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USE OF GRAPHIC ORGANIZERS IN TEACHING PHYSICS AND EVALUATION OF ITS EFFECTIVENESS

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Abstract
In the article, graphic organizers are used in the teaching of physics lectures. Venn diagram was used in the teaching of semiconductors and metals and efficiency coefficient was determined.

Keywords: innovative technology, Venn diagram, metals, semiconductors, reliability range, average value, efficiency coefficient

Introduction

Today, innovative technologies are used in educational processes to improve the quality of education in our country.Innovative methods are applied to educational processes based on a creative approach.Innovative technology can be considered as a system that actively moves students in the educational process, brings students to new thinking, increases the quality of education and results.

Innovative technology is a way to effectively implement didactic tasks and achieve the goal in this field. Innovative technology and teaching technology are related, but also have different aspects.Innovative technology is an integrated system covering all areas of the educational process, while teaching technology is an integrated system of teaching certain subjects based on current didactic requirements.Acquaintance with new research in the field of innovative technologies, knowledge and ability to use active methods of teaching are among the main requirements of the time that every pedagogue faces.

Literature analysis

Until now, Innovative technologies have been applied to the educational process. Venn diagram, one of the graphic organizers, is used in teaching English[1], teaching pedagogues[2], teaching mathematics[3]. However, this method has not been sufficiently researched in the teaching of lectures in physics.

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This article presents the use of graphic organizer Venn diagram in teaching topics related to solid state physics.

Research Methodology

The "Venn diagram" method serves to compare two or more concepts and objects and to depict the result in a drawing.

Steps to implement the method:

Stage 1.Students are divided into two groups and one object (concept or subject) is given to each group.

Stage 2.Two intersecting circles are drawn on the board and divided into groups.

Stage 3.Groups take turns writing the characteristics of their objects in their circles.

Step 4. After writing down the characteristics, it is determined whether these two objects have common characteristics or not. Notes about common features in the circles are deleted and they are written as one in the common field.

Step 5. Students analyze the Venn diagram created by comparing two objects. The common and different sides of these objects are once again paid attention to.

In this method, the teacher can directly explain the lectures on the topic, or the students can fill in the Vennas independently in groups. This, in turn, ensures that students actively participate in the lesson.

In the course of the training, experimental-test groups were given a lecture on subjects related to optics and physics of solid bodies using Venn diagrams. In the control groups, training was conducted without using the Venn diagram.

The application of the Venn diagram to physics lectures is presented in Figures 1.

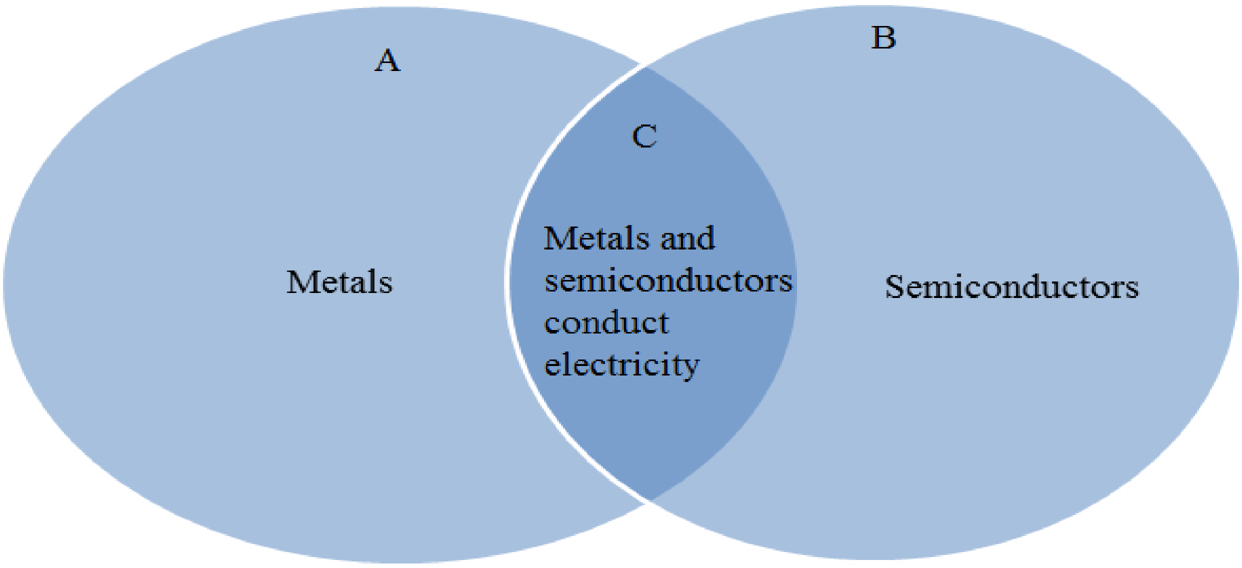

Figure 1. Comparison of the topics of metals and semiconductors.

Part C presents a similar aspect of semiconductors and metals. "What's the similarity?" if we answer the question:

In part A, free electrons generate electric current in metals. Atoms of metals are very close to each other in their solid state. It turns them into positive ions. These positive ions are located at the nodes of the crystal lattice, free electrons separated from them move freely inside the ion lattice. The abundance of free electrons in metals ensures that they are good electrical conductors.

In part B, free electrons and holes also participate in the generation of electric current in semiconductors. How free electrons and holes form in semiconductors and generate an electric current can be summarized as follows: semiconductors in their pure state are intrinsic semiconductors, and their conductivity is intrinsic conductivity. As a result of external influences, the thermal motion of atoms in the crystal lattice increases and the covalent bond is broken. As a result, electrons that were previously in a valence bond become free electrons and move freely between the crystal lattice. After the covalent bond is broken, the electron becomes vacant. This space has a positive charge and is called a cavity. As a result of the formation of a cavity in semiconductors, a positively charged particle is formed that conducts an additional electric current.

When the holes are formed, the electrons bound in the semiconductor begin to move from one neighboring bond to another, and at the same time, the holes move in the opposite direction to the movement of electrons. If an electric field is not created in a semiconductor, then free electrons and holes move randomly.If we introduce a semiconductor into an electric field, electrons and holes move in an orderly manner, and an electric current begins to flow through the semiconductor.

Analyzes and Results

We present the analysis of experimental test works. In this study, an experimental group and a control group were formed. 58 students were selected for the experimental group and 60 students for the control group.The results of the control tests on the topics related to the solid state physics section are given in Table 1-2.

Table of results of control tests on topics related to solids

Table 1

Groups	Number of students	Amount of grades			
		“2”	“3”	“4”	“5”
Experiment - test groups	58	3	11	19	25
Control groups	60	14	23	12	11

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The statistical analysis of the results of this section is presented in the table below.

Table 2

	Experimental group	Control group
Grade value	5 4 3 2	5 4 3 2
Number of matching grades	26 21 9 2	10 17 21 12
Arithmetic mean value of grades	$x_t^* = 4.22$	$x_n^* = 3.42$
Efficiency coefficient	$\eta = \frac{x_t^*}{x_n^*} = 1.23$	
X's credibility interval	$3.9 < x_t^* < 4.36$	$3.06 < x_t^* < 3.60$

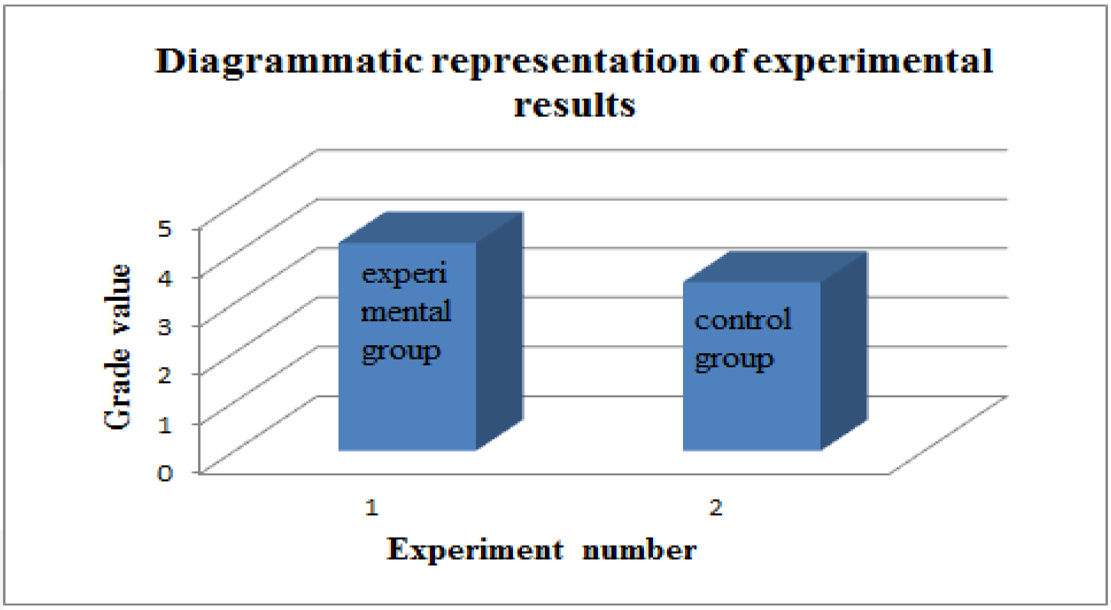

Figure 2. Diagrammatic view of the experimental results.

Conclusions

In short, the confidence interval of the assessment according to the Student's criterion for solid state physics was determined with a probability of 0.95. The coefficient of efficiency in teaching subjects of the solid state physics department is equal to 1.23. It follows that the effectiveness of using Venn diagrams in teaching physics lectures can be seen.

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