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How light affects child's visual perception in educational spaces?

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Abstract : The interaction between lighting design within an architectural space and a child's visual perception is significant, yet it remains largely unnoticed or even ignored, especially within educational buildings. Moreover, this relationship goes beyond simply ensuring the function of vision and perception of the surrounding environment, as many studies have proven that any defect or difficulties in providing appropriate and necessary lighting conditions affect the visual responses to light, and thus on the visual perception of students, as that the latter is an important factor in child's academic performance And his motor skills development, especially in the educational environment. The inadequacy of this environment for the child's visual needs results in visual problems that negatively affect the child's ability to read and learn, and consequently school failure.

This paper endeavors to create an understanding of how the use of lighting conditions affects children's visual perception in the classroom. The research follows in achieving its objective and proving its hypothesis on the descriptive analytical approach to study the research problem. And based on the results and conclusions of the study, The study recommended that attention should be paid to light's characteristics in the design of educational buildings to provide a good quality of educational environmental for its role in the success of the child's visual perception process and to avoid problems that impede his healthy development.

Keywords: light; visual perception; Child; educational spaces; school performance.

Introduction:

Humans are affected both physically and psychologically by light. It plays an irreplaceable role in humans' life, as it affects his productivity, comfort, mood and health in general.(Boubekri, M., 2008). thanks to light we are able to receive the visual information about the surrounding environment by 75 to 90 % of these are received through eye sight ,so offering a suitable lighting in space is an essential element for visual comfort (Veith,J.Aet al 1998). Although the human eye is able to adapt constantly to changing light, the repeated change of light over a short period of time stimulates the visual system and causes eye fatigue and visual discomfort which affects the user's visual perception.(Soo-Young Kima et al ,2006)

Visual perception is defined as the understanding, processing and interpretation of information by seeing stimuli coming from the environment, people, objects, and symbols. If visual perception disorders of children are not detected at an early age, serious learning disabilities and related disorders are likely to occur in the future. (Butun A, et al 2015).

The child's visual perception plays a fundamental role in developing his motor skills, productivity, capacity of reading and writing. Children with visual impairment have difficulty receiving stimuli from the environment and thus have difficulties reading, writing, overcoming obstacles such as sidewalk steps, climbing stairs, determining spatial distance, household items, eating, bathing, dressing, and social skills (Vicari, et al, 2005).

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During the school years the child acquires an enormous amount of information and capabilities that are required for academic learning through the perceptual process. It is an indisputable fact that the interaction of all the senses is necessary for the full perception of the environment and the world. Since 80 % of the information they receive is visual, it can be said that visual perception is the most effective among other senses. (Renshaw, 1945).

Many children in schools suffer from vision problems, which are caused by the visual disturbance due to inappropriate levels of lighting. This is what causes defect in their visual perception; this strongly affects the way they receive visual information in the classroom, but rather more than that, as this impact reaches to their motor proficiency, balance, fine motor skills, mobility-orientation and cognitive functions. (Haddad, et al 2006) .

Children who suffer from visual perception defects in schools, things get mixed up with him and they does not see them or distinguish them with clear visual transparency, (Shumard 1968) pointed out that psychological research indicates that many learning problems, especially in reading, stem from visual perceptual difficulties. That's why designing educative places for children must conform to their physical, cognitive and social functioning and development. Therefore,Light is one of the most important elements that must be taken care of during design processes of schools, So **How can light affect a child's visual perception in the classroom?**

The primary aim of this research is to achieve some suggestions that show and clarify how to achieve an appropriate lighting design in classrooms due to the importance of lighting as a visual stimulus in the architectural space, and how this factor affects the vision process of the child to improve the visual perception process in children

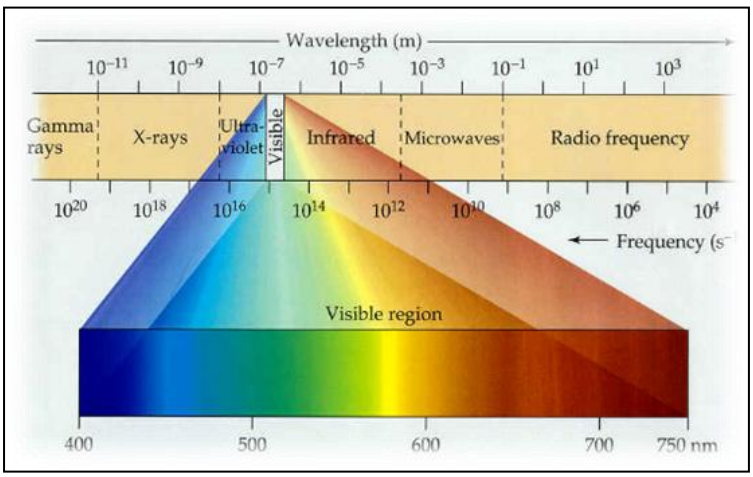
1. Methodology .

In order to achieve the objective of this research, this paper is based on a descriptive-analytical approach to study the research problem and reach appropriate results and solutions, by the analysis of some previous research and studies related to the subject, in order to determine how visual perception is strongly related to the quality of light in the space. And what parameters must be taken into account within classrooms, so as to ensure comfortable vision and effective visual perception.

2. Importance of Light in architectural spaces

light a primary element that can create significant and suggestive spatial experiences, As shown in Fig.1,Light is defined as a radiation consisting of a group of electromagnetic waves that can be seen with the naked eye, where the wavelength of the light ranges between 400 to 700 nanometers between the infrared rays, which are the waves Longer, ultraviolet rays - the shorter wavelengths.(Waldman, 2002). Light is the form of energy that allows living creatures to see things and interact with the environment.

Fig. 1: visible light and wavelengths.



Source : (Waldman, Gary 2002).

Architecture depends literally on light, which unveils its forms and spaces, and at the same time expresses the meanings and intentions that the architect has foreseen through the conception and design of the building.(Elisa V,2019).light is an important element which helps people perceive objects.it is a prerequisite in architectural spaces since it is the element that renders walls and spaces visible. With the right light, well-designed buildings and interiors are considerably enhanced. light helps create an architectural space and adding emotional feelings to it. As such, light is an essential element that helps people perceive architectural spaces and shapes. Thus, it is important for architects to treat light well in their design stages to create a building that accommodates harmonious spaces to enhance the quality of the space.(Chang Sung Kim, et al.2014).Light can underline the experience of architecture, telling us about its structure, materials, texture, the place to which it belongs, the tasks to be performed there, characterizing the experience of time, revealing the link between inside and outside, providing orientation, focus, hierarchy and increasing the importance of the building outside the functional use.(Paula, BC,2020).). And yet, light is often considered either only for aesthetic purposes or to give visibility to tasks. In fact, light should always render both of these aspects and, ultimately, also acquire additional biological importance. On the path of human evolution.(Majeed, M.2019).

In fact, light other than being fundamental to ensure the brighten of the space, and to enable users to see, it has also an impostant effect, it helps to create atmosphere and define the space, by means of light, the architectural space is perceived. It greatly affects the psychology of the user. It casts dark and bright shades of shapes within the building, so as to reveal the contrast in its physical form giving an idea to the users about the rhythmic changes in the space. As such, it adds to people's functional movements an experiential dimension in a more emotional way.(So, H et al .2016). The quality of light has the power of enhancing the relationship between the user and the space by increasing pleasure and comfort. Consequently, lighting can be used as a tool to enhance the user's experience with architecture, therefore understanding the role of light that plays in architecture spaces demonstrates that light has a strong relationship to how we perceive spaces. (Johnson, 2011)

An adequate level of light in space makes it attractive, welcoming, and either comfortable or stimulating depending on the effect produced. It can enhance the architectural appearance of a space and contribute to orientation and road finding. Both daylight and electric light share the role of ensuring visual comfort, however, it is still believed that more research is needed to determine whether it is possible to increase a child's visual perception by providing the appropriate level of lighting within the educational settings in which he is. (Harris, 1949).

The perception of architectural space is influenced by the way that the light in integrated, It is in this way that it determines the user's experience of the essence of space and the exploration of its complementary elements, and it determines the quality of space, including color, shape, size, function and program, with objects and viewers through the lighting sitation. (Michel,1995). Designing with light works on the intervention in human visual experiences, and it provides direction, guide movements, and affect concentration and focus.

3. Light and child's visual perception in educational spaces.

The space and features of the environment immediately influence the child's physical movement, cognitive scanning, and social interaction in a space. Complex sensory and motor movements are involved in these interactions. Perceptual responses, such as vision, which is the most significant in an environment, reveal a tremendous quantity of useful information.(Kateb F.2014).In other words, perception is an active experience in which a child finds information through mobility.

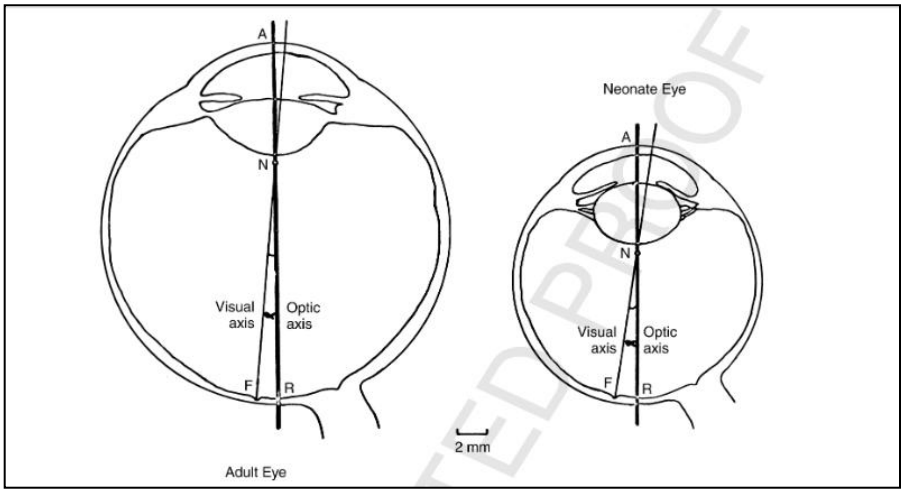
Although children encounter light on a daily basis, this notion is complex. Indeed, light is emitted by "luminous" sources and it interacts with objects in its path.On the one hand, it has intrinsic properties such as rectilinear propagation. On the other hand, it is a vehicle of information for one of our senses: vision. Because it is also one of its properties to carry the information of the shape,the color, the dimension of an object, acquired during its interaction with it.(Jahanbakhsh,H.2014).Thus it is simultaneously object of experience and means of knowledge.

But light as a visual stimulus is not visible and it can be not seen, we see an object thanks to light. And this double status is probably cause of the major difficulty in the acquisition of the notion of light.(Ramos,E. V. 2019).in fact,Light stimuli including physical (active exchanges), physiological (conversion of active streams into neural stimuli) and psychological (neural interpretations of these stimuli) stimuli that inform us about the environment and contribute to human functioning.(Zhang, Y. 2019).

In this context,Light has a tremendous influence over visual perception of children as well as their mentality, and evokes unique feelings from each perceived object**.(**Ali Hadi Jaafar**,** G.2021**)** In addition, Children need a good visual perception to understand, evaluate and interpret what is being seen, it helps the development of their mental functions and is also necessary to gain new skills and experiences; Visual perception during childhood supports both academic and motor skills necessary for success in school, it also helps develop skills needed for math, reading, and writing.(I-Jou Chi,2021).

Speaking about visual perception of children requires first of all, understanding the difference between the child's visual system and the adult human being, as seens in Fig 2, the most prominent difference between them lies in the size of the eye. The size of the eyes and the brain develop gradually from birth until adulthood and this is accompanied by clear changes in visual ability with age. Mature vision requires the ability to see in fine detail (visual acuity) and to distinguish boundaries based on colour, brightness, and texture differences. It also requires the ability to track moving objects and select objects of interest in a crowded environment. Excellent recent accounts of the development of vision in children can be found in (Atkinson, 2000).

Fig. 2: chematic horizontal sections through the (left) eyes of the adult and neonate (to scale), to illustrate differences in gross size, in the shape of the lens, and in the depth of the anterior chamber.



Source: (Alan, S.2002)

Since light is one of the most influential aspects of visual communication.Understanding the relationship between light and vision is necessary for the understanding of the effect of light on visual perception. For nearly two centuries of ophthalmic research, cones and rods were considered the only two and rods were considered as the only two photoreceptor cells of the human eye.(Rahimi-Mehr V,2021). Actuqally The process of vision goes through sequential stages starting with Light reception where The rays of light enters to the pupil and activate the recipient cells in the retina, then the Signals from these cells are transmitted through the optic nerve to the brain. First, it passes through the visual cross (where the right visual field information goes to the left hemisphere, and the left visual field information goes to the right hemisphere), after that the information is released in the lateral geniculate nucleus from the thalamus. Finally the information from our senses goes to the visual cortex from the occipital lobe. These brain structures prepare information and

send it to the rest of the brain to allow us to interact with it. Therefore, the process of visual perception is directly related to the factor of light.(

Light as stimulus in the space it can affect the perceiver's mood; it can create and control the user's visual satisfaction within a given environment through changes in its color, brightness, contrast and intensity. (Tomassoni,Get al,2015). Adequate light received can enhance the children's excitement and alertness while poor lighting can cause dullness and boredom and can be stressful, and that demonstrates how light strongly affect the children's behavioral responses in a space (Ando,T.2003). This is mainly due to the fact that The cones are active mainly in bright conditions (photochromic vision), while the rods regulate vision in dimly lit environments (reversed vision).(Gnambs T.2021). In terms of light stimulus, an important role in triggering photobiological the initiation of photobiological processes seems to be played by the vertical illumination received by the eye corrected for anatomical restrictions, i.e. the light received in the retina.(Rahimi-Mehr V,2021).In this context, Many Neuroscientists have demonstrated that child's visual perception and attention can be strongly effected by the quality and type of light perceived in the space.**(** Jaafar, G. A. H.2021**)**.Visual perception begins when light hits the retina. This is what makes the eye able to distinguish between colours, patterns, structures or shapes.(Garje Mona, et al. 2015).

In children, visual perception develops as part of visual motor development and is particularly important for the development of their necessary visual movements such as learning to use their hands, and fingers… which eventually allows them to manipulate objects, change movements based on the weight of an object, adjust grip based on size, shape or surface, and direct them in Manipulating objects for play and social interaction.(Taşkin, F.et al 2020). These skills develop and mature as the child is exposed to different experiences in his environment, especially at school age. Where it is necessary to provide a quality visual environment, the more easily and clearly the eye receives information, the more it contributes to the eye's ability to interpret what it sees.(Garje Mona, et al. 2015).If a child has difficulty with visual perception, he will find his world very confusing and will have difficulty performing tasks that most children take for granted.

For children's in schools a Good visual perception is a prime necessary, especially for school success. Visual perception is vital in the development of school readiness skills. That's why Children need good visual perception to discriminate well, copy text accurately, develop visual memory of things observed, develop good eye- hand co-ordination and integrate visual information while using other senses in order to perform tasks like recognizing the source of a sound …etc (Betts,1968). In addition ,it helps to improve visual motor coordination, figure ground perception, perceptual constancy, the ability to perceive position in space, and the ability to perceive spatial relationships. One of the most important symptoms that appear on them are :

- Loss of attention and concentration, easily distractible.
- Day dreaming.
- Poor handwriting, difficulty writing on lines or keeping margins.
- Bumping into things, inability to catch objects, etc.
- Failure to recognize spatial relationships
- Difficulty copying information from the board or a book.
- They also struggle to draw shapes and numbers.
- The patterns do not flow, and numbers and letters may be typed dashed and choppy.

This will undoubtedly affect their academic performance; they may become frustrated. They may have behavioral problems and refuse to engage in activities that require visual perception skills. They may rely on others to do things for them and be slow to develop independence(Taşkin, F.et al 2020).This requires the child to have an accurate interpretation of and response to sensory stimulation in their environment, which facilitates their ability to focus on important visual information and filter out unimportant background information.As well as the ability to find differences and similarities between things, including looking at shape, color and size. (Garje Mona, et al. 2015).

In light of this, To avoid all this, the first ingredient to start with is light. As the most important factor of a healthy environment and the stimulus responsible for the vision .Providing a suitable and comfortable visual environment for the child will allow him to concentrate more and better. Indeed it is necessary to have a thorough knowledge of the characteristics and standards of lighting design in classrooms, which make the process of visual perception successful.in fact, Threshold values for retinal illuminance are assumed to be of about 1,500 to 2,000 lux, thus of a much higher order of magnitude than the recommended illumination on the work surface for most tasks (300 to 500 lux).(Navarrete-de Galvez, E.et al.2021).This result implies that lighting dynamics in terms of intensity, spectral composition, and direction over the course of the day appear to play an influential role.

The distribution of light within the school space and Bright light levels may affect the overall impression of that space. Whereas Differences in illumination levels and uneven distribution of light affect the perception of space and create intimate atmospheres,(Tomassoni, G et al 2015). Light varieties include patterns of light, and shade as well as colors, brightness and contrast are considered the most important characteristics to pay attention to it because it affects the child's visual perception within schools, and to promote his visual perception it is necessary to ensure that this caracteristics are provided appropriately.thats why We have summarized the most important features and highlighted their importance and effective role in shaping the child's visual environment as follows :

2.1. Brightness and contrast

The light brightness and contrast tend to affect how users perceive the space, they affect their behavior, emotions and mood. And allow them to recognize the perception of materials and forms present in architectural spaces or texture of objects. The degree of brightness and contrast affect strongly the user's visual perception, they create conditions that affect emotions and determine how people behave. High contrast between the object and his background is often seen as dramatic, while low contrast can result in a uniform appearance (Monice, 2004).

In classrooms, To avoid any visual distraction or loss of focus that affects the child's visual perception, it is necessary to avoid shadows on Work surfaces so as not to distract the student or tire their eyes, where the The contrast ratio according to NBN standard EN 12464-1should not exceed:

- 1:3 at the center of the visual field.
- 1: 10 in the circumference of the field, or between the circumference and the center.
- -The contrast ratio between the light source and its background should not exceed 1: 20.

It is also verry imporatnt that The brightness of the surfaces in his field of view is as homogeneous as possible,Writing black on a bright blackboard, or white on a blackboard. In generale.it recommended to provide light conditions that Minimize the contrast between the elements as much as possible.

2.2. Color and light patterns

Color and light patterns in the space have a significant value; they can make the space trigger an emotional response in the perceiver that can range from activity to calm, or from excitement to calm. Visual perception is strongly influenced by the variation of colors produced by light, and its patterns. (Gibson, 1966) (Steffy, 2002).since the perception of color coms from light , it can reveal an object's dimension and depth. It also has the ability to affect the environment temperature, size and shapes.

According to Gibson and Steffy (Steffy, 2002), using different colors lighting the same space has different emotional effects on the visual perception of space. The diversity of colors creates a different atmosphere. The space tends to be more inviting and comfortable with warmer colors while the cool light creates a lonelier atmosphere.tat's why it's important In classrooms, to paint the main surfaces in cold and light colors, and to avoid the use of dark colors for their direct effect on vision The chromatic appearance of the electric light must also be taken into account.

All these characteristics and varieties work together to influence a child's visual perception. They work in conjunction with cultural and social backgrounds to influence feelings, create comfort,

alter moods and allow them to perform different functions. Therefore, in order to to promote the child's visual perception in classrooms And to create an appropriate visual environment within the school classroom, we need to understand, and control the different aspects of light.The designer should arrange the elements of light, which is the visual stimulus in a way that helps the recipient child to perceive efficiently.

4. Conclusion

Basing on the literature,This paper confirms that Light is a physical element in the environment that cannot be negligible in space conception, it's a construction element specially in childeren space where it can be used in many ways according to children's needs.And the fact that creating a clear, well-designed, and balanced lit environment is vital to his visual perception. This is important because approximately 75% of classroom learning is visible. A child with mild visual perceptual difficulties will struggle to learn in the classroom and often in other areas of life. That's why The designer must understand and controle the interaction of light characteristics in the space like it's distribution, intensity, direction, color, brightness, contrast and patterns. They all working together to influence the child's visual perception.

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