IMPACT OF NATURAL LIGHTING IN SCHOOLS

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Keywords: *light, refringence vicious, spectrum lighting*

Abstract: *Light is electromagnetic radiation or complex of radiations emitted by luminous (flame or flameless) or luminescent bodies as waves wich impresses the eye when the wavelength is within the visible spectrum. (27). The usual light sources found in classrooms are: natural lighting provided by sunlight; lighting provided by incandescent and fluorescent light. Natural lighting shows optimal characteristics for a good performance of the visual apparatus: high light intensity, varied and continuous spectral composition, and adequate light distribution. Sun emits all radiations from X-rays to Hertz waves. Wavelength radiations close to the upper and lower limits of the visible spectrum may trigger the luminous sensation (the retinal excitation depends on whether light rays are able to cross the inner environments). (20) Measurements performed in natural light have highlighted the impact of classroom lighting both on emmetrope pupils and on ametrope ones. Natural lighting is influenced by the orientation of the windows in relation to the sun, the size of the windows and the distance of the banks in relation to the windows.*

Cuvinte cheie: *lumină, vicii de refracţie, spectru luminos*

Rezumat: *Lumina constituie o radiaţie sau complex de radiaţii electromagnetice emise de corpuri incandescente (cu sau fără flacără) sau luminiscente sub forma de unde, care impresionează ochiul, când lungimea de undă este în spectrul vizibil. Sursele de iluminat în sălile de clasă sunt reprezentate de: iluminatul natural (lumina solară); iluminatul artificial (incandescent şi fluorescent). Iluminatul natural prezintă caracteristici optime pentru buna funcţionare a aparatului vizual: intensitate luminoasă mare, compoziţie spectrală variată şi continuă, distribuţie luminoasă adecvată. Soarele emite toate radiaţiile de la razele X la undele Hertziene. Radiaţiile de lungime de undă aproape de limitele inferioară şi superioară ale spectrului vizibil pot da naştere la senzaţia luminoasă (excitaţia luminoasă depinzând de posibilităţile razelor luminoase de a traversa mediile interioare). Măsurătorile în lumină naturală au scos în evidenţă influenţa iluminatului natural în sălile de clasă asupra elevilor emetropi şi ametropi. Iluminatul natural este influenţat de orientarea ferestrelor faţă de Soare, mărimea acestora şi distanţa băncilor faţă de ferestre.*

The optimal performance of the visual apparatus is first of all conditioned by the quantitative and qualitative characteristics of its physiological stimulus - light.

In view of the fact that 40% of the quantity of information and more that 80% of the quality of knowledge we get from the surrounding environment is facilitated to us by the visual apparatus, its complex performance is conditioned by the quantity and quality of direct and reflected light.

The definition of light

Light is an electromagnetic radiation or a complex of such radiations emitted by luminous (flame or flameless) or luminescent bodies as waves acting on the matter through a flow of elementary energetic particles having zero mass (photons), each of them having an amount of quantum energy that impresses the eye when the wavelength is within the visible spectrum (380 - 760 nm).(27)

This research means to provide data on natural lighting in schools and its impact on the pupils' visual acuity.

Light - the physiological stimulus of the visual apparatus is the electromagnetic energy ranged between 4000 and 7600 Å wavelength.

The spectral composition of light physically materialises in various wavelengths that make the visible light.

Since every wavelength corresponds to a certain spectral colour, any light source shows a certain colour hue, which is given by the colour of the wavelengths forming it.

The usual light sources found in classrooms are:

- Natural lighting provided by sunlight;
- Lighting provided by incandescent and fluorescent light.

These lighting sources also include invisible radiations (UV and IR) in addition to visible radiations (4000 – 7600 Å).

Natural lighting shows optimal characteristics for a good performance of the visual apparatus: high light intensity, varied and continuous spectral composition, and adequate light distribution.

Physiological aspects of lighting spectrum

Electromagnetic radiations in the visible spectrum have the ability to stimulate the eye. It becomes a sensory receiver due to the retina that has cells which transform physical energy into a nervous message by a series of complex photochemical reactions (transduction); the result materializes in the emittance of a message that changes the polarization of the plasma membrane thus producing the nervous influx.(20)

The start of the process that leads to the elaboration of an action potential by changing the polarization of the

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ACTA MEDICA TRANSILVANICA March 2010; 2(1):235-237

membrane, is due to an ionic motion: the movement of calcium from the intracellular environment to the intradiscal environment. In the electromagnetic spectrum, some radiations have the ability to stimulate the eye. They make the light of the visible spectrum and the wavelengths are arbitrarily ranged between 380 and 760 nm. Therefore, the retinal excitation depends on whether light rays are able to cross the inner environments. Wavelength radiations close to the upper and lower limits of the visible spectrum may trigger the luminous sensation.(20)

Light is invisible. It is highlighted by the presence of the objects it lightens. The objects surrounding us become visible only on receiving light. We then say they are illuminated. The eye does not actually perceive the light a surface receives, but it perceives the light that surface reflects.(26)

Types of interactions of luminous radiations

Luminous radiations are characterized by the wavelength or its reverse (oscillation frequency) and by the energy transformed by the photon in its undulatory motion and whose energy increases in importance with the frequency of oscillations (the two versions of the theory of light - undulatory and quantum).(20)

According to whether the undulatory or the quantum version of light is used, two great types of interactions stand out:

1. When the incident luminous beam strikes the separation surface of two different environments, according to the physical and chemical properties of the matter found, it is:
   a. reflected, i.e. sent back to the first environment;
   b. refracted, when it enters the second environment;
   c. diffused, sent out in all directions from the separation surface;
   d. absorbed;
   e. transmitted.
2. When the photons of a light beam, loaded with energy, which are not transmitted, reflected, diffused, are transformed into irradiant bodies creating the following possible phenomena:
   a. luminous emission, after light absorption;
   b. thermal action;
   c. chemical action;
   d. mechanical action.

Main sources of light

Light is a form of energy. Primary sources are identified at whose level exists a transformation of another form of energy X into luminous energy, which takes place at the moment when an electron passes from the excited level to a stable level, which occurs with emission of photons.(20)

The Sun is the primary light source. Its energy is of thermo-nuclear origin; it emits a large quantity of photons at a very high temperature: 4 protons (hydrogen nucleus) merge to create a heavier body - helium, with a small loss of mass that is transformed into energy. The Sun emits all radiations from X-rays to Hertz waves. Radiations with a wavelength of 280 nm are absorbed by the ozone layer, while radiations over 2000 nm (beyond infrared) are stopped by the water vapours existing in the atmosphere. Illumination in full sun is of 100 000 lx.(15)

Non-ionising radiations coming from the sun and reaching the Earth are distributed as follows:

a. infrared – 50%
b. visible spectrum – 30%
c. ultraviolet – 10%

In assessing the quality of sunlight, important factors are the height of the Sun in the sky (the hour and the season) and the geographical and atmospheric conditions which influence the spectral composition of sunlight and its energetic intensity. Various personal conditions lead to sunlight being tolerated differently. Pathological eyes (albinos, corneal and lenticular opacities) hardly tolerate natural sunlight.

In natural light, highlighting a lesion or disease due to an intensity which is too high as regards either the quantity or the quality of the luminous energy, requires the use of protective optical systems.

CONCLUSIONS

1. Natural light is one of the best light sources. It nevertheless has a major disadvantage: it is difficult to manage its use at any moment. Its essential qualities are:
   a. great homogeneity of spectral emission;
   b. high luminosity;
   c. excellent diffusion;
   d. pleasant luminous atmosphere.
2. Measurements performed in natural light have highlighted the impact of classroom lighting both on emmetrope pupils and on ametrope ones.
3. In schools where natural lighting is insufficient (especially in rural areas), a higher number of children with refractive errors may be noticed than in schools where natural lighting is adequate.
4. An important thing is the orientation of the windows in relation to the sun; a higher intensity of light is noticed in classrooms where the windows are oriented to the East, the light intensity diminishing in classrooms where the windows are oriented to the North, while intermediary values are obtained in classrooms where the windows are oriented to the West and to the South.
5. The size of the windows is another important factor of natural lighting in classrooms (higher light intensity in schools found in urban areas).
6. The level of light intensity gradually diminishes from the desks placed near the window to the second and third rows.

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