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Interdisciplinary Integration in Physics

Uzoqova Gulnoza Saydullayevna[1]

Abdullayev Ulug'bek Abduvassi o'g'li[2]

Abstuct: The article deals with the study of physics in physical education, especially, physics in the secondary education system, learning the basic principles and rules of physics which is based on interdisciplinary integration.

In addition to this, the concept of interdisciplinary integration in education, the stages of its implementation and its role in ensuring the effectiveness of education are demonstrated.Learning natural sciences in an interconnected way, getting good results via improving students' knowledge about natural phenomena and rules, the importance of creating a holistic view of the physical landscape of the universe is illustrated by examples.

Key words: Natural science, interdisciplinary integration, physical view of the universe

[1]Associate professor of Physics, Karshi State University
[2]Master degree of Karshi State University

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Introduction

There is no doubt that the challenges facing humanity in the 21st century require innovative solutions based on scientific thinking and scientific discoveries. Society needs knowledgeable people who can solve economic, social and environmental problems, develop innovations and conduct scientific research. It can be said that literacy in the natural sciences is the main goal of teaching the natural sciences. Knowledge and skills that is based on natural sciences have a great impact in the personal, social and professional activities of each person, and understanding science and technology that is related to it plays a central role in 'preparing young people for life'.

Literacy in the natural sciences means that a person knows the ideas of the natural sciences, who is able to participate in the discussion about problems related to the natural sciences and technologies based on scientific evidence.

The results of pedagogical research shows that the method of teaching all natural sciences in an interconnected way gives good results in expanding students' knowledge on natural phenomena and rules.

Lack of generalization of knowledge on subjects, lack of attention to systematization, scattering in them also has a negative impact on the educational aspects of education. In particular, ignoring the scientific outlook in students, the integration of knowledge in the formation of culture is one of the serious defects in the formation of the student's personality. It is impossible to get results without applying knowledge of all subjects in explaining the negative consequences of global problems to society. How to organize the integration of knowledge in the education system to solve such a modern problem?

Interdisciplinary connection. First of all, how to differenciate the integration and interdisciplinary connection according to their features and utilization? What are the advantages of it? - It is necessary to find answers those questions. Moreover,the integrated approach in teaching is that, teacher should think about what methods to use? and how to use them in practice? – the answers to these questions are play an important role to solve this problem.

Firstly, unlike interdisciplinary connection, integration is teaching through the transition of disciplines of a high level of interaction. Such interaction of disciplines, i.e. interdisciplinary integration, takes place at different stages in the educational process. Such influence is to some extent covered in the methodological literature, and at its initial level (i.e., at the first stage), the study of the laws of a particular science involves concepts, imaginations, and images relevant to other subjects. In other words, through studying a particular law, the knowledge which is related to other disciplines is used effectively.

Through the systematization of physical knowledge at each stage of physical education, a physical view of the universe is created on the basis of general principles. At the same time, the theory of knowledge develops by combining theories based on the interaction of different natural sciences around a single idea, that is, around the physical landscape of the universe. In the physical landscape of the universe, a clear natural-scientific meaning about the important properties and structure of matter, the form of life (space-motion) and the laws of development is formed and developed. The physical view of the universe is a systematization of the system of knowledge and serves as a means of explaining natural-scientific theories.

In the formation of basic physical concepts in physics lessons, the elucidation of ideas and their

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dialectical interrelationships is important. Such concepts as the law of conservation of energy, the concept of mass, the I-law of thermodynamics, the law of conservation of electric charges, the wave and quantum properties of light, studied in the secondary education system, are such concepts.

The law of conservation of energy and its conversion from one type to another is studied in the VIII grade physics course in the secondary education system. The teacher can ask students the following questions using the teaching materials learned in the chemistry course to explain the topic on the basis of interdisciplinary integration and to strengthen the concepts:

1. Why is heat released in exothermic reactions?
2. Why is energy absorbed in endothermic reactions?
3. What changes occur in the energy absorbed in the endothermic reaction?
4. What is the role of respiration in the life of organisms?

Students, under the control of a teacher, find answers to these questions, discuss, and make conclusions.

The reason for the release of heat in exothermic reactions is the reduction of the internal energy of the reactants as a result of the reconsideration of chemical bonds. In endothermic reactions, the reason for heat absorption is an increase in the internal energy of the substances involved in the reaction, according to the informantion mentioned above.

It is known that living organisms cannot live without breathing. Oxygen that comes from the atmosphere to body's cells, due to diffusion oxidizes nutrients.

Oxidation reaction is an exothermic reaction in which the released energy is received by the cell to meet various vital needs and heat the body.

Furthermore, a chemistry teacher can also use the law of conservation of energy and conversion from one type to another to students in the study of different types of chemical reactions. For example, students could be asked the following questions:

1. Why is it necessary to heat a stone when crushing it?
2. What type of energy is converted into energy absorbed when crushing a stone?
3. Why is heat released in the displacement reaction?
4. Where does heat come from in chemical changes?

In order to answer these questions, students repeatedly use to the law energy storage and its transformation from one species to another. That is, knowing that there is an internal energy reserves in any body, they realize that there is a connection between thermodynamics and thermochemistry. Here, students need to focus on exothermic and endothermic reactions to the internal energy of the body. For example, when methane gas burns in oxygen, energy is released (214.44 kcal).

$$CH_4 + 2O = CO_2 + 2O_2 + Q$$

This energy is equivalent to the reversion of the pre-reaction and post-reaction values of the internal energy of the substance. This is called an exothermic reaction.

Energy is absorbed when calcium carbonate is broken down (42.54 kcal). This is an endothermic

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reaction.

$$CaCO_3 = CaO + CO_2 - Q$$

So, it can be seen from these examples that the exothermic reaction occurs with a decrease in the internal energy of the substance and the endothermic reaction occurs with an increase in the energy of the substance, it can be concluded that alters the internal energy of the substance.

Studying of the law of conservation and conversion of energy from one type to another in a physics course allows students to gain a deeper understanding of chemical and biological phenomena, and to use the law of conservation of mass in a chemistry course to solve physical problems. For example, when solving a problem on the equation of heat balance, that is, when talking about a change in the state of matter (the state of water), the teacher can ask students the following questions:

1. Why do we can assume that the mass of water formed when ice melts is equal to the mass of that ice, and that the mass of steam is equal to the mass of the water that forms that steam?
2. To prove this, can you give an example of a law studied in a chemistry course?

By answering these questions, students conclude that the study of the mass storage law is necessary not only to explain chemical reactions, but also to substantiate physical phenomena such as melting and solidification, evaporation and condensation, amount of heat, thermodynamic balance.

At the next more advanced level of integration process (the second stage), the teacher in the educational process, firstly, uses the methodological principles that form the basis of modern natural sciences, and secondly, focuses on finding and solving problems that need to involve knowledge in different subjects.The methodological principles used in education, the fundamentality of the laws of probability and the principle of symmetry is the most important principles will be.

The use of the principle of symmetry in education shows it is not important only in geometry but also in the laws of physics, chemistry and biology, and is inextricably linked with important categories of dialectics such as conservation and change, generality and unity.

In high school, it creates a wide range of opportunities to use basic laws of interdisciplinary integration.

In strengthening the I-law of thermodynamics, it is expedient to solve issues that represent the relationship between physics and chemistry. For example, calculate the change in internal energy in the addition reaction with sulfuric acid at $20^0 S$ temperature of 1 mol of zinc. The reaction releases 143 kJ of heat.

$$Zn + H_2SO_4 \rightarrow ZnSO_4 + HG_2 + \Delta U$$

Then it can be explained that the change in internal energy as a result of the reaction and the work done against the external pressure. The change in internal energy is as follows:

$$\Delta U = Q + A$$

The work done here is; $A = P(V - V_0)$; $A = PV$;

Considering the Mendeleev-Clapeyron equation, $PV = RT$ 1 mole gas is $PV = RT$.

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The change in internal energy or the thermal effect of a reaction

$$A = 8{,}31 \frac{ж}{моль \cdot к} \cdot 293\,K = кЖ$$

$$\Delta U = 143 + 2{,}4 = 145\ kЖ$$

Or if the thermal effects of diamond and graphite for combustion reactions in oxygen are known, calculate the heat effect of diamond to graphite.

$$C_{графит} + O_2 = CO_2 \; C_{олмос} + O_2 = CO_2$$

$$\Delta H^{\sigma}{}_{98} = 394 \frac{кЖ}{моль} \quad \Delta H^{\sigma}{}_{298} = -396\ кЖ\ /\ моль$$

$$\Delta H^{\sigma}{}_{298} = -(\Delta H^{\sigma}{}_{298графит}) - (\Delta H^{o}{}_{298олмос})$$

$$\Delta H^{\sigma}{}_{298} = (-394 \frac{кЖ}{мол} (-396 \frac{кЖ}{мол}) = 2 \frac{кЖ}{мол}$$

By solving such problems, students are convinced that the I-law of thermodynamics is the basis for calculating the thermal effect of chemical reactions, and that this law is a generalized law for all chemical processes as well.

A physics teacher can also use biology teaching materials to explain the I-law of thermodynamics. For example, students may be asked the following questions:

1. Why do small animals eat so often?
2. Why do they eat so much?
3. Why does a runner's body heat up?
4. Why does a person's breathing speed up after hard physical work?

To answer such questions, students rely on their knowledge of biology. In living organisms, it is important to remember the knowledge about the energy cycle during the functioning of muscles. Energy is released as a result of the breakdown of ATF molecules in muscle fibers. Only 60 percent of this energy is spent on mechanical work. The remaining 40 percent is converted into internal energy. That is why the body heats up. The amount of ATF molecules in the tissues will be limited. ATF molecules are rapidly depleted during physical exertion given to the body. Tissues begin to synthesize nutrients at the expense of energy released due to oxidation. Oxygen is needed for oxidation. Therefore, an athlete who is exercising or doing strenuous physical activity often breathes. Energy is released during the oxidation of nutrients, but only half of it is spent on the synthesis of ATF molecules. The rest of the released energy is converted into internal energy. That's why a person gets hot.

A living organism must have a constant source of energy to survive, a function that can be seen in the example of exothermic reactions that take place in the body, especially the oxidation of carbohydrates.

During glycolysis, 2 moles of ATF are synthesized, and during the oxidation of glucose, 36 moles of ATF are synthesized.

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$$C_6HQ_6 + 6O_2 \; 6CO_2 + 6H_2O + ATФ$$

Based on the VIII class physics, it is possible to generalize the knowledge learned from the natural sciences about the phenomena associated with the distribution of electrons and other charged particles based on the concept of the law of conservation of electric charges. The study of this topic can be carried out on the basis of the following plan:

- The essence of the law of conservation of electric charges;
- Application of this law in the explanation of phenomena such as the laws of electrification of objects, eletricity, constant eletricity;
- This law is used to formulate chemical reaction equations, formulas for valences;
- This law can be used to explain the relationship between ionites and soil rocks.

It is necessary to rely on students' knowledge of chemistry.

Methods. In order to achieve interdisciplinary integration in grades V1-1X, students should be done more independent work, homework writing. The approximate plan of the homework, used literature is recommended by the teacher. For example, in a 1X grade physics course on "Properties of Solids, Liquids, and Gases," a physics teacher may give students homework entitled "Properties of Water and Its Role in Living Nature" and suggest that they write it according to the following plan:

1. Thermal expansion properties of water.
2. Evaporation and condensation, its role in nature.
3. Evaporation of water, melting of ice, the importance of these phenomena for the survival of living organisms.
4. The role of surface tension, wetting and non-wetting phenomena in nature.
5. The phenomenon of capillary and its importance in nature.

Interdisciplinary integration can also be used to explain the laws of nature in a 1X grade physics course. For example, in the study of the chemical and biological effects of light, students should be asked the following questions:

- What chemical reactions confirm the quantum properties of light?
- Why does photosynthesis occur under the influence of visible species?
- We feel the effects of infrared rays, but we do not see ourselves. How can this be explained on the basis of the law of conservation of energy and its transformation from one type to another?
- Why γ - rays and X-rays have great mutagenic properties?

We have briefly considered interdisciplinary integration in the interpretation of the laws of nature on the example of the physical, chemical, and biological sciences.

Conclusion.The idea of interdisciplinary integration in education, changes in the structure and content of educational disciplines, the full coverage of the structure and content of disciplines (primarily natural and mathematical sciences), the use of new textbooks and manuals on integrated education and the development of qualitatively new poses an output problem.For

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example, textbooks such as "Chemistry in Physics", "Biology in Physics", and "Social Sciences in Physics" will be needed.

In conclusion, the implementation of interdisciplinary integration in education is important for students to study the phenomena of nature and its laws, to understand the material world as a whole and interconnected, to form a holistic view of the physical world.

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