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THE SIGNIFICANCE OF VARIOUS SCIENTIFIC KNOWLEDGE CATEGORIES IN NURTURING STUDENTS' CREATIVITY

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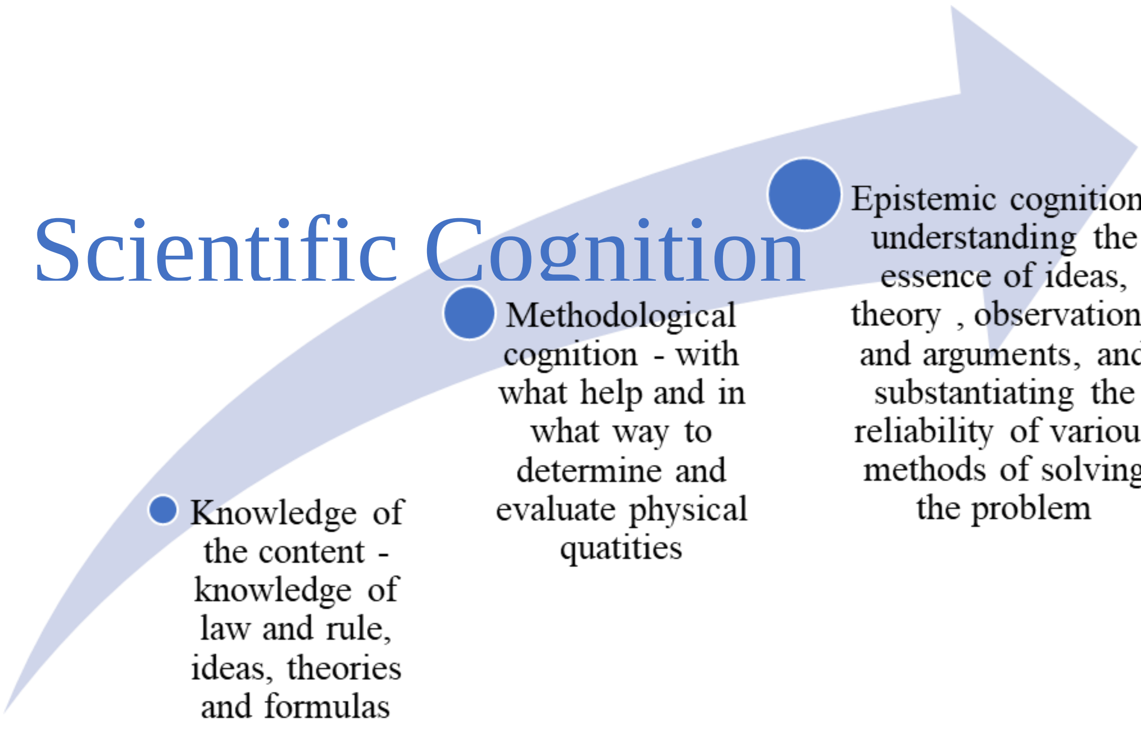
Abstract. In the thesis, the formation of types of scientific cognition, especially epistemic cognition among students is considered as an example of problems related to the analysis of the movement of a point charge in the electric field of uniformly charged bodies of finite size. In addition, the integration of electric field strength over different intervals was shown to obtain information about the trajectory of the field force lines consisting of broken lines and the trajectory of the point charge accordingly. It is proposed that solving these types of problems helps students acquire epistemic knowledge and develop creativity by applying it to possible conditions.

Keywords: Scientific cognition, methodological and epistemic cognition, point charge, electric field lines, electric field strength, Barycentric coordinates, electrostatic potential.

In the training of specialists who need to meet all the requirements of XXI century education, it is necessary to introduce new concepts of education and assessment of students in general Secondary Education, which is the main link of education, into the educational system of our Republic [1]. One of these international assessment programs is PISA, which, mainly evaluates student literacy in reading, mathematics and natural sciences. So, in physics education, learners must have formed the following three competencies according to the requirements of the PISA.

1. Being able to scientifically explain physical phenomena and see the problem in it
2. Design scientific research to solve a physical problem and scientifically assess the optimal solution
3. Scientific interpretation of the data and evidence used in solving the problem. Scientific justification of the use of the solution of the problem in solving a second problem.

All three of the above competencies are based on science, and therefore it is necessary to focus on scientific knowledge in the educational process. Scientific cognition consists of the following types of cognition, which are inextricably linked and continue without interruption.



Let us see the formation of epistemic knowledge in students using the example of working on issues related to the electric field. It would be expedient to set the problems of determining the movement trajectory of a charged particle for the formation of epistemic cognition in students with the help of these types of problems.

It is somewhat difficult to find the value of the electric field intensity vector or potential value of charged bodies with finite dimensions since the lines of electric field force are not symmetrical about the center and the axis. Issues related to this direction are covered in detail in several articles, including [2] where the electric field potential of a plane-charged triangle is found in barycentric coordinates, but the disadvantage of this method is that the field strength does not provide an opportunity to successively find the direction of the vector. Several other studies have been conducted on the calculation of the electric field potential of flat-charged bodies of different shapes and their application to education, but they were also limited to finding values for specific points [3,4].

By determining the electric field lines formed around charged objects of finite size, we use the method from simple to complex, ensuring coherence in the formation of epistemic knowledge in students, following didactic principles. For this, we will first consider the following problem.

Problem: If a point charge, q is released from a dielectric rod of length L charged with a uniform charge density τ from a point A that does not lie on it, what trajectory will it move along?

Taking this problem as a qualitative problem, the students tried to justify it by accepting two different trajectories as solutions.

1. A point charge moves away from a rod of length L in a direction perpendicular to it (Fig. 1). As a basis for this, the electric field lines of an infinitely charged thread are perpendicular to the thread symmetrically, in all directions.

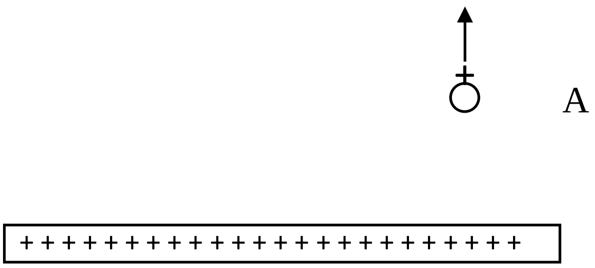


Fig. 1

2. Assuming that a point charge moves along a straight line drawn from the center of a rod of length L to the point where the charge is located (Fig. 2)

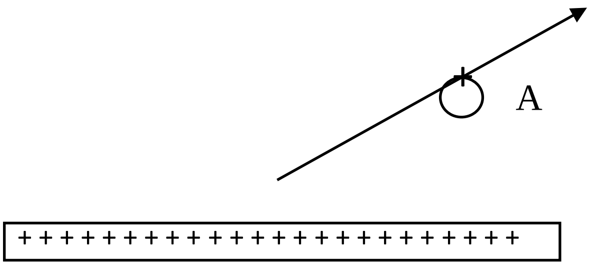


Fig. 2

For this case, we will use the rod cut into small Δl ($\Delta l \ll L$) pieces and note that we use the distance and vector between these pieces and the point charge (Fig. 3).

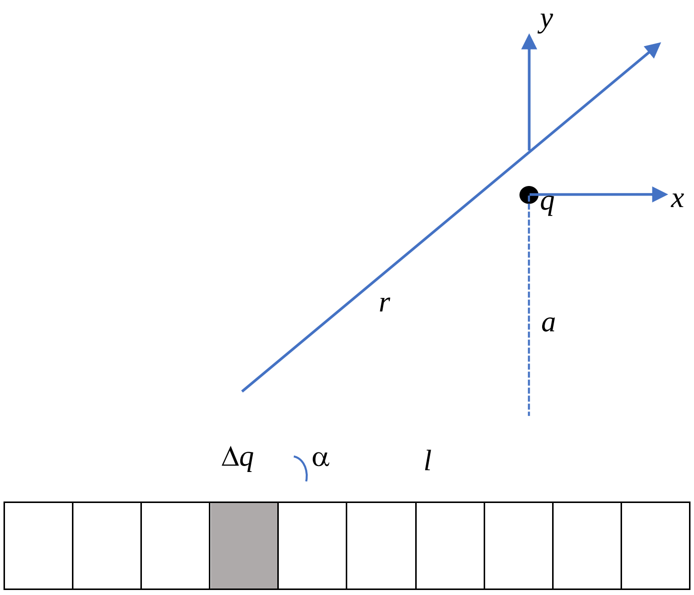


Fig. 3

In this case, we use Coulomb's law, because since $\Delta l \ll L$ we can also consider the particle Δl as a point charge. Therefore:

$$\Delta F_i = k \frac{q\,\Delta q_i}{r_i^2}$$

or since the total force equals $\vec{F} = \sum \Delta F_i = qE$ it yields $\vec{E} = \sum \Delta E_i = k \sum \frac{\Delta q_i}{r_i^3} \vec{r_i}$. Using the expression, we can find the value of the field strength vector.

Considering that $\Delta q \to dq = \tau dl,\quad l = actg\alpha \quad \to \quad dl = a\frac{1}{sin^2 \alpha}\, d\alpha,$

$r = \sqrt{a^2 + l^2}$, we can have $E = \int \frac{\tau dl}{a^2 + l^2}$. While calculating this integral, considering that the electric field strength is a vector quantity, it should be noted that it is necessary to first find the components of E in the x and y axes, and then find $E = \sqrt{E_x^2 + E_y^2}$. Where $dE_x = dEcos\alpha$ and $dE_y = dEsin\alpha$ or $E_x = k\tau \int \frac{ldl}{(a^2 + l^2)^{3/2}}$ and $E_y = k\tau \int \frac{adl}{(a^2 + l^2)^{3/2}}$; $(\cos\alpha = \frac{l}{r} = \frac{l}{a^2 + l^2}$ and $\sin\alpha = \frac{a}{r} = \frac{a}{a^2 + l^2})$.

It should be explained to the students that the components E_x and E_y are primarily important in finding the trajectory of a free point charge, i.e. lines of electric field strength. Because in a small-time interval, a charged particle starts moving from point A to the x-axis and changes its coordinate from (x_A, y_A) to $(x_A + \Delta x, y_A + \Delta y)$ coordinate in a small-time interval Δt. Here, $\tan(\alpha)$ can be determined from the relationship $tan\alpha = \frac{\Delta E_y}{E_x}$ to find the relationship between Δx and Δy gains through the relation of $\Delta y = \Delta x\, tg\alpha$. In that case, we calculate the next positions of the points where the point charge is based on the condition of the problem as $(x_A + n\Delta x,\ a + \sum_{i=1}^{n} \Delta x_i tg\alpha_i)$. Taking this into account, by integrating the above integral over different intervals, we get a motion trajectory consisting of broken lines or a line of field strength in the form of a broken curved line (Fig. 4).

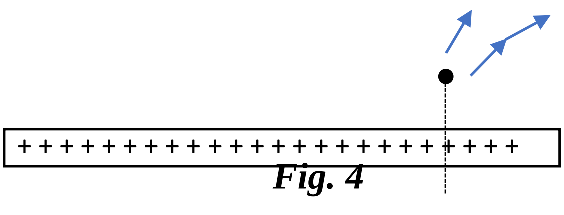


Fig. 4

If we calculate the integral using computer numerical modeling, our possibilities expand even further and we can describe the appearance of field lines of force on a charged rod of finite length.

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YADRO FIZIKASI BO'LIMIDAN SEMINAR MASHG'ULOTINI TASHKIL ETISH METODIKASI

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Annotatsiya. Yadro modellari mavzusi bo'yicha amaliy (seminar) mashg'ulotni tashkil etishga bag'ishlangan. Unda yangi pedagogik texnologiyalarni qo'llagan holda yadro modellaridan mashg'ulot ishlanmasini tuzish hadiqa so'z yuritilgan.

Kalit so'zlar: yadro modellari, kollektiv modellar, yadro materiyasi, tomchi model, umumlashgan modellar, bir zarrali modellar, Fermi gaz modeli.

Talabalarning metodik tayyorgarligini kuchaytirishda seminar mashg'ulotlari muhim o'rin tutadi. Ularning asosiy maqsadi, talabalarning ma'ruzadan yoki darslik, o'quv qo'llanmalardan va maxsus metodik adabiyotlardan mustaqil olgan bilimlarini chuqurlashtirish, mustahkamlash va kengaytirishdan iborat. Bunday mashg'ulotlarda talabalar fizikadan o'quv dasturlari va kitoblarining mazmuni va xususiyatlari bilan tanishadi; mavzu va mashg'ulot rejalari, mashg'ulot ishlanmasini tuzish,