A USER-CENTRIC APPROACH TO DESIGN INCLUSIVE AND PROSTHETIC LEARNING ENVIRONMENT FOR AUTISM

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SUMMERY

The present study employs a multistage research method based on environment and behavior studies, to explore the effect of identified environmental issues on children with autism as well as able-bodied children for universal access and application. There are several stages to this; in initial stages, learning behaviors of children in educational spaces helped in defining the 'enabling environment' for autism, termed as 'environmental design parameters'. These eighteen design parameters are then tested in the subsequent stages to provide user-centric evidence-based body of knowledge to design inclusive and prosthetic learning environment for autism.

KEYWORDS

Autism Friendly Design, Prosthetic Environment, Inclusive Learning Environment, User-centric Approach, Evidence Based Design

BACKGROUND AND PURPOSE OF STUDY

Autism is a developmental disability significantly affecting verbal and nonverbal communication and social interaction, generally evident before age three that adversely affects a child's educational performance. Other characteristics often associated with autism are engagement in repetitive activities and stereotyped movements, resistance to environmental change or change in daily routines, and unusual responses to sensory experiences [APA,2000] Raised awareness and advent of inclusive education have made it vital to explore the scope of environmental design for children with autism.

> *'If Universal Design is to achieve its goal of making settings that are usable by all people it must go beyond simply or primarily eliminating physical barriers for people with sensory and physical impairments. It must also address the cognitive barriers that effect in decision making process of individual with memory impairments'* [Calkins, Sanford, Proffitt, 2001].

In educational spaces, the accessibility standards take care of physical access to certain extent, but children with cognitive disabilities still remain unrepresented in the environmental design issues. With escalating incidence of autism and increase in

number of children served in inclusive educational set-ups, the present research investigates the effect of physical environment on children with autism in educational spaces.
This paper presents the concept and objectives of the present research, research questions raised to explore the subject systematically, research methodology adopted and scope of the study. The paper ends with a brief discussion on the results obtained.

CONCEPT AND RESEARCH OBJECTIVES

The present research is carried out based on the concept that 'Performance of pupils with autism is enhanced in appropriate physical environment'. The concept stands on the authors' experiences of children with autism and their unusual sense of space perception. Two main purposes of the study are to determine the enabling aspects of educational environments assisting children with autism in learning, and develop design guidelines for successful inclusive learning environment. The principal objectives of the study are:

- To identify the 'enabling aspects of educational environments' for children with autism.
- Measure the impact of 'enabling aspects of environment' on educational performance of children with autism.
- Explore the effect of the 'enabling environment for autism' on able-bodied children for universal access and application.
- Develop evidence based design guidelines that will lead to the development of effective inclusive educational spaces for children with autism.

RESEARCH QUESTIONS

To address the above objectives, this study has utilized a multiple stage research program to examine the following research questions:

- What knowledge is available from previous research and literature on design and autism?
- What kind of limitations do the children with autism have in learning due to their deficits and associated conditions?
- What kind of limitations do the pupils with autism encounter in the physical environment due to their condition?
- What kind of approaches in teaching are adopted to help children deal with their deficits and what are the environmental design implications of these teaching strategies used for children with autism in educational spaces?
- What kind of curriculum modifications and supporting services are required for children with autism? How do they affect the design of educational spaces?
- What are the enabling aspects of environment those might help children with autism in educational spaces?
- What tools and measures can be developed to validate these enabling aspects in the environment for children with autism?
- How does the educational performance of children with autism get influenced by the environment?

- How do the age and type of educational setting affect this inter-relationship of performance and environmental design?
- What do autism experts and regular education experts feel about the enabling aspects of environment for children with autism?
- Are the environmental design aspects, important for children with autism, also significant for the able-bodied children?
- How enabling is the existing educational environment for children with autism?
- What are the design implications of the identified enabling environmental aspects those can act as guidelines for architects and designers to design autism friendly educational spaces?

RESEARCH METHODOLOGY

The methodology (please refer figure-1) adopted in the research largely derives from Environment-Behavior research methods [Ziesel, 2006], [Cherulnik, 1993]. It starts with a concept; carries out detailed preliminary studies to formulate the hypothesis and tests the idea in an orderly way for the purposes those can be generalized.

The study builds on the concept *'Performance of pupils with autism is enhanced in appropriate physical environment'*, based on author's experiences with children with autism and the literature on autism. The concept propels the whole study and sets the direction of the future observations. The objectives are to identify the enabling aspects of educational environments for children with autism, measure their effects on educational performance and develop design guidelines those will lead to the development of effective inclusive educational spaces for children. The concept and objectives raise the research questions which are analyzed systematically in five phases of this multi-stage research.

An extensive preliminary diagnostic study is carried out to deepen the understanding of the concept. This establishes the users' needs, based on the theories of environment-behavior research and disability studies, literature on autism, teaching strategies used for the management of autism and the literature on previous works on design and developmental disabilities; this diagnostic study is the opening phase of the study. A further preliminary field investigation is carried through case studies in different countries of Europe, USA, and India to re-establish the educational needs of children with autism by observing physical traces (layout, walls, ceiling, floor, etc.) in naturalized settings within educational spaces. This unobtrusive environment-behavior research method of observing physical traces is adopted in this stage, as it is described as the most suitable method for the population that is sensitive to the researcher's presence and the population that cannot be interviewed [Ziesel, 2006].

The theories, literature studies and environmental adaptations in existing settings led to the development of detailed environmental design considerations those are enabling for pupils with autism in the second phase of the study. To present the concept tangibly, identified enabling design considerations are summarized as design parameters. This third phase sets the descriptive hypothesis in the present research that is tested subsequently in the fourth phase to have empirical evidence in favor of the concept.

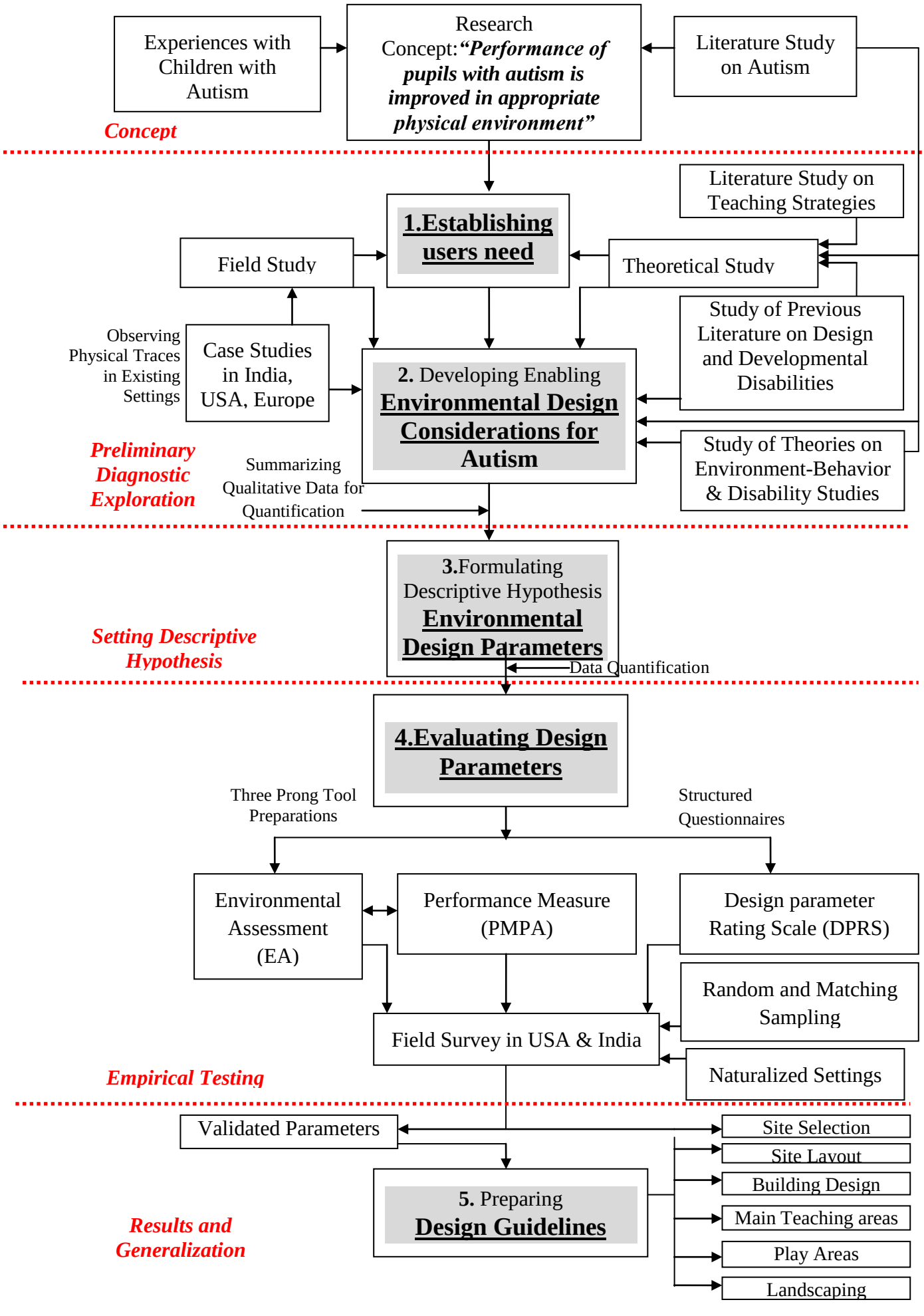

Figure 1: Research Methodology

Empirical testing to evaluate the set of descriptive hypothesis or design parameters is carried out to quantify the qualitative data, using multiple sets of tools in the form of standardized questionnaires. These tools are environmental assessment (EA), performance measurement scale for pupil with autism (PMPA) and design parameter rating scale (DPRS). The above mentioned parameters are tested in existing educational setup based on post occupancy evaluation in environment-behavior studies [Ziesel, 2006; Preiser, 2005, 2001]. The EA and PMPA data are collected from sixteen educational spaces in USA and six in India and DPRS data is collected from eighteen experts working with severely autistic kids and also from fourteen regular education experts. The data is collected from teachers and therapists working with the children with autism, in a naturalized setting that is familiar and comfortable for children. The samples although selected randomly, represent all age groups, elementary, middle and primary; different type of educations settings, inclusive and specialized; different education experts, autism and regular education and different countries- developed and developing. The empirical data is then structured, compared and analyzed both intimately and distantly at the same time. Manifest and latent inferences from observations are drawn to answer the research questions formulated in the beginning of research.

The research in the final phase presents important findings in a way, which can be used in applied design situation [Reizenstein, 1975]. It presents highly rated universally applicable parameters for children with autism in the form of guidelines; they are also beneficial for able-bodied children. These guidelines create a developmental framework, for architects, designers and facility managers, to design high performance educational spaces for children with autism. The guidelines are prepared for site selection, site layout, building design, play areas and landscaping. The results are specific and can be generalized as well, because of the amplified breadth and depth of the present research. The design guidelines for educational facilities are expected to be inclusive and provide equal educational opportunity for everyone.

This multi-disciplinary, multi-stage research employs multiple research approaches in a coherent way. It incorporates inter subjectivity, reliability, validity, testability and generalizability, the indicators of quality research [Ziesel, 2006]. For inter- subjective judgments, presentations and publications are done at every stage and the subject matter is shared with educators, autism experts, researchers and designers for diverse opinion. The research uses multiple techniques from theory, and employs literature surveys, field surveys, different set of tools and multidisciplinary inputs, all adding reliability. A testable hypothesis and multi-level empirical testing enhance the validity of the research and finally, the inclusive autism friendly educational space guidelines, beneficial for all users with and without autism, make it generalizable.

SCOPE AND RELEVANCE OF STUDY

The present research identifies enabling aspects in educational environment for children with autism and explores the effect of those on performance of children. The methodology adopted is similar to the post occupancy evaluation techniques in environment-behavior research, rather than a research process involving environmental intervention. This is due to the complexity of the disorder and ethical

issues involved in the research with vulnerable population. The enabling aspects are developed and tested for (1) Low functioning children with autism, high on autism spectrum (2) All age groups in elementary, middle and secondary schools (3) Different type of educational settings from inclusive to special (4) Educational settings in different countries.

Autism is a spectrum disorder and includes varied degree of functioning levels; this is because of the combination of three deficits and associated sensory dysfunction. The conditions of autism are irrespective of the intelligence level (IQ-level), however, considerable children with autism also have mental retardation [Siegel, 1988]. 'Low functioning children with autism, high on autism spectrum' refers to those children who are not only very low in functioning level but also have more autistic features (lack of communication, imagination and social interaction) and sensory dysfunction. Enabling aspects are developed and tested on these children with a belief that the environmental conditions those are enabling for more complex conditions in autism will also be helpful in conditions not so complex.

To explore how enabling are the environmental aspects for different age groups in educational spaces, primary, middle and high school level educational spaces are tested using a three prong scale specially developed for this research. When tested in pre-primary or preschool set-ups, it is found that these settings are more like clinical settings rather than educational setting based on one to one teaching rather than classroom teaching. So pre-school age group is excluded and the study is limited to the age groups between five to eighteen years.

Different types of educational settings from inclusive to special are included in the validation of environmental aspects. Inclusive settings have varying degree of inclusion, from self-contained autism classes in regular schools to the class rooms with full radical inclusion, whereas, specialized settings have autism classroom or classrooms for intellectually disabled.

Although case-studies from different countries are included in the research, the educational settings survey for validation of identified enabling aspects is mainly done in United States of America. This is because they have an established educational setup for children with autism, which is predominantly inclusive. Afterwards, the existing environment in India is also assessed for children with autism, to establish cross-cultural connection, and also to present a case of a developing country with limited resources.

The developed guidelines for inclusive educational spaces at the end of research are 'autism-friendly specifications for architects and designers. They supplement existing design standards for 'school design' in different countries to facilitate children with autism in inclusive setups and no way claim to replace the existing standards.

RESULTS

The data collected from elementary, middle and high schools for autism shows strong correlation between educational environment and performance. Both environment and performance are assessed (using tools of Environment Assessment-EA and Performance Measure-PMPA) relating to the identified design parameters and their interdependence is clearly visible in figure-2. Some variations

in the slope of graph profiles portray that although environment plays an important role, the performance is not solely dependent on it and there are several other factors affecting it. The results are also compared for inclusive and specialized settings separately, refer figure-3, and it is observed that specialized settings are higher in environment than inclusive. Performance is highest in inclusive elementary but gradually declines in middle and high schools, whereas performance in specialized setting improves throughout their school education.

The environmental design parameters are ranked high by educational experts who work with autistic children as well as able-bodied children using teacher environment checklist (DPRS), 95% high school teachers, 92% middle and 92% elementary school teachers rated the design parameters as highly recommended on a five point scale. This confirms that the design issues are not only favorable for autistic kids but are also beneficial for all school children (Figure 5 and 6 show average rating).

Universal consequence of the design issues to the educational environments is furthermore defined by the mean values that establish equilibrium between environment and the demand of all users with and without autism. Figure-4 illustrates this mean value as recommended value for design for all children with and without autism. When compared with existing environment, it is observed that existing schools comply with the recommended value 76% at elementary school level, 74% at middle school level and 70% at high school level. This is encouraging, but unfortunately this presence is only because of the environmental interventions by teachers in the autism classrooms and a few related areas in accordance with special education, all other areas in the building designed by architects do not show much sensitivity to the needs of children with autism.

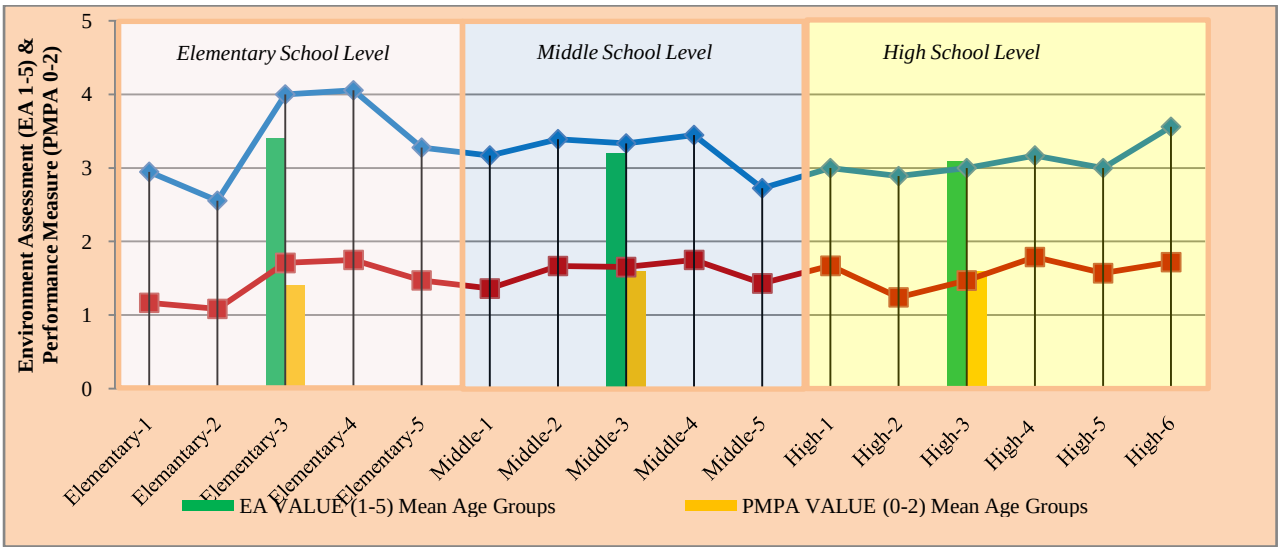

Figure 2: Graphical Representation of Environment Assessment (EA) and Performance Measure (PMPA) Data in Primary, Middle and Secondary School

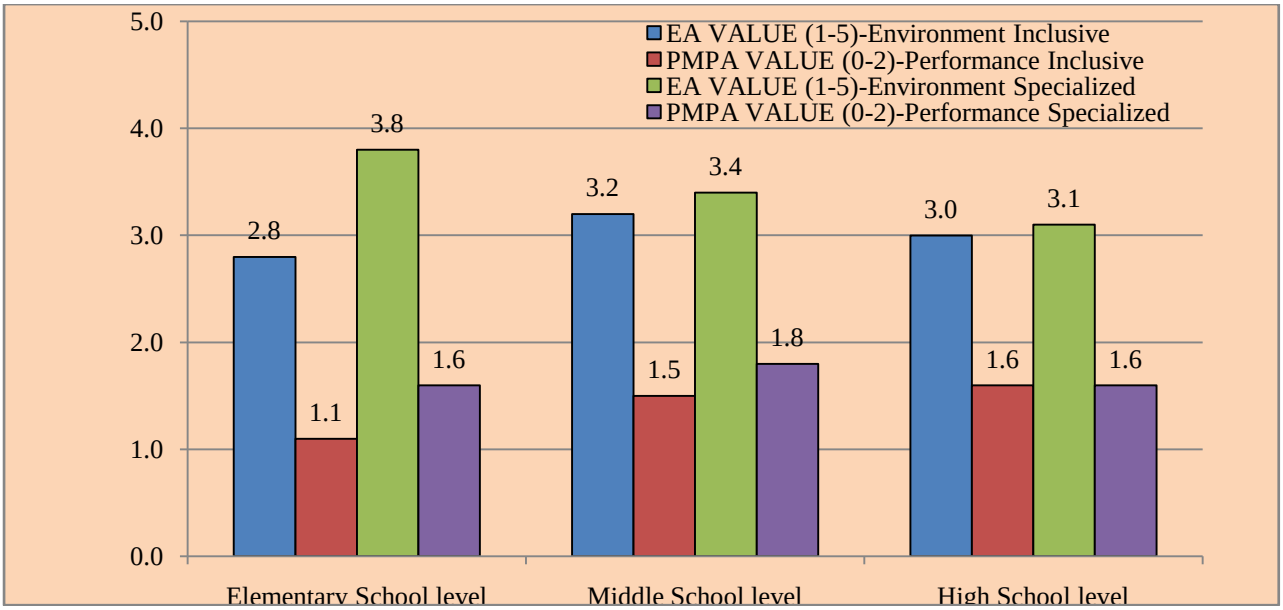

Figure 3: Graphical Representation of Environment Assessment (EA) and Performance Measure (PMPA) Data in Inclusive and Specialized School at Primary, Middle and Secondary School Level

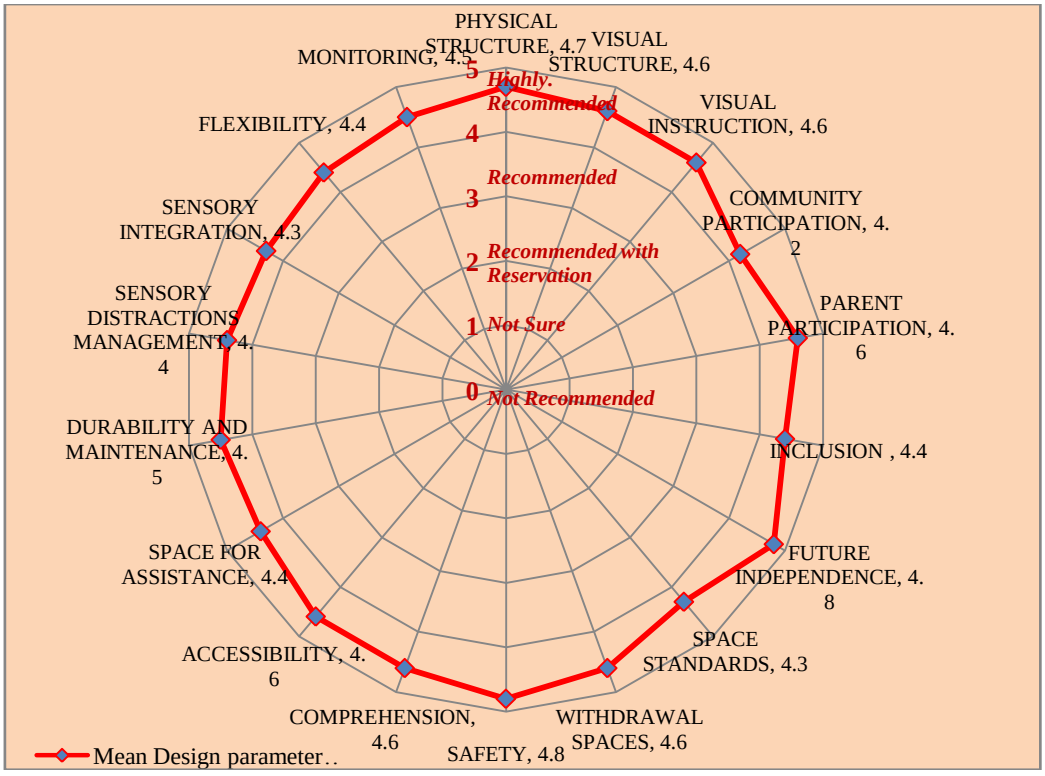

Figure 4: Mean Rating for Universally Applicable, Autism friendly, Inclusive Educational Environment for All

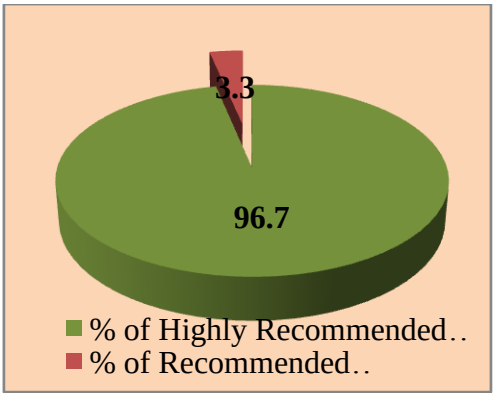

Figure 5: Graphical Representation of Design Parameter Rating Scale (DP DPRS) data from autism experts for pupils with autism

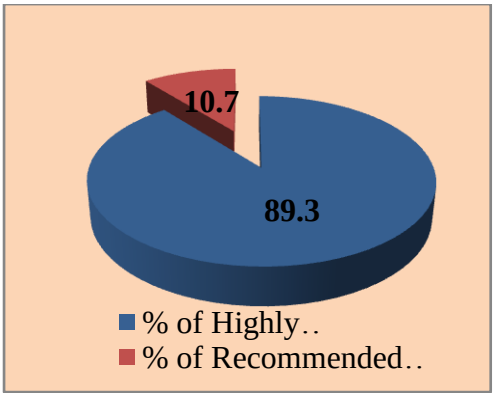

Figure 6: Graphical Representation of Design Parameter Rating Scale (DPRS) data from regular education experts for able bodied pupils

CONCLUSION

Most of the early researches on educational space design for developmental disabilities are limited to the segregated setups for children; moreover, there is no research that talks about autism and environment design. With growing drive towards full inclusion in the world after Salamanca Statement [1994], the present research becomes extremely relevant in providing suitable environment to children with autism in inclusive settings.

The research is expected to catch attention of multidisciplinary team of researchers and has direct application in the field for all stake holders. The developed enabling environmental aspects may prove valuable to the researches in the field of autism, design, education and environmental-behavior research. The design guidelines provide a framework that may be used by designers, architects, teachers, educators, experts, school administrators and all those who wish to provide a successful environment for children with autism. A new knowledge is developed through research, and practitioners may like to implement the findings to design and operate better schools for children with autism.

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