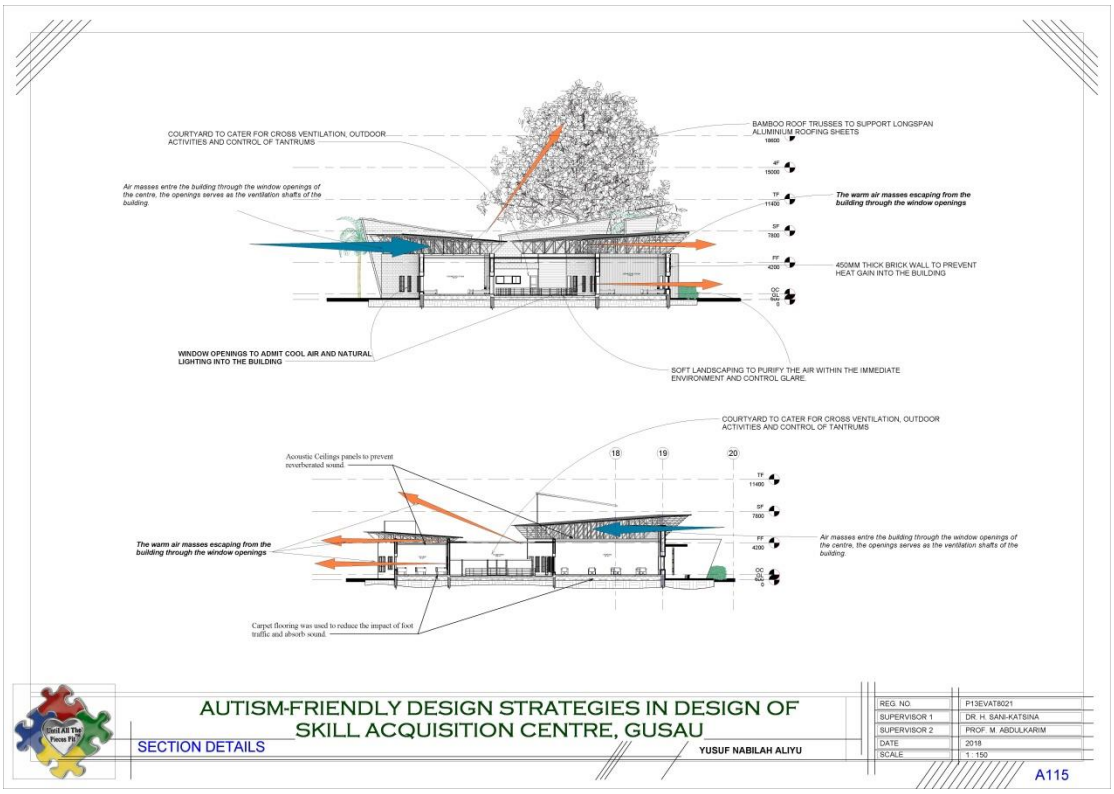
Appendix 9: Third Floor Plan



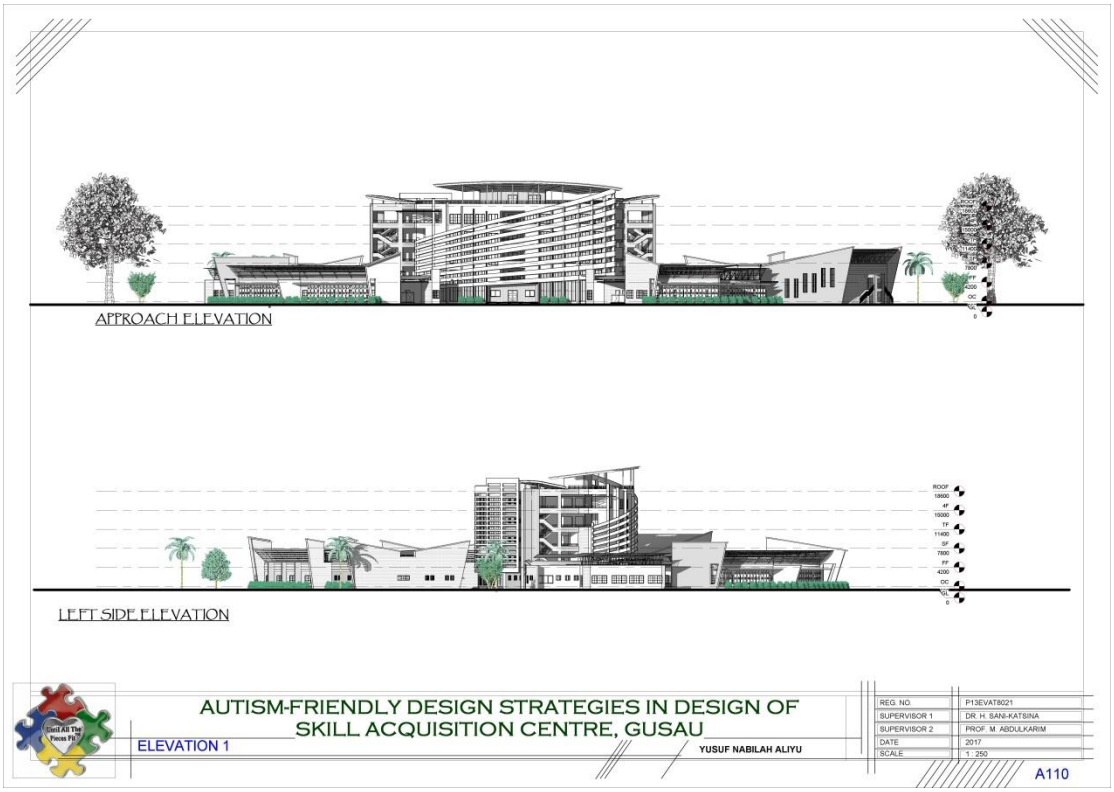
Appendix 10: Fourth Floor Plan



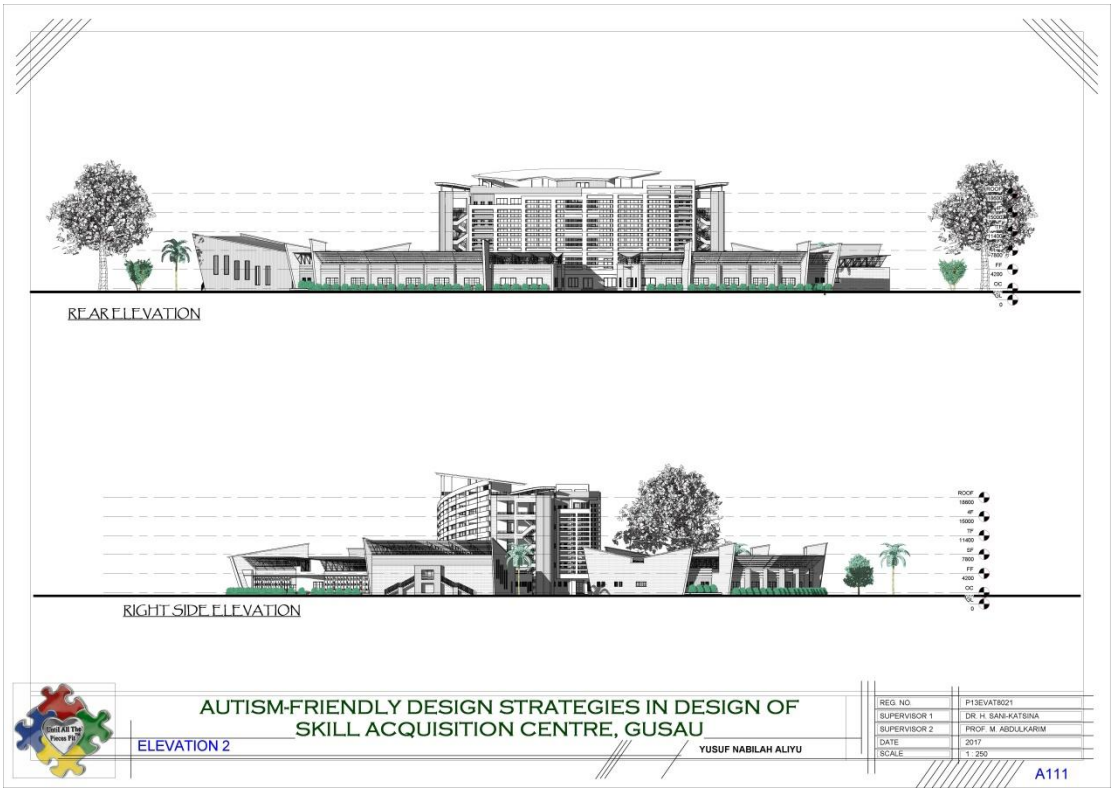
Appendix 11: Roof Plan



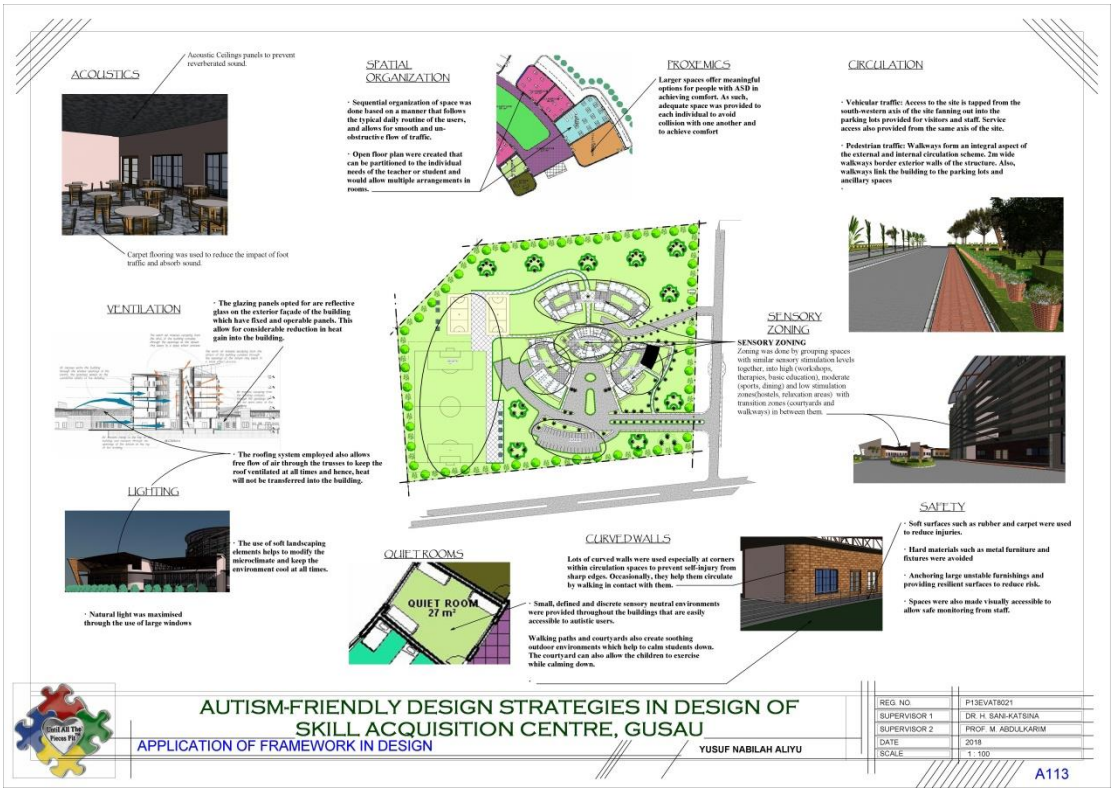
Appendix 12: Section Details for ventilation



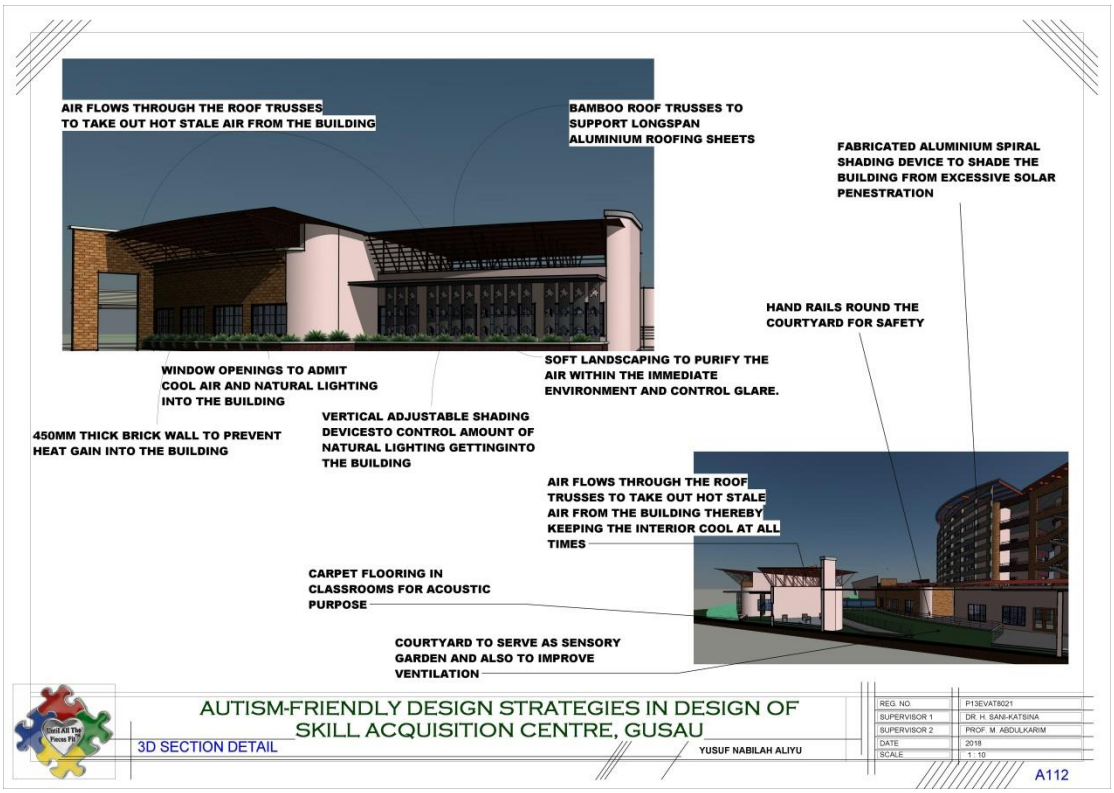
Appendix 13: Approach/Left Side Elevation



Appendix 14: Rear/Right Side Elevation



Appendix 15: Application of Framework in Design



Appendix 16: 3D Details