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# Organization of Physics Lessons on the Basis of Module Educational Technology Light Dispersion

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***Abstract***

This article discusses the modular educational technology that stands out among the pedagogical technologies. Modular learning allows students to develop their knowledge and personal skills. This technology is based on the knowledge acquisition by students as a teaching result, working with popular science literature and information.

***Keywords:*** *Dispersion; Monochromatic; Refraction Law; Optical Properties; Normal Dispersion; Anomalous Dispersion; Triangular Prism; Spectrum; Absorption Spectrum*

## *Introduction*

**Modular learning** is one of the pedagogical technologies. It simultaneously accelerates the learning process, ensures integrity in the learning objectives application, and allows students to develop their knowledge and personal areas. This technology is based on the knowledge acquisition by students in the teaching process, working with popular science literature and information as a teaching result. Modular technology allows a student with a wide range of opportunities for independent management to strictly control their learning activities.

## *Discussion*

Modular teaching is based on supplementing the physics course with additional information and finding more effective studying methods the material. An important technology achievement is its integration feature, as the module is used as a content and learning technology unit through a set of technologies integrated in the module:

- problematic,
- algorithmic,
- programmed,
- gradual formation of mental movements,
- "complete mastery".

It should be borne in mind that the module should take 2 academic hours when developing a lesson, because in a similar lesson to determine the initial knowledge level and student's skills on the subject, provide new information, control the development and output of educational material it is necessary to transfer. The following algorithm can help you create a training module:

1. Determining a modular lesson location on a topic.
2. Describe the topic of the lesson.
3. Define and describe the lesson purpose, in this case the integrator, and the final learning outcome.
4. Selection of necessary evidence material.
5. Selection of teaching and control methods and forms.
6. Identify students' learning activities.
7. Divide the learning content into separate logically complete learning characteristics (LCh) and identify specific didactic goals for each.

Thus, the tiered differentiation principle is applied in the use of modular technology, which allows students not only to master the state educational standard, but also to reach a higher education level.

The teacher role in the modular teaching lesson is to manage the students' work, to correct the solving ways the tasks, to give advice, to help and apply to the students. In this case, the teacher has the opportunity to communicate with each student in the classroom.

At the end of the modular lesson, conclusions are made, children summarize assignments on all aspects of the subject and submit notebooks for review. Students who complete assignments schedule ahead will receive additional points.

The modular course is a grouping of students, with several low- and medium-level students and at least one strong student. Thus, in the working process, a strong student helps a lower level student and at the same time improves their knowledge.

Classes using modular technology are included. Practice shows that this technology can be used in the middle and upper classes. The teaching process effectiveness will be higher if the student learns independent teaching methods. After all, the main task of a teacher is to teach his students to search for knowledge independently, to work independently with different sources, to develop their intellectual abilities. Below we will study the light topic dispersion in physics on the basis of modular educational technology, so we must first determine the modular teaching relevance. Next we need to thoroughly rate the topic.

*Light* is an electromagnetic wave sensed by the human eye (vibration frequency 4,0YU14—7,5YU14 Gs*)*. This vacuum corresponds to ~ 400 Nm to ~ 760 Nm wavelengths.

The infrared and ultraviolet spectrum areas are also called light. There is no sharp boundary between the infrared spectrum and X-rays region. Various lamps (sun, stars, light bulbs, etc.) emit light. Light has wave properties as well as corpuscular properties. Some phenomena (diffraction, interference, polarization) show the wave properties of light, while other phenomena (photoeffects, luminescence, atomic and molecular spectra) show the corpuscular properties. The wave properties of light are described by wave theory, and the corpuscular nature is described by quantum theory; both properties complement each other. The corpuscular light theory was developed by I. Newton, the wave theory by H. Huygens, and the quantum theory by A. Einstein. The light laws are studied in optics. J. K. Maxwell proved theoretically that light has a mechanical effect. Light has thermal, electrical, photophysical, and other effects. Some beetles, plants, and elements also emit light.

Units of light - units of light intensity, luminosity, brightness, luminous flux, etc. International units candlestick is used as a unit of system light power. The lumen is taken as the unit of luminous flux. The surface illumination is determined by the light flux incident on the surface, that is, the quantum density of light. The luminous flux of 1 lumen falling on 1 $cm^2$ surface is represented by a fot (f). Radfot (radiation) is used in addition to fot. Clarity is measured by the light intensity falling vertically on the surface; the clarity unit is stilb (sb). In photometry, light energy is measured in joules and luminous flux in watts. Light pressure is the light effect on reflecting and absorbing objects, particles, and individual molecules and atoms. I. Kepler first used the light pressure hypothesis in 1619 to explain the comet tails deviation as they flew close to the sun. In 1873, J. K. Maxwell calculated the light pressure magnitude on the basis of electromagnetic theory. It is too small for the most powerful light sources (solar, electric). Under terrestrial conditions, it is masked by lateral phenomena (convection currents, radiometric forces). Therefore, it is difficult to measure the light pressure in its purest form. It was first identified experimentally in 1899 by P. N. Lebedev. The results he obtained were in line with J. K. Maxwell's calculations. He proved in 1908 that it was possible to measure the light pressure on gases. Comets are thought to form under the light pressure influence. According to electromagnetic theory, the pressure exerted by a flat electromagnetic wave perpendicular to an object surface is equal to the *i* density of the electromagnetic energy near the surface. This energy is made up the waves energy that come in and out of the body. If the electromagnetic wave force per $1cm^2$ of the body surface is Q erg/sm2s, and the reflection coefficient is R, then the energy density near the surface is u=Q(h+R)/c. Hence, the pressure of light on the surface of the body is P=Q(h+R)/c . Light pressure scales are very important in astrophysics and atomic fields, which differ significantly from each other. With the lasers advent, the use of light pressure in various fields has expanded dramatically (see Compton effect, Myossbauer effect, etc.). The light vector (in the light field) is a vector that represents the light flux intensity, which determines the light energy magnitude and the transfer direction. It is of practical importance in photometry, which determines the light volume density, the light flux absorption, the surface illumination, and so on. The light quantum is photon energy. M. Planck proved that light has a corpuscular, that is, quantum, nature, along with the waves propagation. According to Planck's theory, light emerges from the matter atoms and molecules not in a continuous stream, but in a certain amount of individual particles, and is absorbed by them in such a fraction. These fractions are quanta. The photo effect phenomenon can be explained based on this theory. The quantum mechanics laws are also based on this theory.

When monochromatic light waves pass from one medium to another, according to the refraction law, the light rays direction changes in such a way that the angle ratio of incidence sine to the refraction angle does not depend on the incidence angle.

This ratio is equal to the phase velocities ratio of the waves in the two media

$$\frac{\sin i}{\sin C} = \frac{\upsilon_1}{\upsilon_2} = n_{21} \quad ,$$

$n_{21}$ – is the relative refractive index of two media. If the first medium is a vacuum, the light speed in it is *s*, in which case

$$\frac{\sin i_0}{\sin C} = \frac{c}{\upsilon} = n \quad ,$$

*n* – will be an absolute refractive index of the second medium.

If a parallel rays' beam of different wavelengths falls on a vacuum surface, in the second medium they propagate in different directions and form a fan (Figure 7.1). This phenomenon is explained by the fact that the propagation speed of light waves of different lengths in the material medium is different. So for these waves, the refractive index is a light wavelength function in a vacuum.

$$n = f(\lambda_0) \; ; \quad \upsilon = f(\lambda_0)$$

The optical properties dependence of this substance on the light wavelength or frequency is called the light dispersion.

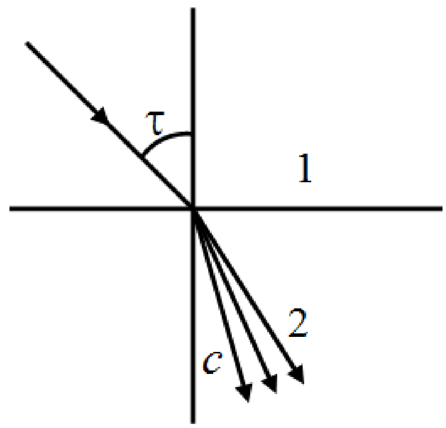


*Figure 1. The formation of a light fan*

As a unit of measurement for each substance, the dispersion of the substance, that is, the product $dn/d\lambda$ along the wavelength of light from the refractive index in vacuum, is used. In most cases, the value of this product is negative, and the value of the refractive index decreases with increasing $\lambda_0$.

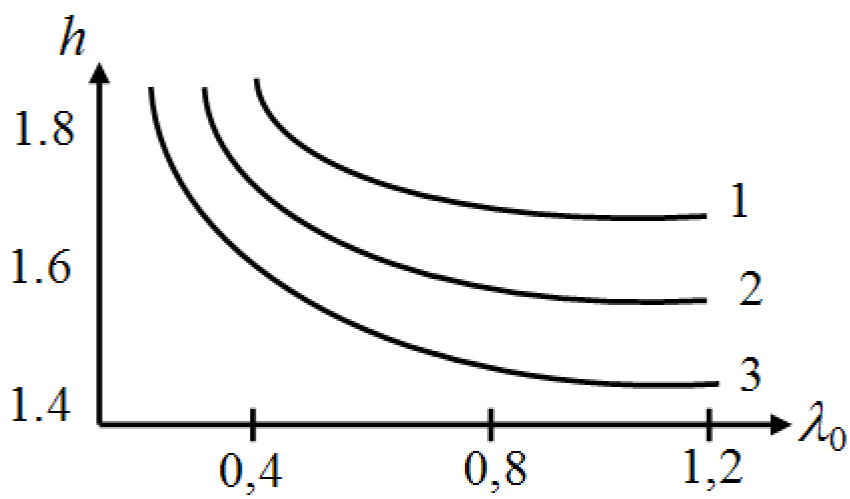


*Figure 2. Dispersion of glass (1), quartz (2) and fluorite (3)*

Figure 2 shows the dispersion of clear substances such as glass, quartz and fluorite $n = f(\lambda_0)$. The variance in this case is called the **normal variance**.

If $\frac{dn}{d\lambda}$ the product is positive, it is called variance-anomalous. Anomalous dispersion is observed in a given medium due to the absorption of light of certain wavelengths.

The dependence of the refractive index on the wavelength in normal dispersion is represented by the Cauchy equation.

$$n \approx n_0 + \frac{a}{\lambda_0^2} \ ,$$

here $n_0$ – is a refractive index of very large wavelengths. $n_0$ and $a$ are constant quantities for a given environment.

If parallel rays of white light of different wavelengths fall on the left edge of a triangular prism, they will refract and scatter in different directions (Figure 7.3). This spread increases when you cross the other side. The flat screen on the right side of the prism emits a different colored rays spectrum in different screen parts.

Longer wavelengths (red rays) deviate less from the prism, while shortwave rays (airborne colors) deviate more.

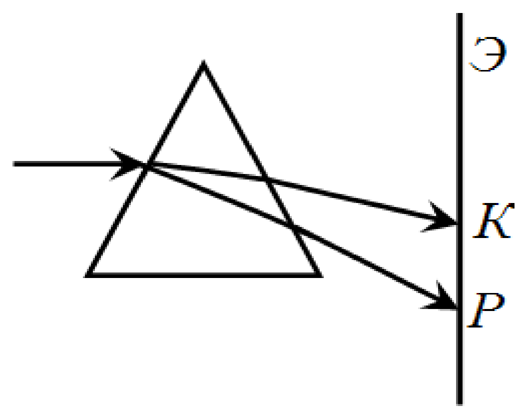


*Figure 3. The light dispersion in a triangular prism*

The spectrum obtained through the prism differs from the spectrum obtained from the diffraction grating. In a diffraction grating, the rays deflection from the initial direction is proportional to $\lambda_0$, while in the prism, the deflection depending on the wavelength is inverse and complex.

Normal dispersion is explained by the electric field oscillation of a incident wave by the electrons interaction bound to the atoms nuclei of a given medium by an elastic gravitational force.

Under the field influence, such electrons begin to oscillate with the field oscillation frequency. As a result, these electrons emit secondary waves at the same frequency that are different from the primary phase.

In the environment, the incident waves combine with the secondary waves to form phase-effect waves that differ from the descending waves phase. Staying out of this phase results in a decrease in the wave velocity as it weeps as the wave passes through the medium. When the oscillation frequency is high, the lag in phase per unit length in the medium is greater, the resulting wave speed decreases more, and the refractive index increases. This is the normal variance.

Clear objects, in the visible spectrum part, have no absorption fields, and absorption is observed in the ultraviolet and infrared regions. In the visible part of the light spectrum, the absorption areas indicate the object color. For example, red glass absorbs almost no red light and absorbs the remaining light well. Therefore, if we illuminate a red glass with white light, it looks like red, and if we illuminate it with green light, it looks black, which means that it is not clear.

If the particles are distributed randomly in the medium, then the light they emit is non-coherent and the scattering is appropriate on all sides. However, in practice, molecules in a chemically homogeneous medium also emit light due to thermal action and the density or sparseness created by the disorder.

## *Conclusion*

The teacher-student collaboration began with the teacher’s support for the students. It gradually becomes more active and grows into a student-teacher interaction position. It is important that the teacher cooperates with the students in the learning process. The students' devotion level to science depends on the teacher's ability to organize this cooperation process, that is, pedagogical creativity. In the process of using interactive methods, it is also important to take a creative approach to establishing a collaborative relationship and to organize student collaboration with the teacher and students at the same time. In particular, interactive methods in physics lessons often focus on shaping students ’worldviews.

In this case, the student cooperation establishment in small groups helps even students with poor knowledge and low speech to try to say something with the help of their peers, the reader to overcome the “I understand but can’t speak” speech barrier in front of him and to unleash his inner potential.

This allows students to work continuously and independently on themselves, both in the classroom and at home, and to achieve extremely effective results: leads to the self-confidence emergence in students, a love of science, and a sense of devotion.

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