

# Furnishing and Indoor Environment for Hyperactivity and Distracted Attention (in the Context of Sustainable Design)

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## Abstract

Non-government institutions have been upgrading the level of services provided to people with special needs since their numbers have increased worldwide, due to the recognition of new diseases, such as hyperactivity, distracted attention and learning difficulties, which increase in number annually. The main aim of the research is to investigate the criteria of furniture design and class arrangement which reflect the needs and desires of students with ADHD and staff, but unfortunately, schools are often designed and built without fully considering the needs of the community who uses them. Such considerations contribute to develop their ability to learn, i.e. create an appropriate and compatible learning environment with student's abilities to enhance academic performance. To achieve the aim of the research, the researcher reviewed the literature and previous research to identify: 1- the characteristics and behaviour of ADHA students, as well as the patterns of their movement behaviour in the classrooms; 2- the problems of the students and teachers, which are related to dealing with the elements of furniture. The researcher conducted a field study to observe the behaviour of a group of students, as well as the problems related to the elements of furniture. This is in addition to an interview with a group of specialists to deal with such students. However, this methodology depends on exploring possible options for choosing suitable materials. Since there are many options for choosing sustainable materials that have garnered little attention, material efficiency, using less new materials to achieve the same goals is a rich opportunity to create sufficient spaces for students who suffer from hyperactivity and distracted attention. The research method involved a selected sample of teachers of ADHD students aged from 4 to 12 years from five schools in Riyadh. The aim of this study is to develop design criteria that reflects the foundations and considerations of interior design in the context of the Saudi Code of designing special places for people with special needs according to principles of sustainable material use.

*It is difficult, if not impossible, to separate instructional activity from the physical environmental setting within which it occurs.*  
— Lackney & Jacobs

## 1. Introduction

Affecting three to seven percent of the population, Attention Deficit Hyperactivity Disorder (ADHD) is one of the most common of the childhood behaviour disorders. Associated with this disorder's core symptoms of inattention, hyperactivity and impulsivity are a variety of disruptive classroom behaviours (e.g., calling out, leaving seat, interrupting activities, etc.). Consequently, it is not surprising that these students often require behavioural interventions. Attention deficit and hyperactivity disorder (ADHD) is a complex disorder that affects the sense and communication. Furniture design is one of the key factors that can contribute to address this condition.

This research tried to integrate furniture design and layout as a method of increasing positive classroom behaviours for students with (ADHD) to support improved academic performance of such students. In addition to concern to take into account the principles of sustainability and Saudi CODE. Interior designers must carefully consider which materials, colours, texture and form to achieve the appropriate furniture design for people suffering from hyperactivity and distracted attention. The materials can be natural or synthetic, virgin or recycled, simple or high-tech, local or exotic. It can be evaluated as part of a whole design assessment .The interior's purpose should inform the palette of materials used. It's important for the designer to pick natural materials. Especially for students with special needs such as those suffering from hyperactivity and distracted attention.

**Keywords:** Distracted attention, ADHD, Sustainable materials, Furniture design, Indoor environment, Furnishing educational spaces, Schools for children with ADHD, Riyadh

**Article history:** Received: 11 April 2014  
Revised: 02 January 2015  
Accepted: 23 January 2015

## 2. How does attention deficit / hyperactivity disorder affect development of students at school?

ADHD is a hidden disability. It is a disorder that is often invisible. Children with ADHD act impulsively because of the deficit with the verbal memory. They often engage in the same deprecate behaviour repeatedly because of the deficit with the working memory. They have problems following rules because of the deficit in self-regulation.

Some students with AD/HD mainly show attention deficit only, others mainly show hyperactivity, while some show both symptoms. Students consistently exhibit these symptoms in different settings (including at home and at school), leading to obvious difficulties in learning and social interactions. Such students often fail to remain seated, stay in queue or listen to teachers' instructions attentively; Have difficulty concentrating on lessons and doing class work, frequently make careless mistakes during examinations, thus adversely affecting academic results; Poor compliance to school regulations and get punished frequently [1].

The behavioural Characteristics of Students with ADHD can be summarized as follow:

### Hyperactivity:

- Fidgets with hands/feet (Over stimulated).
- Squirms in seat/leaves seat unexpectedly (Under stimulated).
- Shows preferences for gross motor activities (i.e., running).
- Shows frustration during fine motor tasks (i.e. Writing, art projects).

### Impulsivity:

- Inability to delay responding.
- Difficulty waiting turn in social and academic situations.
- Interrupts/intrudes on others.
- Emotional outbursts/reacts based on feelings not facts.
- Poor performance on tasks requiring planning (i.e., tests).

### Inattention/Distractibility:

- Difficulty filtering irrelevant sensory information.
- Attraction to "novel" environmental conditions.
- Restriction of activity when experiencing excessive stimulation (inattention).

- Initiation of sensation seeking activity when insufficiently stimulated.

### Disorganization:

- Misplaces or loses belonging.
- Difficulty handling materials with multiple pieces.
- Messy desk appearance.
- Difficulty completing tasks and tests within a time framework.
- Overestimates time intervals.
- Haphazard, illegible penmanship.

## 3. The classroom environment – the silent curriculum

ADHA is a disease whose treatment requires avoiding stimuli and distractions to increase concentration. The correlation between furniture design and the design of ceilings, walls, floor contributes in the formation of a space that has great impact on the disease's treatment [2]. A sense of unity is therefore preferred that can be achieved by using finishing materials so that the ceilings are of the same colour as the walls and the floor, with the same lines, durability, degree of isolation, and level of sound absorption . A complex interior or architectural design can create stress for people with ADHD [3].

The environment of educational Spaces include several elements, including climate, light, acoustic and the contact to the outdoor environment. Educational spaces' design requirements have to meet the needs and characteristics of ADHD students [4]. A clear, simple design for the school buildings facilitates the occupants' use of the space, maintains the psychology of movement, and provides time and effort expended in a space , all of which essential in the treatment of people with special needs. Moreover, furniture design and layout help to regulate movement and control ADHD students and contributes to enjoyment of the space.

### 3.1. Seating

Most schools provide a combination of chairs, desks, or tables made of wood, steel, or plastic for each student. When students sit on those inflexible surfaces, about four square inches of bone supports 75% of their total body weight. The result is physical discomfort that distracts them from concentrating. Thus, they squirm, fidget, rock and, eventually, need to get out of that chair. Inevitably, boys are more hyperactive in class than girls [5].

Dynamic seating options used as a method of increasing positive classroom behaviours of students with ADHD

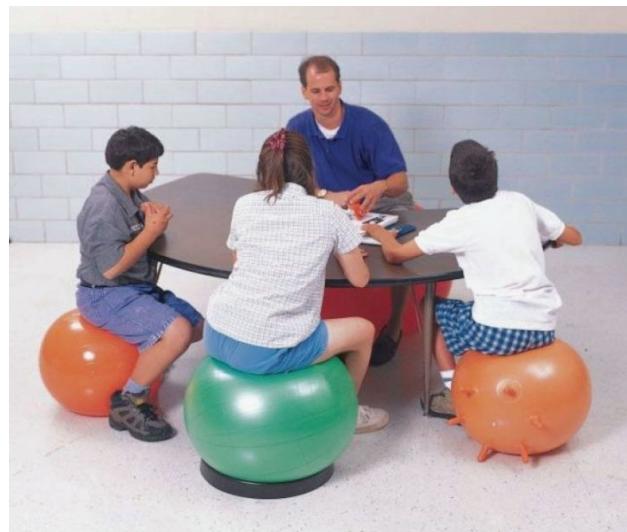


Figure 1. Balance ball chair for ADHD [7]



Activity Board - Learning alphabets

Interchangeable Activity Boards  
Decide your own activity by changing the activity board on the rocker

\*Learn Phonics by pressing to hear the alphabet



Figure 2. Music Cloud Chair and Rock On – Interactive Rocking chair for children with ADHD

[6]. Instead of chairs the use of therapy balls for students with ADHD as an alternative classroom seating option. For all participants, both in-seat behaviour and legible word productivity improved when seated on the therapy balls (Figure 1). The intervention was effective with 3 students with ADHD who varied in terms of gender, concomitant diagnoses, and medications. In addition, the teacher's and students' general preferences for therapy balls for seating supported the social validity of the intervention [7].

There is a need to an informal, flexible and simple design for seats. Gradation and simplicity of form and colour help to maintain shape and function. Interestingly, this simple design contributes to providing security and revives wide spaces with highly technical details and bold lines by using linear relations and colour gradation in the space to reduce visual stimuli and environmental impact. Simple colour gradation of furniture connecting the colour of the walls, floor, and ceiling facilitates self-control, provides a sense of security and greater calm in the space, increases concentration, and eliminates distractions. At the same time, natural lighting is one of the important elements that achieve adequate lighting of the area.

Teaching children with Attention Deficit Hyperactivity Disorder (ADHD) is usually done on a one-on-one basis. So in a class of handful students, when the teacher is busy with one student, the rest are usually occupied in lesser engaging and stimulating activities in the off-task area. Rock On is a special rocking chair meant for the students who are not being taught, for the moment, by the teacher and are waiting for their turn. This fun rocker sports different activity boards to keep these students calm and engaged. This is done by satisfying their need for other kinds of sensory stimulations, on top of vestibular stimulations. Rock On is a passive way of keeping the children active and intrigued. (Figure 2) [8].

### 3.2. Arranging the classroom

It takes considerable thought and planning to select the student's location in the classroom, as well as introduce supportive classroom features. Here are some suggestions (see Figure 3, for a visual summary) [9] [10]:

- Arrange the classroom in a traditional row-seating pattern, because this is the most structured and predictable option. Placing the student at a table with five other classmates detracts from the student's attentiveness.
- Simply placing the student in a desk is not enough; his placement in the room is crucial. That desk should be positioned in the front row, where he or she is less likely to be disturbed by others.



Figure 3. Node Chair for steelcase share

- Remove the student from potentially distracting areas, such as near windows.
- Place the student directly next to teacher's desk. Close proximity to the instructor may also alleviate an additional dilemma of the student with ADHD—to provide for immediate feedback and close monitoring, reluctance to ask for help when experiencing difficulty.
- Surround the student with ADHD with well-behaved, attentive classmates as desk neighbours. This placement will automatically encourage positive peer interactions. Additional opportunities for peer interaction can be arranged by placing tables in the back of the classroom for occasional cooperative learning activities.
- Designate a stimuli reduced area of the room, where a student who is fidgety and overly aroused can complete his or her assigned task. One way of achieving this is by creating an isolated peninsula in the back of the room, a square-shaped area surrounded on three sides by bookcases (books facing outward to prevent distractions) or other "obstacles." Clear this area of any overly-stimulating visual information so as to prevent overload. You could include some plush chairs and pillows to provide the student a safe, comfortable place in which to focus. If the area is large enough, you could even use it as a whole-group meeting/presentation area.
- Establish "stations" that permit students to move from one section of the room to another as each completes short segments of a longer assignment.
- Place needed reference materials in a table in one corner, media in another, hands-on resources in another, and perhaps informal seating in another.

- Establish one section of the room as a Quiet Quarter, another as Permitted Pair Partnering, another as a Small-Group Section. Permit disciplined movement from one area to another.

### 3.3. Noise abatement

Noise distractions are one of the biggest drains on the concentration of such student. So that reducing classroom noise and reverberation helps all students and the teacher enjoy a more pleasant listening, learning, and teaching experience. A quieter classroom environment also improves student and teacher motivation and morale: 1 Putting felt or rubber caps or tennis balls on chairs and table legs will help to reduce distracting noises when moving chairs and desks; 2 Covering the table surface with fabric helps in reduction noise levels; 3 Arranging the classroom so that instruction occurs away from noise sources is also helpful [11].

If the classroom has an external heating, ventilation, and air conditioning (HVAC) system, as is the case with most portable classrooms, the main instructional areas should be planned away from this area if the HVAC system is a source of noise [12]. Mobile bulletin boards and bookcases may be placed at angles to the walls to decrease reverberation in the classroom. This may also be useful in partially blocking noise from the computer, bathroom, or learning centre areas.

### 3.4. Choose a peaceful colour

White is cold, harsh, and may cause anxiety. Red is a high-energy colour that spikes a child's blood pressure and contributes to stress and aggression. Orange encourages creativity and may chase away the blues. To reduce anxiety, go with warm earth tones. Blue hues are known for slowing down the heart rate, reducing respiratory rhythm, and encouraging calm and focus. In general, stick with muted or pastel shades, and avoid primary colours [13].

### 3.5. Using sustainable material

Sustainability has a direct impact on the health of both our members and the communities we serve," [14]. In addition, environmental interior design focuses on materials' intended applications, aesthetic qualities, environmental and health impacts, availability, ease of installation and maintenance, and initial and lifecycle costs. Interior designers must first evaluate, compare, and rank potential materials and products based on each individual project before providing sample options to the client [15]. This section examines the current situation and future outlook for critical materials used in

sustainable energy applications in the design of furniture for individuals with ADHD. These materials have the capacity to transform the way we capture, transmit, store, and conserve energy[16].

Interior materials and finishes are a component of buildings whose overall lifecycle impacts may be significantly greater than those associated with the initial manufacture and installation of the products. Interior finishes are replaced many times during the course of a building's service life. Materials and finishes are also frequently replaced prior to functional obsolescence for aesthetic reasons. The CSA Standard S478-95 Guideline on Durability in Buildings compares the interior components in a typical office building to the design service life of the building itself.

Some of the materials are simply rare in their overall abundance in the Earth's crust or do not commonly occur in single deposits with significant concentrations. Others are difficult to recover economically [Critical Materials for Sustainable Energy Applications. Therefore, the interior materials used should minimize resources and waste, as well as their impact on the environment throughout the lifecycle.

Indoor environmental quality includes statements for nine specific characteristics, including four for indoor air quality and five for human comfort [17].

Indoor air quality:

- Meet the minimum requirements for indoor air quality.
- Prevent exposure of building occupants to environmental tobacco smoke.
- Prevent indoor air quality problems that result from the construction or renovation process.
- Specify low-emitting materials and furnishings.

Human comfort

- Provide a high level of individual occupant control of thermal, ventilation, and lighting systems.
- Provide appropriate thermal conditions.
- Provide a connection between indoor spaces and outdoor environments of lifecycle design · Minimize the amount of materials used.
- Facilitate disassembly for recycling or reuse.
- Specify salvaged or refurbished materials.

Indoor materials have the ability to support healthy environments, to reduce transportation energies that carry secondary health concerns, and to influence thermal performance and improve air quality, including minimizing outgassing, toxicity, and mould. Additionally,

the selection of proper materials can positively affect the respiratory and digestive systems, as well as the eyes and skin [18].

### 3.6. Different applications for using sustainable materials for hyperactivity and distracted attention student

In recent years concern for the environment has affected every aspect of life. Sustainability is more than a marketing scheme. To those who truly seek to improve where and how they live, sustainability involves avoiding the depletion of natural resources. So sustainable interior design applications are thus defined as the balance between interior design applications and use of the Earth's resources or natural resources that benefit humans and the Earth now and in the future [18]. Sustainable interiors would be designed in such a manner that they sensibly address the impact of all their functions, parts, and elements on the global environment. The author also defines environmentally conscious interior design as professional practice that attempts to create indoor spaces that are environmentally sustainable and healthy for the occupants [19].

Sustainable interior design practices are actions that lessen environmental impact due to site selection, water use, energy use, and material selection [20]. This paper focuses on sustainable material selection that is suitable for users afflicted by hyperactivity and distracted attention. Examples of sustainable design applications in this paper include specifications of new types of sustainable furniture [21].

Sustainable furniture can be made of wood, bamboo, cardboard, metal, plastics, and fabric. In addition, it is worth noting that cardboard can be a sustainable option where durability is not a major concern, but certified and recycled sources should be sought. The potential of using reclaimed furniture, which is widely available from antiques shops and easy to fit into any interior scheme, should, however, not be discounted. Vintage finds can include chairs, tables, sofas, and beds, as well as accessories, from lamps to pictures to sculpture [Sustainability in Interior Design looking at furniture is a good way to understand sustainable construction, since furniture design demonstrates construction techniques on a small, manageable scale.

Cardboard offers a good opportunity for the design of sustainable furniture products. Cardboard can be fully recycled and can be made from up to 100% recycled paper and cardboard. Cardboard will not replace many of the current applications for which plastic is used, but there should be a conscious effort to replace as much as possible. There are six classes of material defined in this typology: corrugated cardboard, paperboard, tube,

pulp, paper maché, and paper cored board. Four common methods of constructing furniture from cardboard sheet are found in the survey folding, fabricating, and laminating.

Figure 4 shows four common methods of constructing furniture from cardboard sheet, as determined from the survey -folding, fabricating, laminating, and mechanical fastening—since cardboard varies in the size of fluting and paper type and quality.

Another example of using cardboard to make furniture is the Kraft and Solo benches by Brazilian designer Domingos Totora. These Kraft benches exemplify their devotion to sustainability by barely hiding the material. Slices of recycled cardboard pulp, 1 cm thick, are held together with a water-based glue, proudly proclaiming their origins. The bench varies in width, depending on the number of slices of cardboard used. Viewing the piece, one can easily imagine the source material being put out on the streets of cities across Brazil for recycling. Other work, such as the Solo bench—recently a nominee for Design of the Year by Design Museum London—showcases the malleability and potential of the material and its ability to easily change textures. The Solo bench is finished and sanded so finely that it takes on the appearance of stone. Even on close inspection, it is difficult to pick up on the fact that what you are seeing and touching is recycled cardboard. Only the color, a brownish hue familiar to anyone who has ever taken out the trash, hints at its origins. [22].

Sustainable furniture can be made of smart materials. Smart materials or Self-healing materials have the structurally incorporated ability to repair damage caused by mechanical usage over time. The inspiration comes from biological systems, which have the ability to heal after being wounded. Initiation of cracks and other types of damage on a microscopic level has been shown to change thermal, electrical, and acoustical properties, and eventually lead to whole scale failure of the material. Self-healing materials can be used by incorporating them in interior design and furniture finishing works, because of the significantly effectiveness in improving the performance of their surfaces over the long run by fixing cracks and scratches aphid, therefore providing solutions to reduce the cost of damages occurring during their life cycle. Until now, these materials are not commercially available so that it's urgent to carry out more researches [23].

## 4. Results and dissections

The main objective of the research is to explore the guidelines for furnishing and other components of educational space (wall and ceilings and floors). So that contributes to containment students with ADHD enabling them to overcome learning problems. Design



Figure 4. Classroom arrangement

based on the study of all functional, technical, and aesthetic requirements, -combined with taking advantage of modern catalogues of furniture and processes used in the design of modern educational classes- can be achieved a successful experience of

communicational, educational and promotional guidelines that are compatible with the characteristic of students with ADHD. The field study was based on observation and data collection of five specialized schools in Riyadh.

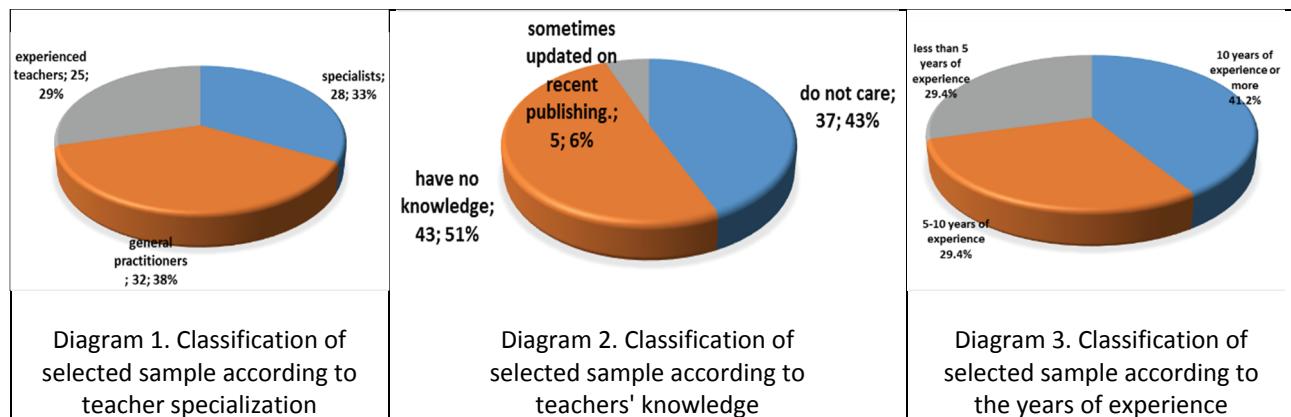


Table 1: Summary of results from the questionnaire and survey

	General Characteristics	Morphological characteristics of the furniture
Fulfilling		
Indifferent	Educational spaces can be re-designed and formed to meet the requirements Both of the individual and group education.	Furniture do not hinder the movement.
	Furniture is flexible, movable and can be redesigned.	Furniture have no Sharp edges
	Furniture is Comfortable and suitable for children.	Scale of furniture is suitable to students in different ages
	The environment of classrooms is enjoyable and help the students to concentrate on Lessons.	Furniture is easy to be maintained and resistant to fracture
	The colours of walls, floors and furniture are impartial colours.	The colours of furniture are suitable.
Ineligible	Classrooms are Well-ventilated and quiescence.	Furniture is comfortable
	The environment of classrooms Limit the movement of pupils Increasing their Increase their commitment	Furniture is durable, made of appropriate materials and have good appearance.
	Classrooms have contact with outdoor.	Furniture is in harmony with the other Components of space.
		Furniture is not movable
		Furniture is suitable to chaotic behaviour of students with ADHD.

An intentional Sample selected from teachers who have varied practical experience. The sample can be classified according to three types. 1 – According to teacher specialization is as shown from Diagram 1 that 37.9% of the teachers were classified as major, and 32.9% of them were general practitioners for learning difficulties, and 29.4% of them were experienced teachers. 2 – According to teachers' knowledge about the most recent in the field of design factors of indoor environment and appropriate Furniture is as shown from Diagram 2 that 50.6% of the teachers have no knowledge about the design factors of space, 43.5% of them do not care, and 5.9% are sometimes updated on recent publishing. 3 – According to the duration of educational experience is as shown from Diagram 3 that 41.2% of the sample are 10 years of experience or more,

29.4% of them are 5-10 years of experience and 29.4% are less than 5 years of experience.

The field study is the first study in KSA to explore the educational spaces for children with ADHD. The researcher gathered one of the most detailed pictures of such spaces from two aspects. The first one is about the general characteristics of the educational spaces and the second is about general and morphological characteristics of the furniture of educational spaces. Such study will be of great value and practical assistance to designers. Summarizing these results reduces the complexity of the problems and the richness of the data.

Table 1 provides an edited version of results from the questionnaire, showing that the majority of the sample

were indifferent as well as ineligible with either the general characteristics of the educational spaces or the morphological characteristics of the furniture of educational spaces. This mean that the educational spaces are in need to be redesigned as well as the furniture.

From the interviews with teachers the following themes emerged: the relationship between colour, mood and behaviour; differences and difficulties in movement and co-ordination; the importance of control and predictability for the children (to provide feelings of security. The greatest challenge to accommodate children with ADHD is the behavioural contradiction i.e. for one child we may wish to increase certain behaviour, for another reduce it. Such differences point to the need for a classroom realm that can not only be adjusted to each child, but which can allow the child to increase their interactions with it. Based on their experiences, Interviewees expect that all students will benefit from Flexible and informal Furniture.

## 5. Conclusion

Review of previous literature showing that the third component of a strategy for effectively educating students with ADHD involves physical *classroom accommodations*. Students with ADHD often have difficulty adjusting to the structured environment of a classroom, determining what is important, and focusing on their assigned work. They are easily distracted by other students or by nearby activities in the classroom. As a result, many students with ADHD benefit from accommodations that reduce distractions in the classroom environment and help them to stay on task and learn. Certain accommodations within the physical and learning environments of the classroom can benefit students with ADHD. Specially-designed furniture should, be differ from standard classroom furniture. This does not have to be expensive. Furniture can be designed based on principles of sustainability.

Educational spaces and furniture affect children of ADHD category. The comparison of teachers' answers showed that the current classrooms are not suited to the educational process. As well as furniture does not achieve the aesthetic and functional aspects. In addition to that, there are many visual distractions such as walls drawings and decorations works that distract and obstruct the educational goal. So that the case study cleared that the physical classroom space is in need to be redesigned with the consideration of several physiological and psychological aspects of students. These factors include individual and group attention spans, seating, lighting, sound, and temperature preferences. Such students require informal seating,

soft illumination, peaceful colours, and calm educational space.

Designers need to take advantage of the potential within students suffering from hyperactivity and attention deficit. Their kinetic energy can be exploited as a source of one of the energies required within interior spaces, such as electrical, thermal energy, or light energy. Therefore it can be exploited as a kind of sustainable materials means that applied to achieve higher efficiency of the interior spaces at the lowest possible cost or the optimal exploitation of available and reused materials. It can also exploit solar energy in warm areas to be converted to electrical energy or light within general spaces, as well as within spaces reserved for student with hyperactivity and distracted attention. For these types of spaces materials should be selected that meet sustainability requirements, such as a floor that takes advantage of the kinetic energy of users to emit thermal or electrical energy inside the space.

In the spot light of the previous study, the researcher invites the owners of schools to embrace an integrated and efficient design of the educational spaces as general, furniture In particular. The goal is to create an educational environment that helps to direct and control the movement of students, as well as accommodate them with their behaviour. This study is the starting point to publish those designs in all educational media and to insert them into Saudi Building Code and construction specifications. There is an urgent need for a clear strategy to increase the efficiency of the performance both schools and educational services. The strategy has to contribute to create distinctive learning environment that help to improve the behaviour of students with ADHD.

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