ACTUAL PROBLEMS OF MODERN SCIENCE, EDUCATION AND TRAINING

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CONTENTS

UDC: 519.6

BUILDING FUNCTION GRAPHS IN OCTAVE SOFTWARE

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Annotatsiya. Ushbu maqolada Octave dasturi va interval paketidan foydalanib funksiyalarning ikki va uch o‘lchovli sohada grafiklari qurilgan. Octave dasturida funksiya grafiklarini qurishda foydalaniladigan buyruqlari keltirilgan. Ikki va uch o‘lchovli funksiya uchun interval va interval bo‘lmagan grafiklarning qiyosiy tahlili qilingan.

Kalit so‘zlar: *Octave dasturi, interval paket, funksiya, grafik, buyruqlar.*

Аннотация. В этой статье построены графики функций в двух-и трехмерной области с использованием программы Octave и пакета интервалов. В программе Octave перечислены команды, используемые при построении графиков функций. Проведен сравнительный анализ интервальных и не интервальных графиков для двух-и трехмерной функции.

Ключевые слова: *Программа Octave, пакет интервалов, функции, графика, команды.*

Abstract. In this article, graphs of functions in two- and three-dimensional domains are constructed using the Octave program and the interval package. The Octave program lists the commands used in plotting functions. A comparative analysis of interval and non-interval graphs for two- and three-dimensional functions is carried out.

Keywords: *Octave program, interval package, functions, graphics, commands.*

Introduction

As a scientific and technical programming language, the Octave program has become one of the leading representatives of computer algebra systems. It consists of many special programs that perform mathematical and technical tasks, as well as about 60 command systems, various mathematics, mathematical-physical, projected, communication, economics, etc. there is. Octave is a mathematical computing system designed primarily for numerical calculations, but with powerful visualization and mathematical calculation tools. Octave is known for its Matlab-like environment and high-level programming language. The main feature of Octave is that it is not a commercial product, that is, it is distributed with free, source code. It has versions that run on GNU/Linux, Windows 2000/XP/Vista/7/8 and other platforms.

Provides an extension of the interval package system for Octave software. It was created by Oliver Heimlich (Germany) and contains some procedures for solving a number of standard interval analysis problems in addition to actual interval arithmetic

and elementary interval operations. It is freely distributed and is one of the IEEE Std. 1788-2015 compliant software tools for computing intervals.

Also, by connecting directly with Octave to Microsoft Office, MatLab and several other programs, you can use Octave's commands "live" on the worksheet in these programs.

The Octave worksheet is divided into three parts:

1. The command input field consists of a command line. Each command line begins with the >> symbol (this symbol is automatically at the beginning of the command line and does not need to be typed).

2. The output field contains the generated data (analytical expressions, results, and messages) after processing the input commands.

3. Field of textual comments - comments on errors or executed commands, messages of various nature.

Research Methodology

Statement of the problem

Octave is an open source interactive software system for digital computing and graphics. The Octave interval package is a complete product that can be used for practical interval analysis needs.

The integrated environment (interface) of the Octave program works in a universal - interactive mode and has the ability to solve mechanics, mathematics, physics, engineering and management problems, to model, design, describe and analyze various energetic, mechanical and dynamic systems. On the one hand, using the Octave program as a programming language, it is possible to obtain all kinds of calculations and their descriptions on various energetic, mechanical and dynamic systems based on existing (or the user's own) functions, calculation algorithms, and their descriptions very quickly and with high accuracy. on the other hand, it is possible to model, design, describe and analyze the above systems as a virtual laboratory.

The following commands are mainly used to draw two-dimensional graphics in the Octave program: loglog, polar, stairs, area, color, line, pie, plot, semilogx, comet, bar, fill, colormap, ribbon, pie3, strips, semiology, stem, barh, patch, rectangle, scatter, error bar, images and etc.;

Designing and managing graphs and graphics windows is done through the menu and toolbar items of the graphics window and the following commands: grid, axis, hold, figure, shg, clf, subplot etc.

The plot command is commonly used to plot graphs of univariate functions and their various representations.

```
>> x=[a:h:b];
>> y=f(x);
>> plot(x,y)
```

To edit the drawing, you can change the color, type and style of the line using the symbols shown in Table 1 or the options of the graphics area:

Table 1.

Line color		Line points type	
y	Yellow	x	Crest (cross)
m	Pink	+	Plus sign
c	Apostle	*	An asterisk
r	Red	s	Square
g	Green	d	Rhombus
b	Blue	v	Angular
w	White	<	Angular
k	Black	>	Angular
Line type		p	Five stars
-	Continuous, complete	h	Six stars
:	Dotted		and so on
-.	The bar is dotted		
--	Dashed		

The following commands are mainly used to construct three-dimensional function graphs in the Octave program: bar3, plot3, mesh, surf, sphere, cylinder, bar3h, contour, meshgrid, fill3, ellipsoid, logo etc.;

Analysis and Results

When plotting a function of one variable, first enter the interval partitioned with a given step h, then enter the function, followed by the plot command.

Example 1.

Graph the function y= e^{-x} sin(6x) [-3; 4] build in the interval.

```
>> x=(-3:0.05:4);
>> y=exp(-x).*sin(6*x);
>> plot(x,y)
```

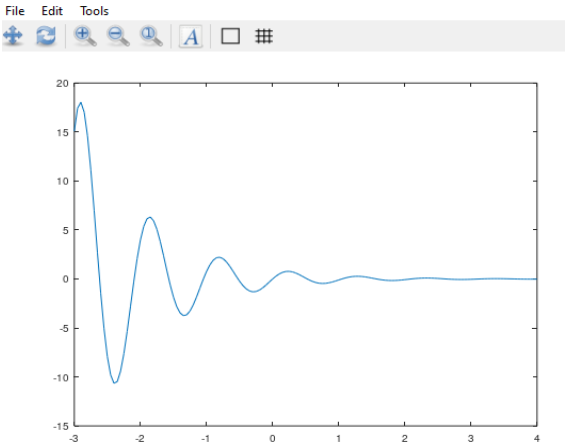

Figure 1. Drawn graph as function y= e^{-x} sin(6x).

Example 2.

```
>> x=linspace(0, 2*pi, 50);
>> y=sin(2*x);
>> plot(x,y)
```

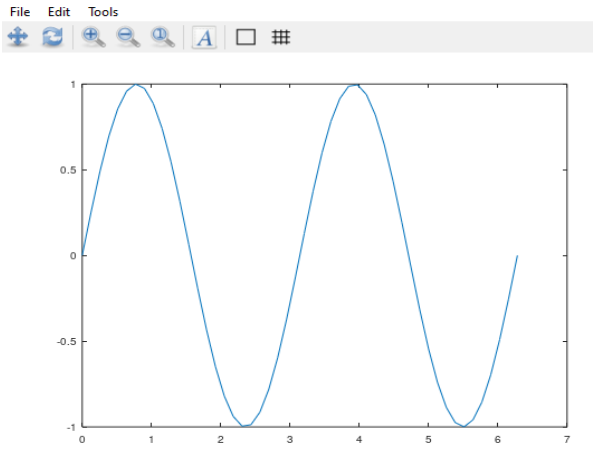

Figure 2. y=sin(2*x) the graph of the function.

Example 3.

```
>> x=linspace(-20,20,100);
>> plot(x,x.^2.*sin(2*x));
```

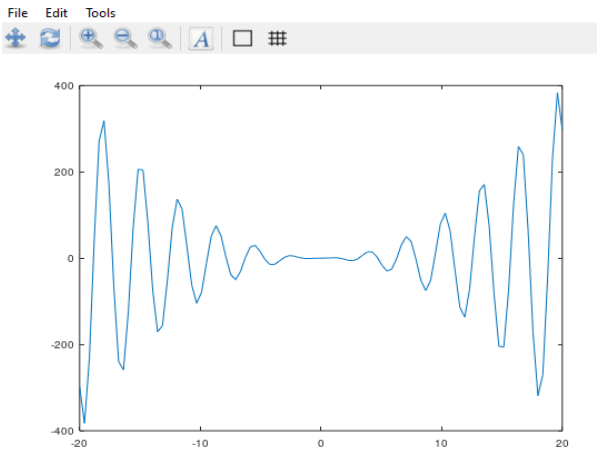

Figure 3. Plot data graph.

The Mesh command and its various representations are commonly used to plot graphs of multivariable functions.

Example 4. *r(t)=sin(2t)i+cos(2t)j+tk* creating graphs of functions in a three-dimensional field.

```
>> t=linspace(0, 2*pi, 60);
>> x=sin(2*t);
>> y=cos(2*t);
>> z=t;
>> plot3(x,y,z)
```

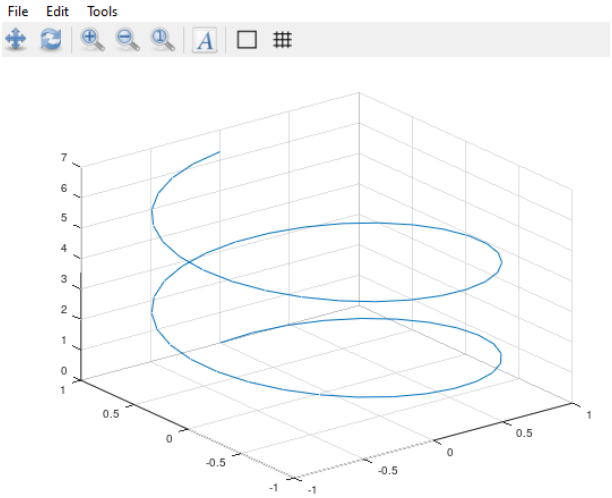

Figure 4. *r(t)=sin(2t)i+cos(2t)j+tk graph of a function.*

Example 5. *x=(3+sin10t)cost, y=(3+sin10t)sint, z=cos10t* construct a graph of a function.

```
>> t=linspace(0, 2*pi, 300);
>> x=(3+sin(10*t)).*cos(t);
>> y=(3+sin(10*t)).*sin(t);
>> z=cos(10*t)
>> plot3(x,y,z)
```

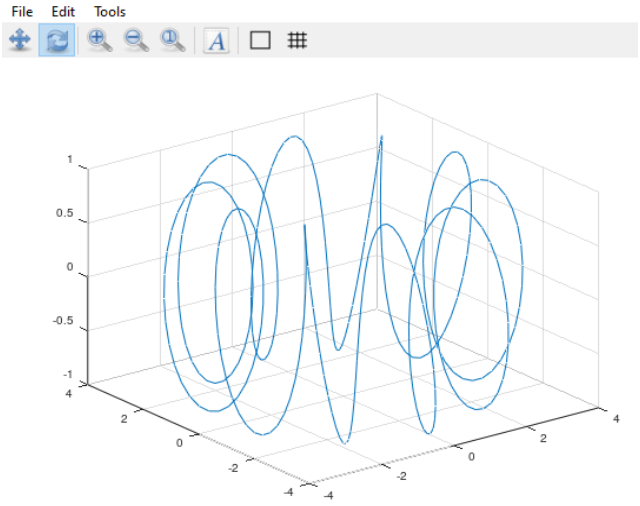

Figure 5. *x=(3+sin10t)cost, y=(3+sin10t)sint, z=cos10t* graph of a function.

Example 6.

```
>>x=linspace(-3,3,40);
>> y=linspace(-3,3,40);
>> [X Y]=meshgrid(x,y);
>> Z=(X+1).^2-Y.^2;
>> surf (X,Y,Z);
```

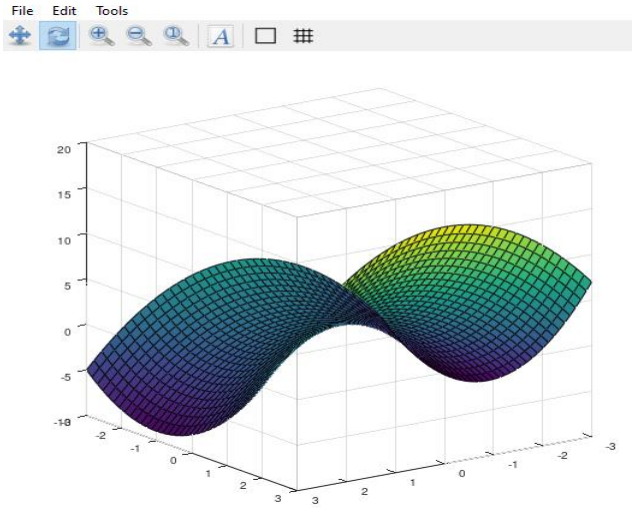

Figure 6.

Example 7.

```
>> [X,Y]=meshgrid(-1:0.1:2, 0:0.1:3);
>>Z=4*sin(2*pi*X).*cos(2*pi*Y).*(
1-X.^2).*Y.*(1-Y);
>> surf(X,Y,Z)
```

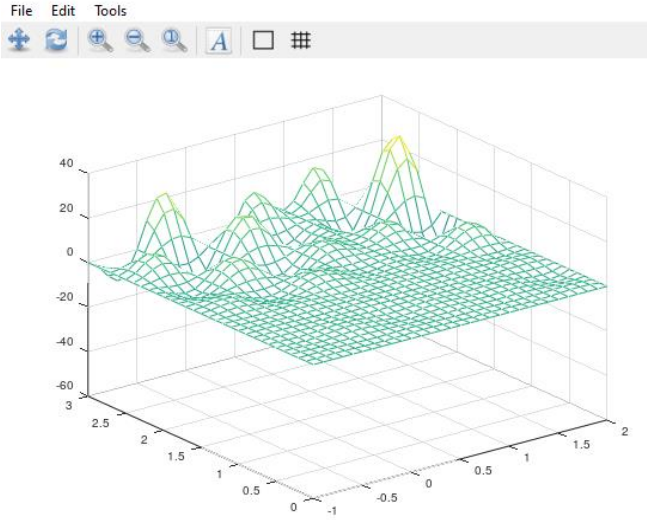

Figure 7.

A number of commands such as sphere, cylinder, bar3h, ellipsoid are used to describe geometric objects in space.

```
>> sphere
```

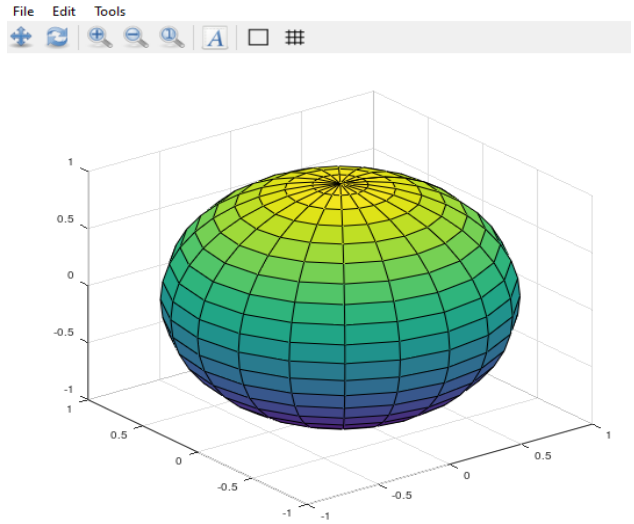

Figure 8. Sphare

>> cylinder

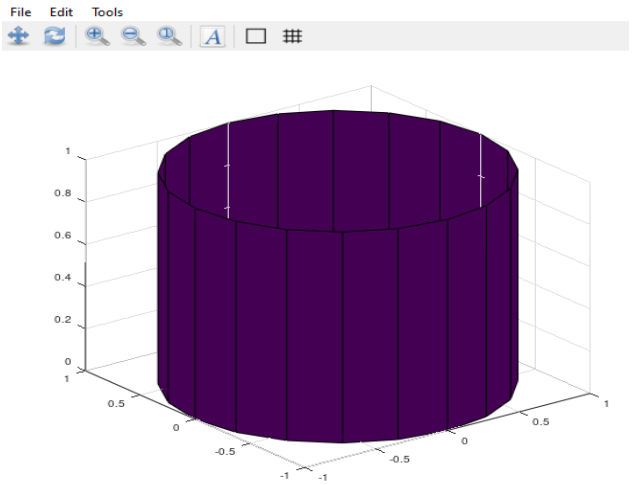

Figure 9. Cylinder

Octave is equipped with a visualization tool and allows you to create 2D, 3D graphics and models. The plot function is used to create two-dimensional graphs. If we pass the interval y as an argument to it, then the set of points (1, y) with y∈y is displayed.

To plot a two-dimensional interval, the plot function is also used, and it uses 2 intervals made as rays.

>>q=infsupdec(-5,5);
>> plot(q)

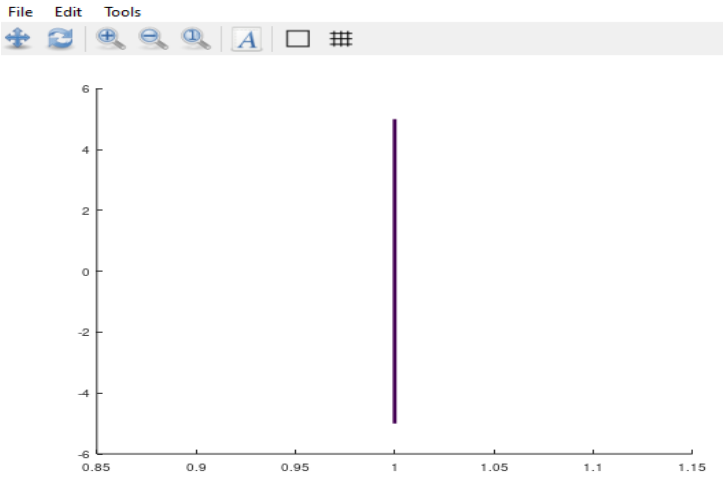

Figure 10. Two-dimensional interval

Example 8.

>> q=infsupdec(-4,4);
>> w=infsupdec(-2,5);
>> plot(q,w)

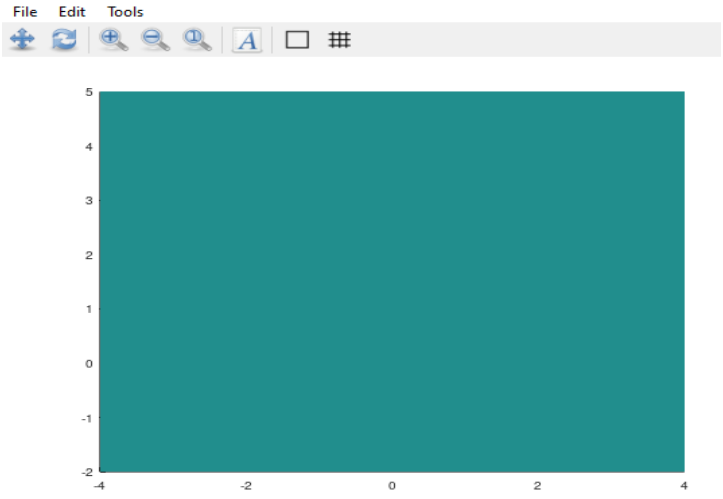

Figure 11.

By adding some custom markers to the argument, you can change the color of the graph, the plot type, and more. A list of them can be found by typing help in the command window or in the documentation.

Table parameters can also be adjusted independently, for example, color.

blue = [38 1 39 2 1 0]. / 255
shade = [238 232 2 13]. / 255
gray = [1 65 1 65 1 65]. /255.

The mince (x, n) function divides the considered interval x by the number of subintervals n that can be used to estimate the range of the function. As a result, if we pass the constructor the function in question as an argument to the mince constructor through the intervals x and (x, n), then in each subinterval we get the outer value of the outer function, which is a rectangular string.

In this example, we have presented interval and classical plots of the graph for the possibility of comparing them.

Example 9.

```
>> x=mince (2*infsup (0, "pi"),30);
>> plot (x, sin(x))
```

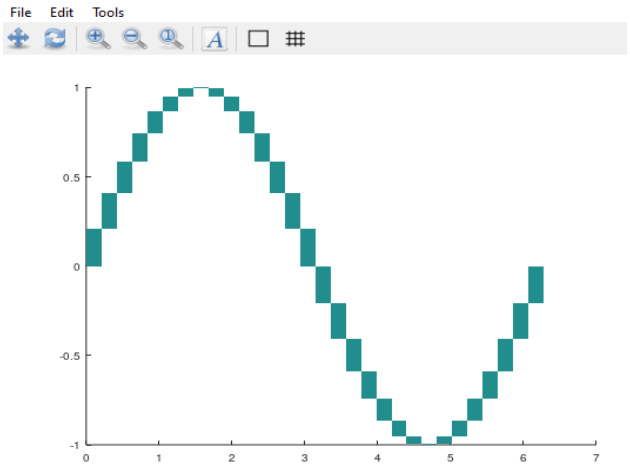

Figure 12.

Example 10.

```
>> x=linspace(0, 2*pi, 20);
>>plot(x,cos(x),
'linewidth',2,'color', "k")
```

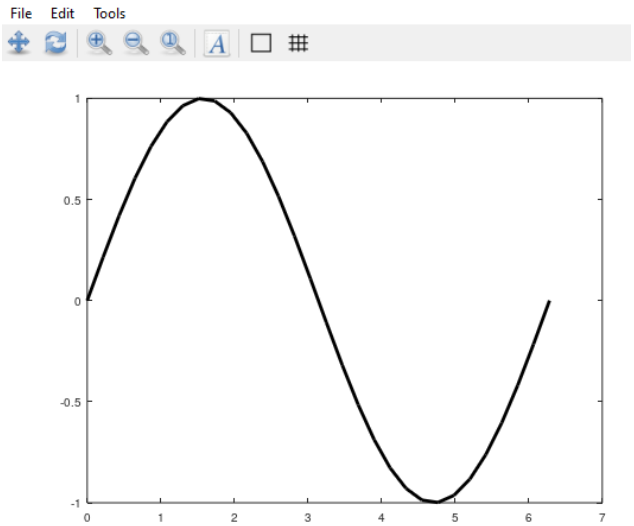

Figure 13.

The Meshgrid (X, Y, Z) function is designed to create a three-dimensional graph, which is a three-dimensional interval matrix. Row vectors or column vectors are passed as arguments, which in turn are converted to matrices consisting of the original repeated rows or columns. If any argument is the y-axis, then a two-dimensional grid is considered, or the Z coordinate corresponds to Y.

We construct interval and non-interval graphs for the same three-dimensional function. On the right is a set of commands to interval a function, and on the left is a graph of a non-interval function.

Example 11.

f=@(x,y)sin(sqrt(x.^2+y.^2))./sqrt(x.^2+y.^2);

```
>> ran=linspace(-8,8,41);
>> [X,Y]=meshgrid(ran,ran);
>> Z=f(X,Y);
>> plot3(X,Y,Z);
>>surf(X, Y, Z)
```

```
>> ran=mince(infsupdec(-8,8),41);
>> [X,Y]=meshgrid(ran, ran);
>> Z=f(X,Y);
>> surf(X, Y, Z)
>> plot3(X,Y,Z)
```

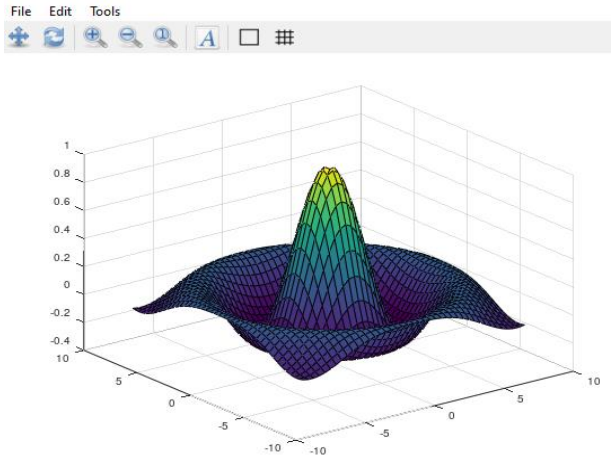

Figure 14. Three-dimensional graph.

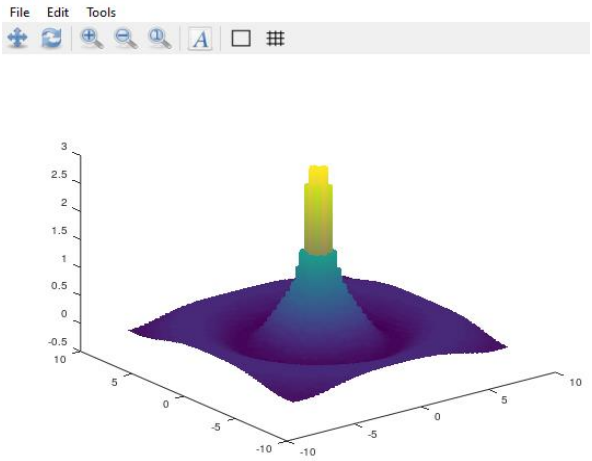

Figure 15. Three-dimensional graph with changing drawing parameters.

Three-dimensional graphs are created using the plot3 function. As an argument, x and y coordinates, the function itself, and 2 intervals for changing drawing parameters are given.

Conclusions

Octave's interval package helps researchers in the field of interval analysis to get some practical information and further develop their theories. The explorer is also equipped with fully functional basic operators and functions. The interval packet conforms to the IEEE-1788 standard for interval computing on a computer. The main operators and functions of the Octave program, the possibilities of working in the interval package, the rules for entering interval values, and the features of the package itself were reviewed. Two-dimensional and three-dimensional graphs of the functions were constructed using the Octave program and the interval package.

Also, in the Octave program, processes such as solving differential equations, statistics, thermodynamics, and control theory can be performed at a high level through geometric representation and animations.

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DEVELOPMENT OF A TECHNOLOGY FOR OBTAINING MANGANESE FROM WASTE

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Annotatsiya. Ushbu maqolada sulfat kislotali tanlab eritish usuli bilan marganes tarkibli shlakdan marganesni ajratib olishning maqbul sharoitlari o‘rganildi. Tadqiqotlar shuni ko‘rsatdiki, reaksion aralashmaga temir kukuni va temir sulfatini qo‘shish marganesni ajratib olish darajasini 45 dan 52% gacha oshirish imkonini beradi, bu esa jarayonni yanada samarali qiladi. Suyuqlanish jarayoniga harorat, sulfat kislota konsentratsiyasi va boshqa omillarning ta’siri tahlil qilingan. Metallurgiya chiqindilarini qayta ishlashning taklif etilgan usullari marganesni ajratib olish orqali atrof-muhitga yuklamani kamaytirish va

shlaklarning iqtisodiy qiymatini oshirishga xizmat qilishi mumkin. Tadqiqot natijalaridan metallurgiya sanoati va o‘g‘itlar ishlab chiqarishda foydalanish mumkin. Bu, ayniqsa, O‘zbekiston kabi marganes rudasi zaxirasi cheklangan hududlar uchun dolzarbdir.

Kalit so‘zlar: *shlak-chiqindi, metallurgiya, kaprolaktam, sulfat kislota, ekstraksion fosfat kislota, natriy sulfit, oksalat kislota, marganes.*

Аннотация. В данной работе изучены оптимальные условия извлечения марганца из марганецсодержащего шлака методом сернокислотного выщелачивания. Исследования показали, что добавление железного порошка и сульфата железа в реакционную смесь позволяет повысить степень извлечения марганца с 45 до 52%, что делает процесс более эффективным. Проанализировано влияние температуры, концентрации серной кислоты и других факторов на процесс плавления. Предложенные способы переработки металлургических отходов могут служить снижению нагрузки на окружающую среду и повышению экономической ценности шлаков за счет извлечения марганца. Результаты исследования могут быть использованы в металлургической промышленности и производстве удобрений. Это особенно актуально для регионов с ограниченными запасами марганцевой руды, таких как Узбекистан.

Ключевые слова: *шлак-отходы, металлургия, капролактам, серная кислота, экстракционная фосфорная кислота, сульфит натрия, щавелевая кислота, марганец.*

Abstract. In this work, the optimal conditions for the extraction of manganese from manganese-containing slags by sulfuric acid leaching were studied. Studies have shown that adding iron powder and iron sulfate to the reaction mixture increases manganese extraction from 45% to 52%, making the process more efficient. The influence of temperature, sulfuric acid concentration, and other factors on the melting process was analyzed. The proposed methods for processing metallurgical waste can serve to reduce the environmental load and increase the economic value of slags due to the extraction of manganese. The results of the research can be used in the metallurgical industry and fertilizer production. This is especially true for regions with limited manganese ore reserves, such as Uzbekistan.

Keywords: *slag waste, metallurgy, caprolactam, sulfuric acid, extraction phosphoric acid, sodium sulfite, oxalic acid, manganese.*

Introduction

The article is dedicated to determining the optimal conditions for extracting manganese from manganese-containing slag using sulfuric acid solutions. It has been established that adding various amounts of iron powder and iron sulfate to the reaction mixture increases the extraction of manganese from manganese slag. Adding equivalent amounts of iron powder and iron sulfate to sulfuric acid increases manganese extraction from 45% to 52%.

Literature Review

In the manganese mining and metallurgical industry, more than 50% of extracted minerals are lost as production waste. This deteriorates production and economic indicators and leads to significant environmental pollution. A particularly challenging task is the utilization of dust, sludge, and slag formed during the processing of manganese ore [1-5].

The study of manganese transformation and transfer processes under the influence of microorganisms aims to create an effective technology for leaching manganese from low-grade ores and metallurgical industry waste (dust, slag, etc.). However, the problem of processing complex manganese industrial waste has not yet been solved.

The object of the research is manganese-containing industrial waste, which is a fine-dispersed dust-like mass separated during dry cleaning of gases leaving the reaction zone of the electric furnace [6, 7].

Steelmaking slags, also known as LD, LSD, or SWS slags, can contain significant amounts of iron due to the specifics of the technology. Iron is present in the slag partly in metallic form, but mostly as oxides, which are closely bound to the slag matrix. Mechanical extraction of iron is impossible, as the oxides are strongly bound to the matrix and require thermochemical reduction to convert to metallic form. The slag matrix consists mainly of calcium oxide, silicon dioxide, and aluminum oxide. Additionally, the slag may contain manganese, which is also present as oxides. Unlike other slags, such as blast furnace slag, steelmaking slags do not have hydraulically active phases, making them unsuitable for processing into cement. Instead, they are used almost exclusively as aggregate for road construction [8, 9].

The accumulation of industrial waste at steelmaking enterprises creates a risk of environmental pollution not only by elements toxic to flora and fauna but also by substances beneficial to plants in excessive quantities. Products from processing such waste in small quantities can help, for example, in the production of compounds added during steel smelting, in the production of imported manganese compounds, and, additionally, in nature conservation and the increase of import-substituting products.

The determination of useful components, harmful impurities, and slag-forming substances is usually carried out using group samples, which allows for establishing patterns in their content within ore bodies. The manganese ores mined in Uzbekistan’s deposits are low-grade, and their industrial use depends on the possibility of enrichment.

Sulfuric acid leaching is the main process in many hydrometallurgical schemes for processing manganese raw materials. Iron compounds and metallic iron are used as reducing agents. To extract manganese from manganese-containing solutions as a precipitate, hydroxide compounds of various metals are used. Factors influencing leaching include temperature, duration, initial slag composition, and sulfuric acid concentration [10].

Various methods of manganese leaching have been developed, including the use of reducing agents such as sulfuric acid and sodium sulfite, sulfur dioxide, metallic iron ions, and sulfite. One method of extracting manganese involves roasting with sodium hydrosulfate followed by water leaching [11].

Research Methodology

Research has developed a method for obtaining manganese salts from carbonate ores with subsequent electrolysis. Unlike water-soluble manganese salts, industrial waste contains manganese in its insoluble form. Using manganese sludge in the initial stage of superphosphate production improves manganese solubility in the final product.

Analysis and Results

In the Republic of Uzbekistan, there are no enterprises producing primary ferrous metal. Steel production at facilities located in this territory is limited to re-melting or secondary metallurgy processes. During these processes, a large quantity of manganese compounds (ferromanganese, manganese-containing fluxes) is used to purify the steel. As a result, a significant portion of manganese is removed into the slag. The average composition of slag formed during the steel smelting process is presented in Table 1.

Table 1. The average composition of the slag formed during the steel production process.

№	Name of compounds	Composition, %
1	MgO	26.07
2	Al_2O_3	4.847
3	SiO_2	30.26
4	SO_3	1.288
5	CaO	5.493
6	MnO	20.64
7	Fe_2O_3	13.70

As shown in Table 1, manganese and magnesium compounds constitute the main part of the slag composition. Considering that the world's manganese ores have varying compositions but contain an average of about 48-52% manganese (Mn), and the main manganese-containing minerals are pyrolusite (MnO_2), psilomelane ($MnO \cdot FeO$), and hausmannite (Mn_3O_4), extracting manganese from slag is as economically beneficial as extracting it from ore. This is because the slags, after undergoing a certain stage of grinding, become ready for processing.

Based on the aforementioned data, experimental work has begun on extracting manganese from the slag composition. Considering the factors mentioned above and the impact of the processing on the environment, the hydrometallurgical method is considered optimal for processing slags.

When analyzing the literature on extracting metallic manganese from slags, the primary goal was to determine the solubility of manganese compounds after establishing that manganese must first be allowed to pass into a soluble state to form a soluble compound. Given that aqueous solutions of sulfuric acid are used as a solvent in the process of leaching manganese-containing slags, experiments were conducted to study the solubility of manganese compounds with sulfuric acid, i.e., the solubility of manganese sulfate. In this process, the factors influencing solubility, temperature, and pH of the solution were taken as a basis.

The obtained data show that the highest solubility of manganese sulfate is observed at a temperature of 25 °C and sulfuric acid concentrations of 5 g/dm^3 and 484-500 g/dm^3. Increasing the sulfuric acid concentration to 85 g/dm^3 and reaching a

temperature of 95 °C significantly reduces the solubility of manganese sulfate. The reason for this is the release of sulfuric acid ions in the solution, which inhibits the dissolution of manganese sulfate. It has been established that manganese can be extracted from slag at low temperatures and low concentrations of sulfuric acid. Furthermore, the possibility of obtaining a solution with a manganese concentration of up to 176.5 g/dm^3 has been confirmed. The analysis conducted within the framework of the technological research corroborated these results.

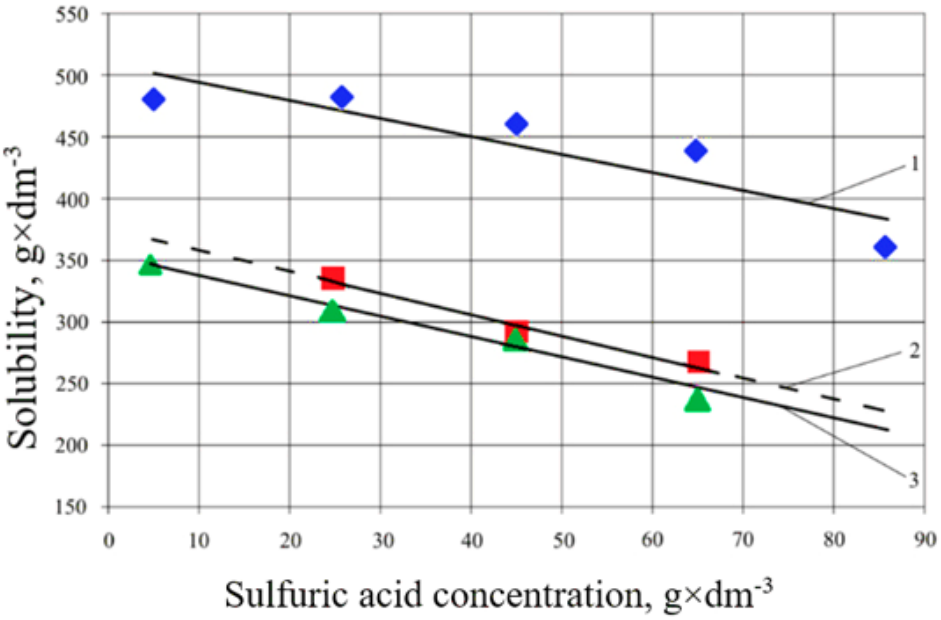

Figure 1. The dependence of manganese sulfate solubility on sulfuric acid concentration at different temperatures. 1 - 25 °C; 2 - 60 °C; 3 - 95 °C.

Based on the data presented above, the initial experiments were conducted using concentrated sulfuric acid at a temperature of 25 °C. A 98% solution of concentrated sulfuric acid was mixed with 200 ml and 100 ml of distilled water and reacted with 100 g of slag sample in a 1-liter laboratory vessel. Sulfuric acid, when mixed with water, has the property of generating heat. Due to the process being accelerated by temperature, sulfuric acid was mixed with the sample without waiting for it to cool. Using a mechanical stirrer, the process continued for 6 hours without interruption. After 6 hours, the solution was left to settle. After 2 hours of settling, the mixture became thick.

To separate the solution from the mixture, filtration was carried out. Due to the concentration of the solution during filtration, the solution was unable to pass through the filter paper and yield a pure solution. Therefore, distilled water was added to dilute the mixture. Subsequently, the solution was passed through a filter, separating the clean solution from the sludge. To determine the composition of the resulting sludge, it was dried and analyzed at 100 °C. The composition of the sludge is presented in Table 2. The composition of the slag is presented in Table 2.

The results in Table 2 show that in the sludge obtained from treatment with concentrated sulfuric acid, the majority of manganese remains in the sludge. Most of the iron has transferred into the solution. This indicates that using concentrated sulfuric acid for manganese extraction does not produce effective results.

Table 2. The composition of the slag after treatment with sulfuric acid.

№	Name of compounds	Composition, %
1	SiO_2	11.66
2	SO_3	63.80
3	CaO	2.506
4	MnO	11.91
5	Fe_2O_3	2.826

Conclusions

Thus, the conducted research has allowed for the determination of optimal conditions for extracting manganese from manganese-containing slag using sulfuric acid leaching. It has been established that the addition of iron powder and iron sulfate significantly increases the degree of manganese extraction. This enables the effective use of these technologies in processing metallurgical waste. These methods help reduce the environmental impact of steelmaking slags and increase the economic value of the waste by extracting manganese for further use in various processes, such as fertilizer production and ferrous metallurgy. Given the limited manganese deposits, especially in Uzbekistan, implementing effective methods for processing manganese-containing waste is of strategic importance for reducing dependence on imports and improving the resource efficiency of metallurgical production.

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UDC: 669, 669.1, 672

EXTRACTION OF MANGANESE FROM STEEL PRODUCTION SLAG

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Annotatsiya. Marganes ferroqotishmalar va po‘lat ishlab chiqarishda eng muhim element hisoblanadi. Ma’dan va shlaklardan marganesni ajratib olish jarayoni bir qator texnologik va ekologik muammolarga duch kelmoqda, jumladan yuqori quvvat sarfi va metall yo‘qotishlar shular jumlasidandir. Maqolada marganesni ajratib olishning pirometallurgiya va gidrometallurgiya kabi asosiy usullari ko‘rib chiqilgan hamda ularning afzalliklari va kamchiliklari tahlil qilingan. Resurslardan barqaror foydalanishga va atrof-muhitga ta’sirni kamaytirishga yordam beradigan marganesni ajratib olishning samarali usullarini taklif etuvchi yetakchi olimlarning tadqiqotlariga alohida e’tibor qaratilgan. Nikopol (Ukraina) va Kalaxari tumani (Janubiy Afrika) kabi asosiy marganes konlari katta hajmdagi xom ashyoni ta’minlaydi, biroq ferroqotishmalarni eritishda marganesning yo‘qotilishi hamon jiddiy muammo bo‘lib qolmoqda. Shlaklarni qayta ishlashning zamonaviy usullari marganesni ajratib olish samaradorligini sezilarli darajada oshirish va ishlab chiqarish xarajatlarini kamaytirish imkonini beradi.

Kalit so‘zlar*: Marganes, po‘lat eritish, shlaklar, ferromarganes, pirometallurgiya, gidrometallurgiya, qayta ishlash texnologiyalari, marganes ekstraksiyasi, ekologik muammolar, metallurgiya ishlab chiqarish, mexanik ishlov berish.*

Аннотация. Марганец является важнейшим элементом в производстве ферросплавов и стали. Процесс извлечения марганца из руд и шлаков сталкивается с рядом технологических и экологических проблем, включая высокие энергозатраты и потери металла. В статье рассмотрены основные методы извлечения марганца, такие как пирометаллургия и

гидрометаллургия, а также проанализированы их преимущества и недостатки. Особое внимание уделяется исследованиям ведущих ученых, предлагающих эффективные методы извлечения марганца, способствующие устойчивому использованию ресурсов и снижению воздействия на окружающую среду. Такие основные месторождения марганца, как Никополь (Украина) и Калахарский район (Южная Африка), обеспечивают большие объемы сырья, но потери марганца при плавке ферросплавов остаются серьезной проблемой. Современные способы переработки шлаков позволяют существенно повысить эффективность извлечения марганца и снизить производственные затраты.

Ключевые слова: *Марганец, сталеварение, шлаки, ферромарганец, пирометаллургия, гидрометаллургия, технологии переработки, извлечение марганца, вопросы окружающей среды, металлургическое производство, механическая обработка.*

Annotation. Manganese is a crucial element in the production of ferroalloys and steel. The process of extracting manganese from ores and slags faces numerous technological and environmental challenges, including high energy consumption and metal losses. This paper examines the main methods of manganese extraction, such as pyrometallurgy and hydrometallurgy, and analyzes their advantages and disadvantages. Special attention is given to research by leading scientists proposing effective methods for manganese extraction that contribute to sustainable resource use and reduced environmental impact. Major manganese deposits such as Nikopol (Ukraine) and the Kalahari region (South Africa) provide large amounts of raw material, but manganese loss during ferroalloy smelting remains a serious issue. Modern slag processing methods allow for significantly increased efficiency in manganese extraction and reduced production costs.

Keywords: *Manganese, steelmaking, slags, ferromanganese, pyrometallurgy, hydrometallurgy, processing technologies, manganese extraction, environmental issues, metallurgical production, mechanical processing.*

Introduction

Manganese is a vital element in the production of ferroalloys and steel, especially in the production of ferromanganese for cast iron alloying. Despite the high manganese content in some rocks, its extraction remains a complex task due to high consumption during processing. The process of extracting manganese from ores and slags faces numerous technological and environmental challenges, including high energy consumption, substantial manganese losses in waste, and negative environmental impact. This article examines the main methods of manganese extraction, including pyrometallurgical and hydrometallurgical approaches, their advantages and disadvantages, as well as prospects for improving manganese extraction technologies.

Literature Review

A wide range of technologies is used in the global practice of processing manganese-containing slags. Hydrometallurgical and pyrometallurgical methods are considered

the most promising among these. In this regard, research by authors such as Dong Jun Shin, Xu Gao, Shigeru Ueda, and Shin-ya Kitamura from Tohoku University in Japan focused on the carbothermic extraction of manganese and phosphorus from steelmaking slags. They synthesized slag with graphite and processed it at high temperatures (1600-1800°C) to separate metals [1, 2]. Experiments showed that the use of graphite leads to a significant decrease in phosphorus and manganese content in the slag, contributing to their effective extraction [3].

Furthermore, researchers such as Aleksandrov, A.A., Dashevskii, V.Y., and Leontev, L.I. investigated methods for extracting manganese from slags obtained during the production of improved manganese ferroalloys. Their work proposes a technology for pre-treating slags, including crushing and grinding stages, followed by heat treatment to recover manganese. Results demonstrated the high efficiency of the method, which allows for the extraction of up to 90% of manganese from the original slag [4, 5].

These studies represent important steps towards developing technologies for processing and extracting manganese from steelmaking slags, ensuring sustainable resource utilization and reducing the environmental impact of the metallurgical industry [6].

Manganese and its major deposits

The main manganese deposits are located in South Africa, Ukraine, Australia, Brazil, China, and India. The world’s largest reserves of manganese are concentrated in sedimentary deposits such as the Nikopol deposit in Ukraine and the Kalahari region deposits in South Africa. These deposits account for over 80% of global manganese ore production.

Manganese is obtained from various minerals, including pyrolusite (MnO_2), manganite ($Mn_2O_3H_2O$), psilomelane ($BaMn_9O_{16}(OH)_4$), and romanechite ($BaMnMn_5O_{16}(OH)_4$). The main manganese deposits are located in South Africa, Ukraine, Australia, Brazil, China, and India. The world's largest reserves of manganese are concentrated in sedimentary deposits such as the Nikopol deposit in Ukraine and the Kalahari region deposits in South Africa. These deposits provide more than 80% of the world's manganese ore production [7].

Issues with manganese losses in ferroalloy production During the smelting process of medium and low-carbon ferromanganese and metallic manganese, up to 40% of manganese is lost in slag. In these processes, manganese metallization rarely exceeds 60-65%. High manganese losses increase production costs and reduce the economic efficiency of metallurgical production.

One of the main problems in the production of manganese-containing ferroalloys is the high loss of manganese in slags. During the smelting of medium and low-carbon ferromanganese and metallic manganese, up to 40% of manganese is lost in the slag. In these processes, manganese metallization rarely exceeds 60-65%. High manganese losses increase production costs and reduce the economic efficiency of metallurgical production [8, 9].

Research Methodology

Modern methods for extracting manganese. Pyrometallurgical methods involve the reduction of manganese using carbon, which requires high temperatures and leads to large energy expenditures. Hydrometallurgy, in turn, is becoming increasingly popular due to its environmental cleanliness and low cost. This method includes steps such as roasting, leaching with acids, alkalis, or water, purification from impurities (such as iron), and refining of metals.

Analysis and Results

The extraction of manganese from ores and waste is traditionally carried out using pyrometallurgy and hydrometallurgy. Pyrometallurgical methods involve the reduction of manganese using carbon, which requires high temperatures and leads to large energy expenditures. Hydrometallurgy, on the other hand, is becoming increasingly popular because it is environmentally friendly and cost-effective. This method includes steps such as roasting, leaching with acids, alkalis, or water, purification from impurities (such as iron), and refining of metals.

One of the main processes in hydrometallurgy is the selective leaching of manganese from ores and slags using sulfuric acid (H_2SO_4). However, such leaching is effective only for manganese minerals containing low-valence oxides (Mn^{2+}), and the manganese extraction rate does not exceed 40%. To improve manganese extraction, reducing agents such as metallic iron or iron sulfate (Fe^{2+}) are added to the solution. This process takes place at a temperature of 95°C, which allows for the acceleration of reactions and increased efficiency.

Methods for extracting manganese from manganese-containing slags using reducing agents. Researchers have conducted extensive work on methods using reducing agents to increase the extraction of manganese from slags. A reducing agent is used to recover manganese from its oxides during the extraction process. To recover manganese from slag, iron metal or iron sulfate (Fe^{2+}) is added, which helps convert manganese from higher oxidation states (Mn^{4+}, Mn^{3+}) to soluble forms (Mn^{2+}). The process is carried out in an acidic medium at a temperature of 60-95°C, which significantly increases manganese extraction [6].

Furthermore, the hydrometallurgical extraction process of manganese with the addition of reducing agents describes a method in which reducing agents such as coal or metallic iron are added. The process involves selectively transferring manganese into solution using sulfuric acid at a temperature of 60-95°C in the presence of reducing agents. This method allows for the reduction of manganese from oxides to a soluble form and its effective extraction from slag, especially from complex slags containing manganese oxides and carbonates [7, 8].

A method for extracting manganese metal from slags using calcium and magnesium salts describes an approach of adding these salts to improve manganese extraction. These salts accelerate reactions between manganese and the acidic medium, catalyzing the leaching process. The method involves roasting slags at high temperatures followed by selective leaching of manganese in an acidic medium [9, 10].

Another method describes an environmentally safe process for extracting manganese using exothermic reactions and organic reducing agents, which reduces the use of high temperatures and minimizes the harmful impact on the environment. This process is

referred to as an environmentally safe manganese extraction process. These methods demonstrate a wide range of approaches to increasing manganese extraction from slags, including the use of various reducing agents and optimization of process conditions, which can lead to a significant improvement in the efficiency of processing manganese-containing waste [11].

The advantages of hydrometallurgical methods. Hydrometallurgy remains the preferred method of extracting manganese compared to pyrometallurgy due to its environmental cleanliness and cost-effectiveness. One of the important advantages of hydrometallurgical methods is the use of reducing agents such as iron or iron sulfates, which increase the efficiency of manganese leaching. Additionally, hydrometallurgy enables the processing of by-products such as sulfates into safe chemical compounds, such as ammonium sulfates or elemental sulfur, which contributes to compliance with environmental norms and standards.

In recent years, numerous innovative hydrometallurgical processes have been proposed for the extraction of manganese. They allow for the optimization of leaching conditions and a significant increase in manganese extraction. These new approaches include the use of environmentally friendly reducing agents such as coal or natural organic compounds, as well as the optimization of temperature and acid concentration during leaching.

Furthermore, methods combining pyrometallurgy and hydrometallurgy are being investigated, allowing for increased extraction of manganese from various manganese ores and slags. These methods can serve as the basis for the stable and efficient production of manganese ferroalloys in the future.

Conclusions

The extraction of manganese from manganese-containing materials is an important task for the metallurgical industry. Modern methods, including hydrometallurgical technologies, allow for a significant increase in the efficiency of manganese extraction, reduce losses, and improve the environmental situation in metallurgy. These technologies are particularly important for countries with low steel consumption, as the development of effective methods for processing manganese in these countries can be an important step towards industrialization and economic growth.

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UDC: 338.4, 517

SERVICE NETWORKS IN SYRDARYA REGION REGIONAL CHARACTERISTICS

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Annotatsiya. Ushbu maqola Sirdaryo viloyati xizmat ko‘rsatish tarmoqlarining hududiy xususiyatlarga bag‘ishlangan bo‘lib, bugungi kunda xo‘jalikning uchinchi yirik tarmog‘i xisoblangan xizmat ko‘rsatish tarmoqlari va viloyatda rivojlanishiga ta’sir etuvchi va ilmiy-amaliy yo‘nalishlari yoritilgan. Shuningdek, yangi turdagi xizmat turlarini tashkil etishga doir tavsiyalar berilgan. Mazkur holat O‘zbekiston respublikasining iqtisodiy geografik o‘rni qulay mintaqasida joylashgan, o‘ziga xos geografik o‘ringa ega bo‘lgan Sirdaryo viloyati misolida ilmiy-amaliy asosda ko‘rilgan.

Kalit so‘zlar. *Xizmat turlari, hududiy tafovut, nomoddiy soha, yalpi hududiy mahsulot, oqilona foydalanish, muhofaza qilish, postindustrial.*

Аннотация. Данная статья посвящена территориальным особенностям отраслей обслуживания Сырдарьинской области, освещаются сферы услуг, которые сегодня являются третьей по величине отраслью хозяйства, и научно-практические направления, влияющие на их развитие в области.

Также даны рекомендации по организации новых видов услуг. Данное положение было рассмотрено на научно-практической основе на примере Сырдарьинской области, расположенной в благоприятном экономико-географическом регионе Республики Узбекистан, имеющей особое географическое положение.

Ключевые слова. *Виды услуг, территориальная дифференциация, нематериальная сфера, валовой региональный продукт, рациональное использование, сохранение, постиндустриальный.*

Abstract. This article is devoted to the territorial features of the service networks of the Syrdarya region, and today the third largest branch of the farm is covered by specialized service networks and scientific and practical areas affecting its development in the region. Recommendations for the organization of new types of services are also given. This situation was seen on a scientific and practical basis on the example of the Syrdarya region, which is located in the favorable region of the economic geographical position of the Republic of Uzbekistan, has a specific geographical position.

Keywords. *Types of services, territorial discrepancy, intangible sphere, gross territorial product, reasonable use, protection, postindustrial.*

Introduction

Focusing on the state of territorial development of the service sector of the Republic, it can be seen that there are differences in the volume of services produced by its administrative units. Geographical differences in this regard are primarily due to the level of socio – economic development and demographic potential of the regions. While development is the impetus for the development of many intangible industries, population demand, which is their main consumer, increases the type of service offered as well as the number of producers [1-3].

Literature Review

Obviously, the main principle for the science of geography is its territoriality. After all, the science of geography cannot be imagined without territorial relations, without space [4]. It is also an effective tool to analyze the division of territories into several groups according to the level of development of the service infrastructure system. This is primarily because the provision of social services to the population is important in the placement of transport and several other service facilities, in determining the social progress of the region and the population [5-7].

Comparison of geographical aspects of Regions is always territorial and in two manifestations: comparisons that are similar and those that are non-existent. In many cases, the first view is more traditional, in which objects with scope, essence and function are compared. The second view would be the opposite of one another in terms of the large - size, function, essence, and other properties of comparable objects [6]. In assessing the lifestyle of the population, at first, the level of provision of housing engineering communication conditions, electricity, clean drinking water, natural gas, sewerage networks are considered important.

Analysis and Results

Social infrastructure is a system consisting of the sum of conditions and networks that serve to meet the personal daily social household needs of the population. In many countries, the benefits from the service sector lead to an increase in GDP, which has a positive effect on the economy of any country. Like other regions of our republic, Syrdarya region entered a new period of socio-economic development. The main reason for social development is the growth of needs. Full-fledged satisfaction of social needs assumes an increase in the quality and scale of service industries.

The leading link in the management of the economy in the process of functioning of the production of society is the socio - economic development program. The effectiveness and development of service sectors and the economy largely depends on how well this program is based. Its initial important basis is the economic forecasts of the services provided.

They describe the development trend and future perspective of service delivery. Economic forecasting of services provides the necessary information about the past, present and future state of the object, alternative ways of development or the consequences of management decisions, thereby allowing an increase in the level of management of sectors of the economy [2]. Along with the increase in needs in connection with the development of society, their composition, structure, priorities, quality content change, new needs appear, and the old ones disappear. As the standard of living of the population increases, there is increasingly an increase in the need for quality services as well.

Today, the country has an average clean drinking water supply rate of 85.4%, in Gulistan it is 99.1 %, Shirin city 99.8%, Yangiyer city 83.4 %, Boyovut district 93.2 %, Oqoltin 93.2%, Gulistan 92.4 %, Saikhunabad 89.5 %, Syrdarya 87.7 %, Mirzaabad 82.8%, Sardoba 79.4%, Khovos district 78.8% of the population has clean drinking water provided with. From the figures, it can be seen that in the Yangiyer city and Sardoba, Khovos districts of the province, the population is not adequately supplied with clean drinking water.

The level of water supply of the population of Syrdarya (in %)

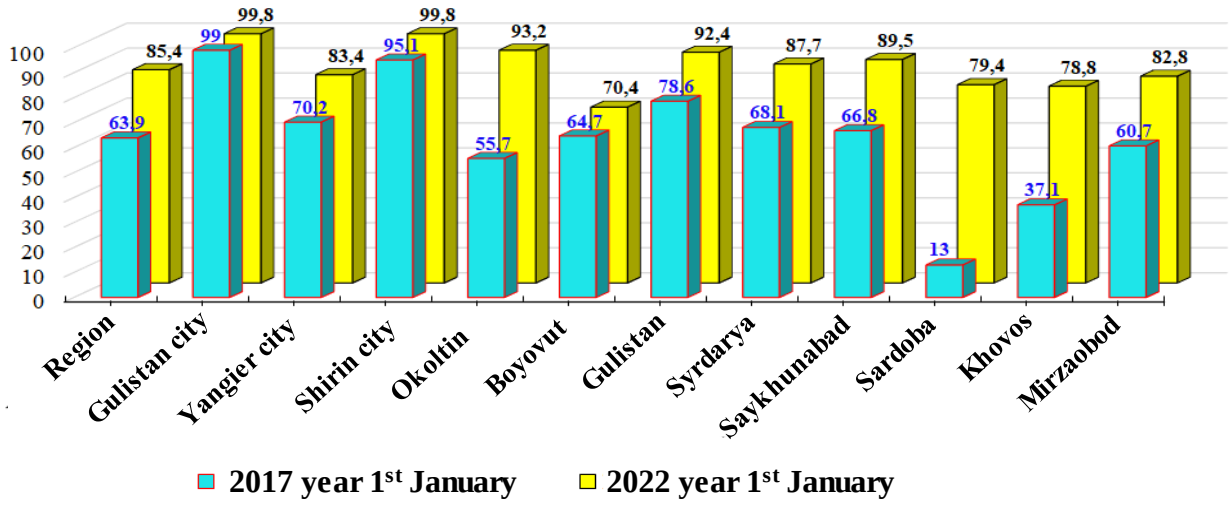

Figure 1. The level of provision of drinking water to the population of Syrdarya region.

As with other regions of the republic, it can be seen that the problems facing the natural gas supply of the population of the Syrdarya region are only fraught with a number of solutions. The average natural gas supply of the population of the region is 60%, while the population of the cities of Gulistan, Yangiyer and Shirin is 100% provided with natural gas networks, while in the districts this can be reflected. 41.1%, Gulistan district 42.3%, Mirzaabad District 51.7%, Oqoltin district 40.0%, Saikhunabad district 32.7%, Sardoba 43.3%, Syrdarya 51.7% of the population are provided with natural gas. In the Khovos District of the province alone, this figure is relatively high, at 84.7%.

The level of literacy of the population, intellectual heritage and modern culture, on the ground of universal values, the use of achievements of science, economy, technology and technology, the formation of a perfect system of Personnel Training System are considered one of the necessary conditions for the development of Uzbekistan. Preschool education, which is considered the initial link of the educational system, occupies a huge place in the development of the foundation of the system of continuous education, the upbringing of the personality of a harmonious and healthy child in all respects and the preparation for school. The number of existing preschool organizations in the region is 163 in 2010, while 217 in 2020. We can see that the number of preschoolers grew from 13,745 to 28,739, and the number of pedagogical employees increased from 1,339 to 2,837 people.

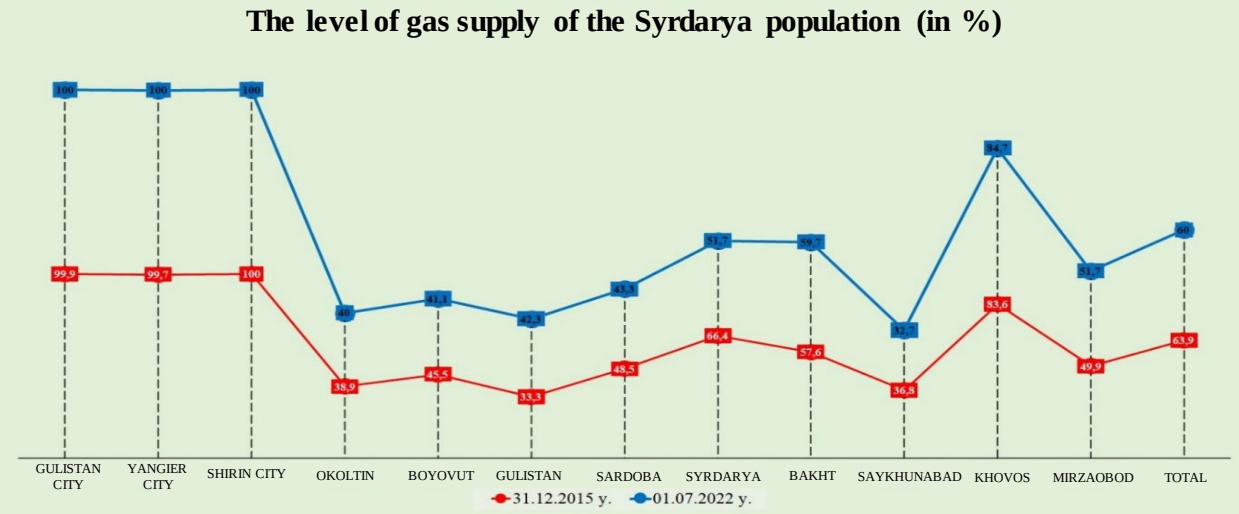

Figure 2. The level of supply of natural gas to the population of Syrdarya region.

It is possible to come to a clear conclusion by considering the activities of the preschool education system in general and the level of use of this type of service by the population in the cross section of the regions. The coverage rate of pre-school children in the region was 77.3% on average, covering 93.7% Gulistan city, 89.2% Yangiyer City, 83% Shirin City, 76.2% Boyovut district, 87.3% Gulistan District, Mirzaabad district 78.5%, Oqoltin district 73.0%, Saihunabad district 65.0%, Sardoba 82.2%, Syrdarya 71.0% relatively low in Khovos district 66.0%, we can see children under the age of 7.

When the rating was determined by the analysis of the level of education and utilities of the regions, the statistics of the last 5 years were calculated on average. According

to him, the lowest rate was recorded in the four hudud districts of okoltin, Saikhunabad, Syrdarya and Khovos. It is known that the rating indicator is mainly provided for the coverage of areas with preschool children under the age of seven, the coverage of school graduates with higher education, clean drinking water, as well as the level of natural gas supply. From this it can be seen that Syrdarya and Saikhunabad districts had a significant impact on the low level of coverage of higher education compared to other regions of the province, lagging behind in preschool coverage in Saikhunabad and Khovos districts.

The number of general education institutions increased from 304 to 316, the number of students studying in it increased from 13,745 to 15,862, and the number of active teachers increased from 9,706 to 13,517 people. When assessing quality indicators, secondary schools can be determined by the level of admission of school graduates to higher educational institutions. The coverage rate of Regional Comprehensive schools with OSMS was an average of 29.15, covering Gulistan city 32.7%, Yangiyer City 30.7%, Shirin City 49.0%, Boyavut District 32.1%, Gulistan District 25.7%, Mirzaabad District 31.4%, Okoltin district 23.6%, Saikhunabad district 23.5%, Sardoba 31.23%, Syrdarya was 17.0%, Khovos district was 24.0%, were students.

The health sector is the sum of health care and medical service facilities that provide high quality guaranteed medical care to the population. Also this system, together with maintaining the health of the population and providing them with medical services and assistance, has important economic-social significance in our national economy as a system that promotes the preservation, rehabilitation, treatment and healthy lifestyle of the labor resources of society from disease. This sphere performs an important economic function, ensuring the continuous operation of the reproduction activities of the layer of the busy population in society, providing the basis for the increase in the volume of material goods produced and the fair functioning among the indigenous people.

The excellent development of the system of medical services for the population, the placement of medical institutions in the mountains, the focus on such issues as population health are of great importance in the structure of social infrastructure. The number of hospital facilities operating in Syrdarya region was 38 in 2010, 42 in 2020, the number of outpatient clinics operating in this year was 157, and the number of Bays of existing hospital facilities reached 4.0 thousand, and the number of medical staff reached 14.4 thousand people. As of 2020, in the cross - section of districts and cities: in the city of Gulistan, 4.3 thousand people, the number of secondary medical personnel was 9.0 thousand, while in 2020 it is 24.9 thousand people. We can see that the number of medical doctors reached 1.4 thousand people in 2010, and 1.8 thousand in 2020. From the data, it can be seen that the regional disparities in the provision of medical services in the province are also large Gulistan and Syrdarya.

The share of services in the structure of the gross regional product in 2022 in the region increased by 1.6% compared with 2021, at 29.6%. The share of services by sector and gross regional product increased by 1.6% compared to the same period last year. The largest share in the services sector was financial services at 32.2%, sales at 24.4% and transport at 13.0%, services. The next places were occupied by

communication and informatization services 5.5%, educational services 3.6%, rent 3.0% and real estate related services 2.7%.

Analysis shows that in January - December 2022, compared to the same period of 2021, there were growth rates in the dynamics of all types of services. Other services 44.5%, rental services 39.6%, communications and informatization services 25.6%, financial services 15.8%, real estate related services 14.4%, architecture, engineering research, technical testing and analysis services 11.8%, health care 10.6%, personal services (Barber and beauty salon services) 7.2%, computers, home appliances, personal item repair services 6.9%, sales services 5.8%, residential and catering services 5.4%, transportation services 5.4%, personal services 5.4%, educational services increased by 1.5%.

In January-December 2022, 45.1% of the volume of services provided fell on the contribution of the city of Gulistan. Next in terms of the largest shares in the total volume of services provided in the region were the contributions of the districts of Syrdarya (13.5%), Yangiyer city (7.9%) and Boyovut (7.1%). But the total number of services provided in the region is very low in the districts of Shirin (1.4%), Oqoltin (3.1%) and Sardoba (3.8%). In January-December 2022, the highest growth rates in the services sector were observed in the districts of Boyovut (131.2%), Khovos (114.7%) and Gulistan (114.7%).

Conclusions

In conclusion, it can be said that there are territorial differences in service in the region. There are also opportunities for the development of new types of services.

- taking into account the social demographic characteristics of the territory, improving the activities of providing sewer networks in residential arrays, developing and implementing new model projects on the activities of sanitary facilities;

- There are problems waiting for a number of solutions at the level of sewage supply in apartment buildings built on the basis of model projects in the city of Gulistan and district centers, from which it is clear that the demand for utilities in the regional region is great to expand the network of this service as much as possible in overcoming these problems;

- proposals and recommendations were made on the development and expansion of agrotourism due to the increase in the cultivation of maize crops, effectively using agro-climate resources in the regions of the region of heavily saline Sardoba, Mirzaabad and Okoltin district, and as a result of this, it is envisaged that the income and employment level of the population of the region can be increased.

From the above proposal as well as feedback, we can know that the development of many types of service networks in the region is sufficient and shows that there are problems waiting for a solution.

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URBANIZATION DEVELOPMENT IN UZBEKISTAN (NATIONAL AND GENERAL CHARACTERISTICS)

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Annotatsiya. Maqolada urbanizatsiya jarayonlarining milliy va umumbashariy jihatlari, ularning madaniyatga ta’siri masalalari tadqiq etilgan. Urbanizatsiya global rivojlanishiga eltuvchi ijtimoiy-madaniy fenomen ekani ochib berildi. “Urbanizatsiya” tushunchasi uning asosiy yo‘nalishlari, tizimi, xususiyatlari va hududiy, regional jihatlari haqida turli qarashlar hamda urbanizatsiyani keng ijtimoiy-madaniy, jugrofiy, etnosotsial, arxitektura, boshqarish, infratuzilmalar, shahar xo‘jaligi, xizmatlar ko‘rsatish, demografiya va migrasiya, aglomerasiya, qishloq turmush tarzi, transport aloqalar, kabi ko‘plab sohalar, omillar bilan bog‘liqligi haqida fikrlar bayon etiladi. “Sivilizatsiya” atamasining insoniyat tarixida ijtimoiy aloqa vositalari, til, boshqarish tizimi, shaharlar yuzaga kelgani bilan izohlanishi va sivilizatsiya va sivilizatsion rivojlanish haqidagi ilmiy bahslar hamda “urbanizatsiya” va “sivilizatsiya” tushunchalari, falsafiy germenevtik nuqtai nazardan, bir biriga yaqin va bir bihamda o‘rnini to‘ldirib keluvchi voqeliklar ekanligi to‘g‘risida fikr yuritiladi.

Kalit so‘zlar: *urbanizatsiya, shahar madaniyati, migratsiya, yoshlar, milliy va umumbashariy, qishloq aholisi, katta va yirik shaharlar, infratuzilma, turar joy, servis.*

Аннотация. В статье исследуются национальные и общечеловеческие аспекты процессов урбанизации и их влияние на культуру. Выявлено, что урбанизация представляет собой социокультурный феномен, ведущий к

глобальному развитию. Понятие “урбанизация” включает в себя различные взгляды на ее основные направления, систему, характеристики, территориально-региональные аспекты, а также широкие социокультурные, географические, этносоциальные, архитектурные, управленческие, инфраструктурные, городское хозяйство, сервисное обслуживание, демография и мнения о связи со многими направлениями и факторами, такими как миграция, агломерация, сельский образ жизни, транспортное сообщение и др. Трактовка термина «цивилизация» в истории человечества с появлением средств социальной коммуникации, языка, системы управления, городов и научных дискуссий о цивилизации и цивилизационном развитии, а также понятий “урбанизация” и “цивилизации,” с философско-герменевтической точки зрения, близки друг к другу и в то же время. Думается, что они реальности, заполняющие место.

Ключевые слова: *урбанизация, городская культура, миграция, молодежь, национальное и общечеловеческое, сельское население, большие и большие города, инфраструктура, жилье, сервис.*

Abstract. The article examines the national and universal aspects of the processes of urbanization and their impact on culture. It is revealed that urbanization is a socio-cultural phenomenon leading to global development. The concept of “urbanization” includes different views on its main directions, system, characteristics, territorial and regional aspects, as well as broad socio-cultural, geographical, ethno-social, architectural, managerial, infrastructural, urban economy, services, demography and opinions about the connection with many directions and factors, such as migration, agglomeration, rural lifestyle, transport links, etc. The interpretation of the term “civilization” in the history of mankind with the advent of social communication tools, language, management system, cities and scientific discussions about civilization and civilizational development, as well as the concepts of “urbanization” and “civilization,” from a philosophical and hermeneutic point of view, are close to each other. friend and at the same time. It seems that they are realities that fill the place.

Keywords: *urbanization, urban culture, migration, youth, national and universal, rural population, big and large cities, infrastructure, housing, service.*

Introduction

Globalization and modernization processes taking place in the world affect the social progress of peoples, lifestyle and urbanization development, showing that the trend of urbanization and urbanization have become a global reality and problem. At the current stage of development, the socio-economic opportunities that lead the human society towards civilizational and urbanization development, the etymological essence of this process, modernity, urbanization development, and the desire to create a subculture are forming as a model of urbanization development. “Urbanization” is derived from the Latin word urbanus, which means “city,” “belonging to the city,” “belonging to the image of the city.” Experts say that urbanization is a multi-faceted geographical, socio-economic and demographic process that occurred as a result of the social stages and regional division of labor based on historical development. The

narrower demographic-statistical concept of urbanization refers to the increase in the number of cities (especially big cities) and the weight of the city population in the world, in individual regions, and in countries [1].

Literature Review

Urbanization is a global process. In it, the growth of cities and urban culture, the migration of rural residents to the city, and as a result the emergence of cities and large cities are important indicators [2-4].

If in 1950 28.9% of the world's population lived in cities, this figure increased to 33.9% in 1960, 37.4% in 1970, 41.1% in 1980, 45.8% in 1990, and 51% in 2000. increased by 2 percent. According to some sources, today more than 60 percent of the world's population lives in cities, and in 1900, the number of millionaire cities in the world was 10. In 2001, their number was more than 200, even Mexico City has 25, Tokyo 20, Seoul 13, Beijing 11 million, Paris, Cairo, Buenos Aires and London more than 10 million [1]. The increasing trend of millionaire cities in the world shows that urban culture is becoming an attractive phenomenon.

Urban culture, by its essence, is an international, multifunctional and open system. It attracts people who are inclined to live freely because it has a good quality of harmonizing with different ethnic cultures and entering into a compromise. This is the reason why major artists, scientific institutes, research and technological centers, educational institutions, and services are mainly located in large cities. In 1900, only two cities, St. Petersburg and Moscow, were contending to be millionaire cities, today there are more than 10 [5]. Tashkent is the only millionaire city in Uzbekistan. Today, there are 548 millionaire cities in the world, 33 of them have more than 10 million inhabitants. According to forecasts, their number will reach 703 by 2030, and 43 of them will have more than 10 million inhabitants [6]. Management and development of such cities in accordance with the general strategic goal encourages solving many problems. Such millionaire cities create complex problems in the form of a state within a state [7]. The fascinating side of large and big cities is the wide range of cultural services they offer to people. However, according to the observation and opinion of the French philosopher J. Baudrillard, they also increase "consumerism" in the population [8]. This problem should be studied separately, but, in our opinion, the emergence of cities and large cities, megalopolises, and new cities will lead to universal convergence and unification of ethnocultures. Even now, Internet communications and the requirements of international humanitarian law are leading to the unification of ethno-traditions. The culture of large and big cities has a situational (adaptation to the situation, adaptation to the problem) characteristic. Rationalization of everything, concentration and "not being behind the times," activity are its main features. There is no room for thinking, irrational considerations, you have to catch up with everything. This pace of life is not characteristic of rural culture, as a result of which there may be a "misunderstanding" between these two forms of culture. This is also a subject to be studied separately.

Looking at urbanization as a form of civilizational development is a priority for today's researchers. Researchers approaching the problem retrospectively note that the first manifestations of urbanization existed as early as 3-1 millennia BC. Urban

development, the transition of people to a settled life, the formation of general norms and lifestyles were such processes in the history of mankind that made culturalization, facilitation and convenience of life a priority desire [9-11]. The next global development is a product of this paradigm.

One of the next signs of urbanization is the increase in population, that is, it is related to the socio-demographic factor. According to him, until the middle of the 20th century, the village was the source of socio-demographic growth, and then the population of the city began to grow. According to experts, the stage of urbanization related to socio-demographic processes corresponds to the years 1750-1950 in North America and Europe. In these years, in the same order, the population of the city increased from 10 percent to 52 percent, that is, from 15 million to 423 million. In the second phase after that, the population of the city increased from 309 million to 3.9 billion people. This indicates that the population of the city has increased from 18 percent to 56 percent. Later, Africa, Asia and the whole world will join this process.

“Urbanization” and “civilization” are concepts related to the city from the etymological point of view. The French philosopher N.A. Boulanger was the first to use the word “civilization” as a scientific term (in 1766). However, since his book was published later, it was Golbach who introduced the term into scientific use. However, some researchers believe that it was introduced into scientific use in 1767 by the Scottish philosopher A. Ferguson. A. Ferguson connected the concept of “civilization” with “social stratum” and the emergence of cities. He used the word “civilis” in the sense of civil, belonging to the city, belonging to the state. The interpretation of the term “civilization” in the history of mankind with the emergence of means of social communication, language, management system, and cities can also be found in the works of other researchers. However, scientific debates on this matter, especially about civilization and civilizational development, are still ongoing, and further research will show which approach is objective and closer to reality. For us, to emphasize the closeness of the concept of “civilization” to urbanization, to show the synergy between them, and to show that the concepts of “urbanization” and “civilization” that we use today, from a philosophical hermeneutic point of view, are realities that are close to each other and complement each other. it is important to confirm, to reveal that both of them have played an important role in universal development.

The new development stage of Uzbekistan is aimed at urbanization. On July 10, 2019, the President of our Republic, Mirziyoyev Sh.M., adopted a special decree “On measures to radically improve urbanization processes” on ensuring urbanization development. It is emphasized that urbanization processes are not sufficiently taken into account in the social development of our Republic. As a result, in recent years, the trend of the level of urbanization has been decreasing, the number of urban settlements has increased from 1065 to 1071. Despite the measures taken to transform large rural settlements into urban settlements, today’s level of urbanization does not meet the modern requirements for the comprehensive development of cities and significantly lags behind world trends. The level of urbanization is still not stable [12].

Analysis and Results

Modern urbanization is not only urban planning and construction of buildings, it means the creation of urban culture in a broad sense, infrastructure worthy of meeting all the needs of city residents. In its center is not only socio-economic, but also demographic, cultural, service provision. In new Uzbekistan, certain works are being carried out in these areas, our cities are changing, cities and new towns are emerging. searches are found in transport services. The decree of the President of the Republic of Kazakhstan “On measures to fundamentally improve the system of implementation of state policy in the field of economic development” (January 10, 2019) also states that urbanization is an area at the level of state policy [12, 13].

According to them, the main tasks of radical improvement of urbanization processes include: In the implementation of a completely new housing policy, affordable housing is provided with engineering, transport and social infrastructures related to urbanization, especially for low- and middle-income families;

1) Guaranteeing the implementation of the right of ownership of land plots under residential and non-residential constructions;
2) Creating conditions for ensuring the movement of rural residents to cities;
3) Ensuring the well-being and employment of residents of large cities, establishing technological parks on the basis of higher educational institutions and scientific research institutes in the regions;
4) Use of foreign experiences in the management of medium-sized cities and development of service industries;
5) Expanding the network of new cities and satellite cities, expanding the territories of social and business zones;
6) Organization of the Urbanization Agency and Urbanization Development Fund under the Ministry of Economy and Industry;
7) Development of the concept of urbanization development in the Republic of Uzbekistan until 2030.

In the implementation of the absolutely new housing policy, it is important in New Uzbekistan to meet the geographic and social needs of the population, especially low- and middle-income families. We cannot forget that settlements built without taking into account the capabilities of the population, especially in the capital, have increased, and the creation of “elite areas and massifs” that took place during the autocracy created negative attitudes towards them in the population. For example, about half of the “elite massif” created near the Tashkent railway station is lying empty. You can see many such empty dwellings. You don't need an architect or a room-by-room study to notice this, and if you cross the street later, you won't see the lights on in the residences we’re referring to. Unfortunately, the level of utilization of housing funds in our country has not been scientifically studied, and even the authorities cannot say anything about it. The housing policy of the new Uzbekistan should eliminate such an unacceptable system built on open usury and even corruption. The way to do this is to build low-cost housing and massifs, and to provide low-interest loans to the population for housing construction.

In large and large cities, every square meter suitable for living is used efficiently. The experience of using undergrowth for cultural and household needs is common in

our country. However, the legal grounds for implementing this procedure on an official basis have not been created. For example, in 2017-2019, an effort was made to remove devices around multi-story buildings in our Republic. The "green house" created by improving abandoned lands were razed to the ground, the fruit trees, flower beds, and sidewalks that decorated the surroundings were destroyed. But instead, the government did not plant anything, as a result, those places were turned into garbage dumps. That is why the issue of legal guarantee of the use of land plots under the residential fund and constructions was raised in the above Decrees of the President.

Activation of rural population's use of urban opportunities and culture is an accelerating factor of urbanization. In urbanization, internal migration, i.e. the movement of rural people to cities, plays an important role and is included in the indicators of urbanization [14]. For example, about 1.5 million people come to Tashkent every day for various purposes. According to QROUNDSWELL, the World Bank, by 2050, the number of "climate migrants" related to weather, ecology, and water shortage in Central Asia will exceed 5 million. They mainly migrate to the Fergana oasis, the suburbs of Tashkent city and the regions of North Kazakhstan [16]. This movement requires the expansion of transport services and creates challenges for the use of urban infrastructures that meet the needs of migrants.

The inclusion of higher education institutions, scientific and technical centers, and the influx of rural youth into the processes of urbanization is one of the most urgent problems. It is also known from life observations that almost more than half of the young people who have received education in HEIs in big cities tend to stay in cities. This affects the city's infrastructure and territories, encourages a new, innovative perception of city life every time [15]. World urban planning and universal life and development are built on the basis of science, technology, and intellectual research. Ensures further activation of HEIs and research institutes. It is an objective necessity that new creative forces and young people enter them. Foreign experience shows that higher education institutions and research institutes in large cities are mainly formed by internal migrants and young people from non-urban areas [16]. But there is a negative side to this, these young people must first adapt to the urban environment and the requirements of the scientific community. This process is slow and sometimes very difficult, because young scientists from the periphery do not quickly and adequately absorb innovations in education.

Conclusions

The problem of urbanization is not only a national need and a demand for development, but it contains aspects of universal significance that contribute to global development. Researching them is primarily the task of social philosophy.

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STUDY OF PHYSICAL AND MECHANICAL PROPERTIES OF SOILS IN THE DESIGN AND CONSTRUCTION OF ENGINEERING STRUCTURES IN THE REPUBLIC OF UZBEKISTAN

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Annotatsiya. Ushbu maqolada O‘zbekiston Respublikasidagi muhandislik inshootlarini loyihalash va qurishda gruntlarning fizik va mexanik xossalarini o‘rganish bo‘yicha ma’lumotlar keltirilgan. Mamlakatimizning cho‘lli hududlaridagi ob’ektlarda olib borilgan tadqiqotlar natijasida sho‘rlangan gruntlar namlanganda va uzoq vaqt suv sizib o‘tganda mavjud inshootlarning amaldagi cho‘kishi loyihadagiga nisbatan 1,5-2,0 barobarga oshganligini ko‘rsatadi.

Kalit so‘zlar: *gruntlar, fizik - mexanik xossalar, mustahkamlik ko‘rsatkichlari, grunt tarkibi, grunt tasnifi.*

Аннотация. В данной статье представлена информация по изучению физико-механических свойств грунтов при проектировании и строительстве инженерных сооружений в Республике Узбекистан. В результате

исследований, проведенных на объектах в пустынных районах нашей страны, при увлажнении засоленных почв и длительном просачивании воды показано, что фактическая просадка существующих сооружений увеличилась в 1,5-2,0 раза.

Ключевые слова: *грунты, физико-механические свойства, показатели прочности, состав грунтов, классификатsiя грунтов.*

Abstract. This article This article provides information on the study of physical and mechanical properties of soils in the design and construction of engineering structures in the Republic of Uzbekistan. As a result of the research conducted in the facilities in the desert regions of our country, when the saline soils are moistened and the water seeps for a long time, it is shown that the actual subsidence of the existing structures has increased by 1,5-2,0 times compared to the project.

Keywords: *soils, physical-mechanical properties, strength indicators, soil composition, soil classification.*

Introduction

The composition, classification and strength of soils depend on their internal bonds, which are divided into 2 groups: crystalline and aqueous-colloidal bonds. *Crystalline bonds* - depending on the chemical composition of the soil, they are very weak, but brittle, they do not recover when broken. The strength of these bonds depends on the minerals. *Aqueous - colloidal bonds* - depending on the amount of water, can be more or less restored after breaking, are sticky, plastic, soft, reversible [1].

Construction of buildings and structures in our country is often carried out in complex engineering-geological conditions, especially in areas with saline soils. These soils cover numerous regions of Uzbekistan such as Bukhara, Jizzakh, Syrdarya, Fergana, Khorezm and large areas of the Republic of Karakalpakstan. In Uzbekistan, saline soils, which can be used as a basis for the construction of buildings and structures, consist of saline, saline, saline and bald soils, differing in the composition and amount of slightly soluble salts. They are often formed in the depressions of the relief: mountain slopes, lowlands, saline lake shores, cliffs, desert zones formed as a result of suffocation, mineralized waters close to the surface (1 - 3 m). The main factor in the formation of saline soils is the mineralized groundwater and saline rocks that lie close to the surface [2]. The main condition for salinization is the impossibility of water flow in places and the fact that the amount of evaporation is greater than the amount of precipitation.

Analysis of the existing literature on saline soils and experience in the design and construction of buildings and structures in different regions of the country, as well as special studies on saline soils show that changes in the composition, structure and physical and mechanical properties of substances during wetting and alkaline leaching. and this phenomenon needs to be taken into account in design work.

As a result of flooding and wetting of areas composed of saline soils, a number of major affects can occur in buildings and structures [3].

Soils are made up of fine particles. In nature, soils erode to form fine particles. The more fine particles in the soil, the higher its contact with the environment. Depending

on the type of substances in the soil, their strength varies, and soils consisting of fine particles consist of 3 parts: solid, liquid and gaseous.

Soils distributed in nature are divided into 4 classes according to their specific characteristics, based on their classification: the most common in nature, which serve as the foundation of the building, the internal bonding and bearing capacity: rocky soils, coarse-grained soils, sands, clay soils [4].

As a result of the treatment of water-saturated sandy soils, their balance is disturbed and their structure changes and becomes fluid, the movement in the sands is faster, because the water flows together inseparably from the sand.

The process in such sands is called coagulation. Sandy soils are loose soils and cannot retain their shape when subjected to force. The strength of loose soils depends on their density and moisture, and in the compacted state it is a loamy soil, otherwise it is a faulty soil [5, 6].

Literature Review

Existing guidelines and normative literature provide recommendations for determining the mechanical properties for saline soils with easy and moderately soluble salts, but the amount of difficult-to-dissolve salts is not taken into account. Studies suggest that in order to ensure the safe operation of buildings and structures built on saline soils, it is necessary to study the process of leaching of insoluble salts, especially when the mechanical properties of the soil are exposed to long-standing water. An experimental study of the laws of change of mechanical properties of water from saline soils over a long period of time. This is because the issues of assessing the change in the mechanical properties of saline soils in the long-term exposure to water to insoluble salts have not been fully studied. Many scientists have worked on engineering-geological research and their use. Including, M.D. Braja, G.P. David, W. Kuhn, B.G. Neal, A.R. Harutyunyan, I.L. Bartholomey, V.M. Bezruk, P.B. Babakhanov, A.A. Glaz, A.I. Grot, R.S.Ziangirov, N.P.Zatenatskaya, M.F.Yerusalimskaya, M.O.Karpushko, A.K.Kiyalbaнev, A.A.Kirillov, N.A.Klapatovskaya, Yu.V.Kuznetsov, A.D. Kayumov, T.Kh. Qalandarov, S.S. Mordovich and many scientists [7]. The following scientists also studied the deformation and strength parameters of soils containing ocon and moderately soluble salts: Bezruk B.I., Glaz A.A., Dolmatov B.I., Lomize L.N., Povilonckiy V.M., Petrukhin V.P., Rozhdectvenckiy E.D., Ukhov C.B., Chokhonelidze G.N., Shulginoy V.P. and others. In 1983, V. M. Bezruk developed classifications of saline soils for the construction of buildings and structures [8]. The specificity of this classification is as follows: the amount of salts in the ground is taken into account starting from 0.3%, in which salinity is divided into two types: 1) chlorinated and chlorinated-chlorinated; 2) saturated, chloride-saturated and coda salinity. V.P. Petrukhin developed a classification in which the minimum amount of water-soluble salts depends on the density of soils in accordance with the design goals of civil and commercial buildings and constructions [9, 10].

Research Methodology

Based on the task set and the results of previous research, the methodological part of the experiment was based on the following laws:

- In the process of interaction of ground distilled water with water, its structure changes as the amount of soluble salts in the water decreases.
- Changes in soil structure during alkali washing lead to a decrease in strength and an increase in deformation (additional suffocation subsidence).
- Changes in the composition and volume of salts in the soil can affect the water-physical properties of soils, in particular, the composition of the microaggregate, plasticity parameters, viscosity, etc. After the initial grunt was thoroughly examined, the diffuser or filter lye was rinsed.

When designing and constructing structures, it is necessary to determine the composition of the soil. The composition of the soil ensures the strength of the foundation. As a result of research, the distribution, composition and properties of soils in nature were determined. In nature, soils are made up of fragments, grains, and particles, the size of which affects the strength of the soil. The ratio of the amount of fraction in the soil to the total weight of the soil is called the granulometric composition of the soil. Fractions are soil grains of the same size and properties. Different fractions occur in the composition of soils. The gravel fraction is 2 mm to 70 mm, the sand fraction is 2 to 0.05 mm, the dust fraction is 0.05 to 0.005 mm, and the gill fraction is <0.005 mm. In the laboratory, the aqueous properties of soils, foaming, coagulation, water permeability, viscosity, volume reduction, capillary height were determined.

Viscosity is the property of soils to adhere to objects. This quantity is measured in g/cm^3 and is measured by the force applied to separate the body from the ground. Viscosity is also characteristic of clay particles in the soil and some dust particles, which occur in the wet state of the soil. The multiplicity property is determined in the A. M. Vasilev instrument.

Most soils are said to expand under the influence of water. This property occurs when particles are saturated with water and is defined by the following expression:

$$\Delta V = \frac{h_1 - h}{h} \cdot 100\% \qquad (1)$$

here: h - sample height at natural humidity, mm; h_1 - the height of the sample after multiplication, mm; if δ larger than 0,04, the soil is foamy. The more montmorillonite in clay soils, the more it will accumulate.

Shrinkage of soils is the opposite of multiplication, which occurs when the soil loses moisture, ie when the water in it evaporates or is absorbed through the roots of the plant. As the volume decreases, cracks appear on the surface of the soil in nature, and the properties of the soil change. Soil Capillary - Dust particles in clay soils form capillary pores. With the help of these capillaries, water rises to the surface. For example: in lyoss the capillary reaches 3 meters.

The scale of the relationship between the subsidence rates of soil particles and their diameters is given in Table 1, and their values are given by Stokes, Sabanin, and Atterberg. The ability of water to rise above the surface of groundwater determines their capillary properties. Capillary properties depend on capillary velocity and capillary height. Capillary height is a quantity that depends on the granular composition of the soil, water temperature, soil density. In soils with a lot of dust grains, the capillary height is higher.

Table 1. The rate at which particles sink in water is between their diameters dependency scale.

Particle sinking speed, sm/s	Time taken to sink 1 sm	The diameter of the particles, mm		
		According to Stokes	According to Sabanin	According to Atterberg
0,2	5 seconds	0,05	0,05	0,06
0,022	45 seconds	0,0168	-	0,02
0,02	50 seconds	0,0156	0,01	-
0,0028	6 minutes	0,0053	-	0,006
0,000046	36 minutes	0,0023	0,005	-
0,00036	48 minutes	0,002	-	0,002

Analysis and Results

The device for determining the capillary properties consists of a glass tube, a funnel, a phosphor vessel. The glass was gradually compacted by gradually priming the pipe through a funnel. The tube was attached to a tripod and lowered into a container of water. In all given classifications of saline dicperc soils, only ocon and moderately soluble salts are taken into account. However, when using man-made solutions, it is necessary to include some carbonaceous powdery soils among the saline soils. The surface of the water in the glass container should be constant during the experiment, ie when the water level decreases, the water should be poured. Soil coagulation. Any soil that serves as the base of a structure behaves differently in water. Some soils dissolve quickly in water, while others retain their integrity for a long time. Soils When soils are submerged in water, some will break into pieces and some will disperse into the water as dust. This is determined using a PR tool, and it is necessary to determine this feature in the construction of structures (dams, bridges) where the soil is exposed to water. The water permeability coefficient of the soil was determined using a spesgeo instrument. The Spesgeo device consists of a metal tube, a mesh base, a metal tube top, and a glass tube divided into levels.

When clay soils are submerged, some species are completely scattered, some are partially scattered, and other species remain intact for a long time. For this reason, soils are divided into water-resistant, low-resistance and relatively resistant types depending on their behavior in the water. An example of a water-resistant soil is lyossimon suglinok. By immersing it in water, it breaks down into particles. Sea clay is an example of resistant soils.

Conclusions

Our research has shown that the longevity of a foundation depends on the strength of the soil. The strength of soils is only equal to the soft bond strength in them, and the value of the load at a given value of moisture is not taken into account. There are 2 different methods of testing: compression test method (laboratory method) and field stamping method.

In compression, vertical compression of the soils without expanding to the side under force was found. Soil was cut from the sample into the ring, and the degree of compression under different forces (P = 2 kg, 4 kg, 6 kg) was determined on a compression device. A study conducted to study their salinity characteristics and the degree of salinity associated with the amount of initial plaster and the degree of salt leaching during prolonged exposure to water based on salt gratings of buildings and

structures allows us to draw the following conclusion. Salts of complex soil, in particular, when water enters the mush with which the plaster is salted for a long time, give them a description of the consistency and amount of salt in them, that is, the degree of salinity decreases, which in turn leads to a decrease in the stagnation of the foundation of buildings and structures and additional deposition. Before designing buildings and structures, it is necessary to determine the initial salinity and solubility of salt - the degree of alkalinity and, accordingly, the salinity characteristics, as well as the degree of salt leaching - the initial salinity of the salty soil of the area in depth.

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USING FUZZY LOGIC AND LINEAR REGRESSION TO ANALYZE LEADERSHIP QUALITIES IN MAHALLAS

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Annotatsiya. Ushbu tadqiqot metatizimlar, ichki imkoniyatlar va turli xil qarorlar qabul qilish shartlari ta’sirida asosiy ijtimoiy guruh tuzilmasi bo‘lgan mahalla assambleyalari (MA) ichidagi jarayonlarni rasmiylashtirishni o‘rganadi. Tadqiqot etakchilikni baholash mexanizmlarini tushunish va yaxshilash uchun funktsional matematik modellardan foydalangan holda statik, dinamik va noaniq muhitlarni o‘rganadi. Mahalliy boshqaruvning muhim elementi bo‘lgan mahalla rahbarlarining yetakchilik fazilatlarini baholash uchun loyqa mantiq va chiziqli regressiyani qo‘llash markaziy o‘rin tutadi. Ijtimoiy ma’lumotlarga xos noaniqlikni bartaraf etish orqali ushbu tadqiqot jamoatchilik fikrini tahlil qilish va so‘rov javoblari asosida etakchilik samaradorligini aniqlash uchun mustahkam asosni taklif etadi. Metodologiya ma’lumotlarni normallashtirish, uchburchak loyqa raqamlar orqali reytinglarni taqdim etish va loyqa regressiya modellarini qurishni o‘z ichiga oladi. Ushbu usullar sub’ektiv va noaniq ma’lumotlarni har tomonlama tahlil qilish imkonini beradi va an’anaviy chiziqli regressiya ko‘pincha e’tibordan chetda qoladigan nozik tushunchalarni beradi. Dinamik modellashtirish MA ning vaqtinchalik faoliyati va xatti-harakatlarini yanada aks ettiradi, bu esa etakchilik va ijtimoiy boshqaruv harakatlariga asoslangan qarorlar qabul qilish imkonini beradi. Topilmalar ma’lumotlarning o‘zgaruvchanligini

qo‘lga kiritish, muhim ishlash mezonlarini aniqlash va jamoa etakchilik amaliyotini takomillashtirishda loyqa mantiqning ahamiyatini ta’kidlaydi. Bundan tashqari, dinamik modellar strategik qarorlar qabul qilish uchun amaliy vositalarni taklif qilib, ijtimoiy guruh evolyutsiyasining uzoq muddatli prognozlariga hissa qo‘shadi.

Kalit so‘zlar: *boshqaruv jarayoni, modellashtirish, matematik mantiq, ma’lumotlardagi noaniqlik, ekspert, loyqa mantiq, dinamik model.*

Аннотация. Это исследование углубляется в формализацию процессов в собраниях соседей (NAs), ключевой структуре социальной группы, под влиянием метасистем, внутренних возможностей и различных условий принятия решений. Исследование изучает статические, динамические и неопределенные среды с использованием функциональных математических моделей для понимания и улучшения механизмов оценки лидерства. Основное внимание уделяется применению нечеткой логики и линейной регрессии для оценки лидерских качеств лидеров махалли, важнейшего элемента местного управления. Рассматривая присущую социальным данным неопределенность, это исследование предлагает надежную основу для анализа общественного мнения и определения эффективности лидерства на основе ответов на опросы. Методология включает нормализацию данных, представление рейтингов с помощью треугольных нечетких чисел и построение нечетких регрессионных моделей. Эти методы позволяют проводить всесторонний анализ субъективных и неточных данных, предоставляя тонкие идеи, которые традиционная линейная регрессия часто упускает из виду. Динамическое моделирование дополнительно отражает временную активность и поведение NAs, позволяя принимать обоснованные решения о лидерстве и действиях по социальному управлению. Результаты подчеркивают ценность нечеткой логики в фиксации изменчивости данных, определении критических критериев эффективности и улучшении практик руководства сообществами. Более того, динамические модели способствуют долгосрочному прогнозированию эволюции социальных групп, предлагая практические инструменты для принятия стратегических решений.

Ключевые слова: *процесс управления, моделирование, математическая логика, неопределенность в данных, эксперт, нечеткая логика, динамическая модель.*

Abstract. This study delves into the formalization of processes within neighborhood assemblies (NAs), a key social group structure, under the influence of metasystems, internal capabilities, and varying decision-making conditions. The research investigates static, dynamic, and uncertain environments using functional mathematical models to understand and enhance leadership assessment mechanisms. The central focus is the application of fuzzy logic and linear regression to evaluate the leadership qualities of mahalla leaders, a critical element of local governance. By addressing the inherent uncertainty in social data, this study offers a robust framework for analyzing public opinion and identifying

leadership effectiveness based on survey responses. The methodology includes data normalization, the representation of ratings through triangular fuzzy numbers, and the construction of fuzzy regression models. These techniques allow for the comprehensive analysis of subjective and imprecise data, providing nuanced insights that traditional linear regression often overlooks. Dynamic modeling further reflects the temporal activity and behavior of NAs, enabling informed decisions on leadership and social management actions. The findings underscore the value of fuzzy logic in capturing data variability, identifying critical performance criteria, and improving community leadership practices. Moreover, dynamic models contribute to long-term predictions of social group evolution, offering practical tools for strategic decision-making.

Keywords: *management process, modeling, mathematical logic, uncertainty in data, expert, fuzzy logic, dynamic model.*

Introduction

Management decision-making is one of the topical issues today, in the market economy, because for the effective and smooth operation of any organization, it is necessary to make management decisions correctly and on time. Nowadays, decision-makers are increasingly based on the analysis of data in a given situation and are moving away from making decisions based on intuition. Mathematical formalization of decision-making processes in order to improve the perfection of management decisions, including a list of activities, methods of implementation, deadlines and limits of specified actions, the range of performers, as well as in the assessment of work activities of groups and employees in executive authorities based on planned results and their evaluation criteria, forecasting, we believe that it is appropriate to use mathematical modeling methods in the process of hiring such employees.

Research Methodology

It is considered appropriate to use scientific and practical work to find effective solutions to complex problems in social groups, systematic analysis, action research, methods of artificial logic theory in the conditions of uncertainty, ambiguous views of information. These methods are based on mathematical modeling methods. So, as an object, in studying, analyzing and determining the processes of social processes (neighbourhood assembly - NA), if it is carried out according to A.N. Tikhonov's methodology, it is possible to achieve a clear result (as given in Figure 1) [1].

Analysis and Results

Modern methods for assessing the work of community leaders require integrating both quantitative and qualitative data. Fuzzy logic provides tools for processing data characterized by uncertainty, which is especially important when analyzing social interactions. This study examines the application of fuzzy logic and linear regression to evaluate leadership qualities in mahallas based on public survey data.

The social group-NA that we are studying does not conduct its activity in a static way, but in a dynamic time-dependent way. Therefore, formalization of NA activity in the method of dynamic modeling is required. Dynamic modeling – reflects the activity and behavior of the object, that is, the NA, in a time interval. In dynamic models, it is

possible to reflect, analyze and make decisions on actions and processes in the conditions of management of social groups. The time factor is clearly manifested, for example, with the help of extrapolation methods, it is possible to predict the long-term development of a social group based on previous events and processes. Therefore, dynamic modeling can be used as a basis for evaluating and comparing the activity of social groups and its management efficiency. It is possible to recommend the use of a dynamic model for grouping the activities of social groups (as shown Figure 2) [1-3].

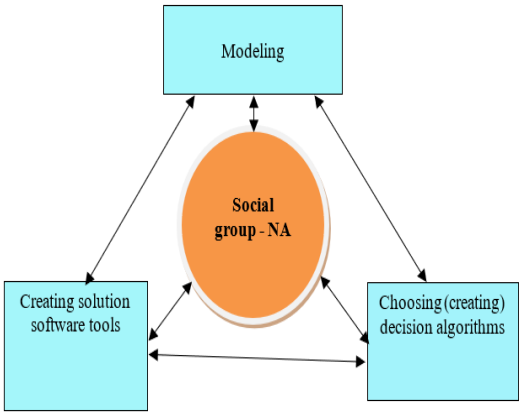


Figure 1. Methodology of object activity analysis.

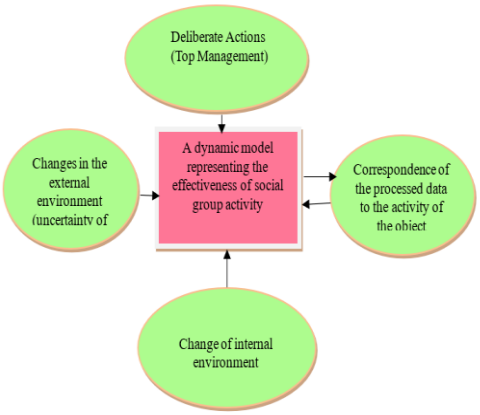


Figure 2. A dynamic model representing the activity of social group-NA.

This model monitors the necessary changes in the managed social group-NA under the influence of the purposeful measures adopted in the management process (by higher organizations), as well as under the real influence of the internal and external environment (data). A characteristic feature of dynamic information reflecting social group-NA activity is that regardless of the initial state and the initial solution, all subsequent decisions are reflected in the results of the previous solution [4].

The social group-NA time-dependent model can be used from the well-known French sociologist Michel Krauze's "Organization model - model of conflicts " [5]. In his many years of research, Michel Krauze researched the methods and ways of evaluating and predicting events, processes, and the interactions of the organization's main staff and groups. His attention is focused mainly on the study of management and decision-making processes in bureaucratic organizations. The conflict model of decision-making takes into account the following, that is, the adoption of important decisions is closely connected with the emotions of a person, a specialist, such as hatred, fear, envy, anger and, above all, stress.

It was believed that stress should be moderate for effective behavior of the decision maker. "Organizational model - model of conflicts" helps to fully understand the characteristics of the processes of making management decisions at the facility, because [5]:

1. In groups, social group-NA, management decisions are always made in the process of uncertainty. The source of uncertainties can be not only the external environment, but also objective and subjective changes in the behavior of social group-NA participants who strive for their goals and try to improve the situation (internal environment).

2. Managers try to use "programming, identification, pre-prepared typical modules" as much as possible for management decisions in order to increase management efficiency and reduce dependence on specialists who control the main uncertainties affecting the social group-NA.

3. Executives, subordinate organizations, and social groups strive to maintain freedom in decision-making and resist the bureaucratic pressure of managers.

4. In order to balance the competence of experts in the social group-NA in the organization, executives deliberately limit the information intended for managers, which creates the need for decision-making in conditions of uncertainty, and therefore strengthens the authority of experts who have complete, reliable information.

Adoption of management solutions in conditions of uncertainty is one of the most difficult components of social group work (manager). It doesn't matter how many managers there are or how skilled they are in running the organization. An economic crisis or an unstable (abnormal) situation in the market is always considered a serious problem for business and social group. Therefore, the task of the head of the social group-NA is to minimize the negative consequences of any solution (decision) using the most effective methods.

Key Areas of Focus in the Research

1. Assessing the Work of Mahalla Leaders

The primary objective of the research is to evaluate the leadership effectiveness of mahalla chairpersons, youth leaders, and social coordinators. These individuals play pivotal roles in managing local communities, fostering social harmony, and addressing residents' needs. Assessing their performance requires a comprehensive approach that accounts for the varied responsibilities they undertake. This includes mediating disputes, organizing community events, supporting vulnerable groups, and maintaining overall social cohesion. The study employs public survey data as a foundational element to gauge their effectiveness in these roles, focusing on both quantitative and qualitative indicators.

2. Application of Mathematical Methods

To ensure an accurate analysis of leadership performance, the research incorporates advanced mathematical techniques, particularly fuzzy set theory. Fuzzy logic is well-suited for handling the inherent uncertainty and subjectivity of social data, such as public opinions and perceptions. By using fuzzy models, the research can better interpret imprecise data, which often characterizes community feedback. This approach enhances the reliability of assessments, enabling more nuanced evaluations that traditional methods might overlook.

3. Identifying Key Evaluation Criteria

Another critical focus of the study is the identification of key performance indicators (KPIs) that are most relevant for evaluating mahalla leaders. These KPIs provide a structured framework for assessment, covering areas such as transparency, problem-solving efficiency, communication with residents, and responsiveness to community needs. By determining the most impactful criteria, the research ensures that evaluations are aligned with the priorities and expectations of the community, offering actionable insights for improving leadership practices.

This comprehensive approach not only facilitates a deeper understanding of leadership effectiveness but also provides a replicable methodology for assessing similar roles in other social structures.

Data Normalization. Survey data is converted into numerical values ranging from 0 to 1 using the normalization formula:

$$x_{norm} = \frac{x - x_{min}}{x_{max} - x_{min}}$$

1. Each survey participant's rating is represented as a triangular fuzzy number (α,β,γ)(\alpha, \beta, \gamma)(α,β,γ), where:
   - α\alphaα — the lower bound,
   - β\betaβ — the modal value,
   - γ\gammaγ — the upper bound.

Example Mapping:

Rating	Numerical Value	Triangular Number (α,β,γ)
Excellent (5)	5	(0.8, 1.0, 1.0)
Good (4)	4	(0.6, 0.75,0.8)
Satisfactory (3)	3	(0.4, 0.5, 0.6)
Unsatisfactory (2)	2	(0.2, 0.25,0.4)
Completely Unsatisfactory (1)	1	(0, 0, 0.2)

Model Construction. Fuzzy Linear Regression:

The fuzzy linear regression model is constructed to incorporate the inherent uncertainty in subjective and imprecise data, such as social feedback. The model is expressed as:

$$Y = A_0 + A_1X_1 + A_2X_2 + \cdots + A_nX_n,$$

where:

- $A_i = (\alpha_i, \beta_i, \gamma_i)$ are fuzzy coefficients, represented as triangular fuzzy numbers. Each coefficient includes:
- α_i: the lower bound,
- β_i: the most likely (modal) value,
- γ_i: the upper bound.
- X_i are normalized ratings, which are also represented as fuzzy numbers.

Objective. The primary objectives of this fuzzy linear regression approach are:

1. Minimizing Uncertainty: The difference between the upper (γ) and lower (α) bounds (γ - α) is minimized to reduce the imprecision in the model.

2. Ensuring Observed Values Fit Predicted Intervals: The observed values (Y_j) must fall within the predicted fuzzy intervals ($Y_j^{predicted}$). This ensures the model remains consistent with the observed data, accounting for its inherent uncertainty.

Defuzzification. To interpret the predicted fuzzy values as precise (crisp) outputs, defuzzification is performed using the center of gravity formula:

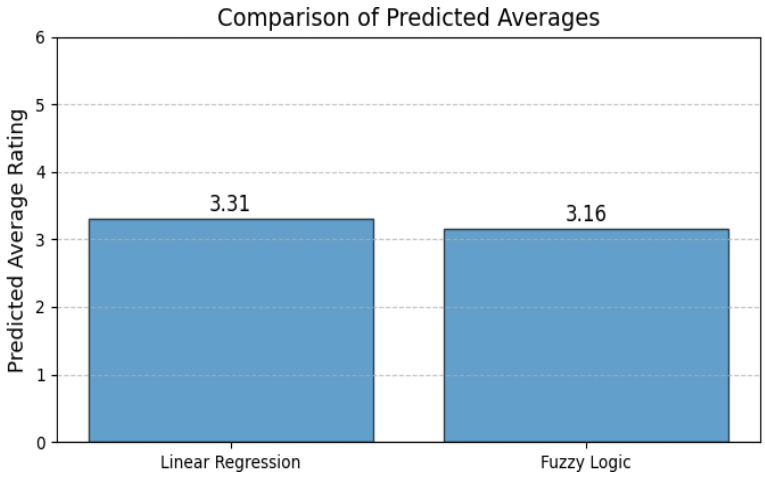
$$Y_j = (\alpha_j + \beta_j + \gamma_j) / 3.$$

This formula calculates a single crisp value for each prediction by averaging the bounds and modal value of the fuzzy output. This step simplifies the fuzzy output while retaining the model's insights, enabling comparisons and practical interpretations.

Comparison of Methods. Results:

Fuzzy Logic	3.1598
Linear Regression	3.3125

Interpretation of Results. Linear Regression:



Predicted a higher average value (3.3125), possibly reflecting a tendency to "smooth out" data without accounting for variability.

This approach is less sensitive to data uncertainty and may overestimate results when data has significant fuzziness or subjectivity.

Fuzzy Logic:

A result closer to reality under conditions of high data uncertainty (3.1598), as the method accounts for the variability and fuzziness of ratings.

Fuzzy logic provides a more adaptive approach, particularly when data has a subjective or uncertain nature.

Conclusions

The findings of this research highlight the effectiveness of fuzzy logic in processing uncertain and subjective social data. While linear regression provides a straightforward method for analyzing structured data, its limitations become evident when handling variabilities and ambiguities common in social assessments. Fuzzy logic, on the other hand, accommodates these uncertainties, delivering results that are both adaptive and closer to reality. The comparative analysis shows that fuzzy logic better captures the nuances of public opinion and leadership performance in mahallas. This methodology not only identifies areas of improvement for community leaders but also offers a robust framework for assessing leadership qualities in other social contexts. Future studies can further explore hybrid approaches, integrating fuzzy logic with traditional models, to enhance the accuracy and applicability of leadership evaluation tools.

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ACTUAL PROBLEMS OF MATHEMATICS, PHYSICS AND MECHANICS

UDC:53, 533, 533.9

OPTIMIZATION OF CORONA PLASMA REACTOR FOR ENHANCED ENVIRONMENTAL AND ENERGY APPLICATIONS

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Annotatsiya. Ushbu tadqiqotda plazma reaktorining ishlashi o‘rganildi, hamda monolit o‘lchami, ishchi gazdagi suvning miqdori va harorat kabi asosiy parametrlarga e'tibor qaratildi. Eksperimental tadqiqotlar reaktor geometriyasi va ish sharoitlarining istemol quvvati, sig‘im va gaz oqimi tezligini optimallashtirishdagi muhim ro‘lini ochib beradi. Muhim natijalar monolit hajmi va suv tarkibining plazma generatsiyasiga va energiya zichligiga ta’sirini o‘z ichiga oladi. Tajriba natijalari amaliyotda qo‘llash mumkin bo‘lgani uchun plazma reaktorlarining dizayni va ishlashi haqida qimmatli tushunchalarni beradi.

Kalit so‘zlar: *Sovuq plazma, ishchi gaz, oqim darajasi, namlik, energiya zichligi, honeycomb monolit, sig’im.*

Аннотация. В этом исследовании исследуются эксплуатационные характеристики сотового плазменного реактора с упором на ключевые параметры, такие как размер монолита, содержание воды в исходном газе и температура. Экспериментальные исследования выявляют критическую роль геометрии реактора и условий эксплуатации в оптимизации мощности разряда, емкости и расхода газа. Среди примечательных результатов — влияние размера монолита и содержания воды на производительность плазмы и плотность энергии. Результаты дают ценную информацию о конструкции и работе плазменных реакторов для масштабируемых приложений.

Ключевые слова: *Холодная плазма, исходный газ, расход, содержание воды, плотность энергии, сотовый монолит, емкость.*

Abstract. This study explores the performance of honeycomb plasma reactor, focusing on key parameters such as monolith size, feed gas water content, and temperature. The experimental investigations reveal the critical role of reactor geometry and operational conditions in optimizing discharge power, capacitance, and gas flow rate. Notable findings include the influence of monolith size and water content on plasma performance and energy density. The results provide valuable insights into the design and operation of plasma reactors for scalable applications.

Keywords: *Cold plasma, feed gas, flow rate, water content, energy density, honeycomb monolith, capacitance.*

Introduction

Cold plasma technology has established itself as an innovative approach to addressing critical environmental and energy challenges. Unlike its thermal counterpart, cold plasma operates at near-room temperatures, making it highly adaptable and ideal for processes involving materials sensitive to heat. The technology utilizes partially ionized gases to produce reactive species, including ions, radicals, and excited molecules, which can effectively drive chemical reactions without the need for excessive thermal energy [1-6].

Honeycomb plasma reactors, in particular, have garnered attention for their ability to enhance interactions between plasma and catalysts. These reactors employ honeycomb-structured monoliths, which provide a large surface area and defined channels that facilitate plasma propagation. By refining reactor designs and optimizing operational parameters—such as monolith size, feed gas composition, and temperature-cold plasma applications can achieve superior efficiency and scalability [7-9].

This study examines the performance of honeycomb plasma reactor, focusing on key variables such as monolith size, water content in the feed gas, and temperature. The research seeks to address knowledge gaps in plasma-catalyst systems and offers practical insights for the development of scalable, high-efficiency technologies in environmental and energy applications.

Research Methodology

Reactor Design and Setup. The experiments utilized a sandwich-type honeycomb plasma reactor constructed with a cordierite monolith measuring 50 mm in length, 93 mm in diameter. The reactor employed custom-made stainless-steel perforated electrodes with 169 evenly spaced holes for gas distribution. Plasma was generated using a high-voltage AC signal at 400 Hz, supplied by a frequency power source and transformer.

Operational Conditions. Humidified air was used as the feed gas, with flow rates controlled via ball flow meters. The air was preheated to maintain consistent inlet temperatures using a forced convection oven. Electrical parameters were monitored

using a digital oscilloscope equipped with high-voltage probes and current transformers.

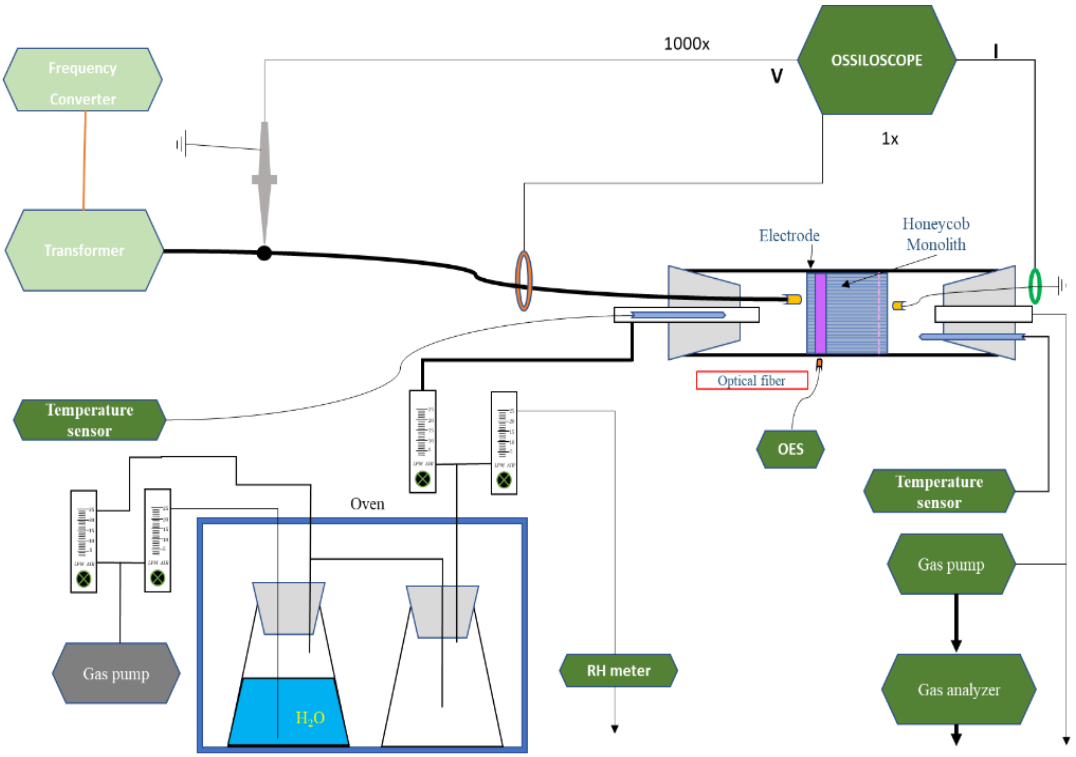

Figure 1. Schematic diagram of the experimental setup.

Measurement Techniques. Gas compositions were analyzed at the reactor outlet using a gas analyzer and gas detector tubes. Capacitance measurements were conducted under atmospheric conditions at a 400 Hz frequency. Discharge power was calculated by integrating instantaneous voltage and current values.

Analysis and Results

Effect of Ambient Temperature. Feed gas temperature significantly influenced monolith capacitance. Figure 2 illustrates the effect of feed gas temperature on the capacitance of the honeycomb plasma reactor.

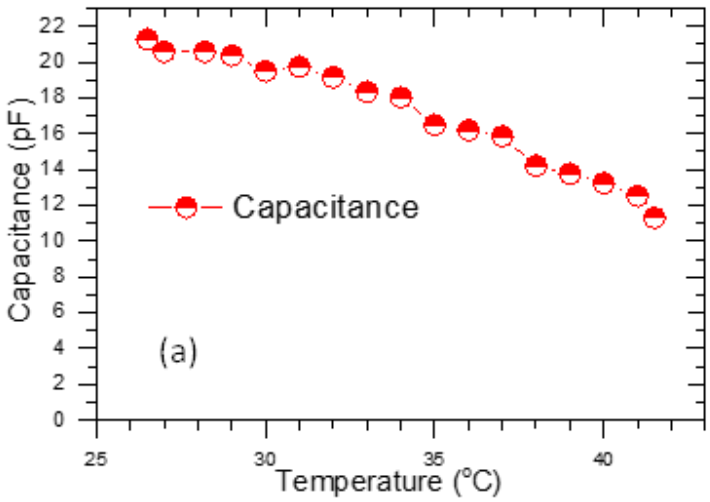

Figure 2. Influence of feed gas temperature on the monolith capacitance without plasma discharge at a fixed applied voltage of 30 kV.

As the temperature increases, the capacitance of the reactor exhibits a clear declining trend. This behavior indicates that higher temperatures reduce the reactor's dielectric properties, potentially due to surface evaporation or changes in the humidity of the monolith material. This result highlights the importance of temperature control in optimizing the performance of honeycomb plasma reactors.

Influence of Honeycomb Monolith. The honeycomb monolith enhanced plasma propagation by providing a high-dielectric-constant pathway for discharges. Plasma formation extended across the monolith channels, significantly increasing discharge power and capacitance compared to setups without the monolith. The figure 3 shows the design and components of a honeycomb corona plasma reactor. The combined design of these components ensures optimized plasma-catalyst interactions, uniform gas flow, and scalability, making the honeycomb corona reactor effective for environmental and energy applications.

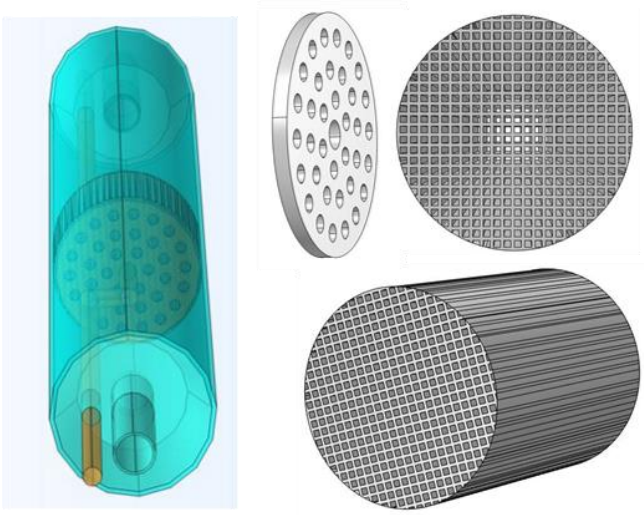

Figure 3. Configuration of honeycomb corona plasma reactor.

Role of Water Content. Water vapor content in the feed gas positively impacted plasma performance. Energy density increased with increasing water content in the feed gas and smaller monolith diameters (50 mm) outperforming larger ones (100 mm). This result can be explained that large energy density for smaller monoliths due to enhanced electric field concentration.

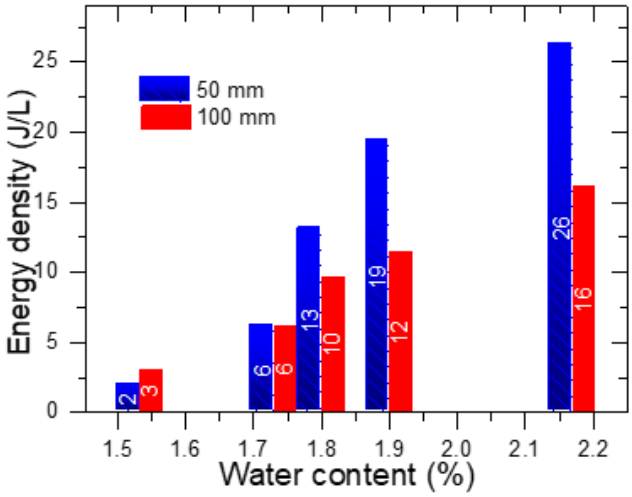

Figure 4. Effect of water vapor content on the energy density.

Gas Flow Rate Impact. Higher gas flow rates required increased applied voltage to sustain plasma, emphasizing the importance of optimizing flow rates to balance energy efficiency and plasma density. Higher flow rates supported stronger plasma fields, enhancing reaction rates for pollutant removal.

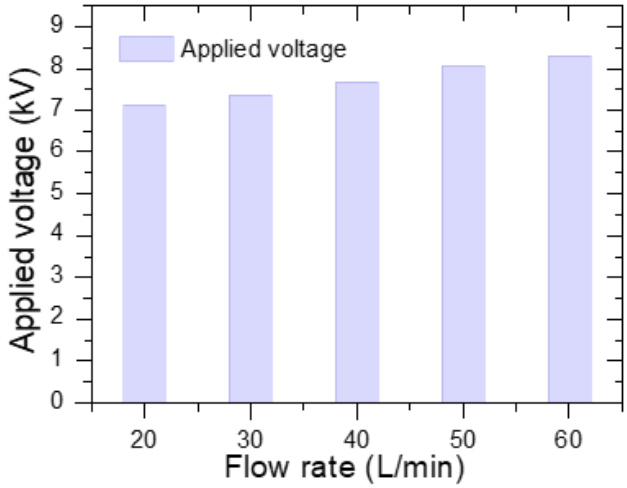

Figure 5. Applied voltage as a function of gas flow rate (maintaining 25 J/L SEI).

Conclusions

This study demonstrates the critical role of operational parameters and reactor design in enhancing honeycomb plasma reactor performance.

Key findings include:

- Feed gas temperature is play important role on reactor capacitance.
- Larger monoliths reduce energy density.
- Water content enhances plasma activity, increasing capacitance.
- Gas flow rate optimization is vital for achieving energy-efficient plasma discharges.

These insights contribute to the development of scalable, high-performance plasma reactors for environmental and energy applications.

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UDC:532, 532.5

PULSATING FLOW OF ELASTIC VISCOUS FLUID IN A FLAT CHANNEL WITH CONDUCTIVE WALLS

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Annotatsiya. Ushbu maqolada suyuqliklarning reologik qonuniyatlaridan foydalanib suyuqlik harakat tenglamalari keltirilgan. Harakat tenglamalari chegaraviy shartlardan foydalanib yechilgan. Devori o‘tkazuvchi quvurlarda suyuqliklar harakati uchun zarur effektlar olingan. Olingan effektlarda puls to‘lqini tarqalish tezligi va to‘lqin so‘nishi tahlil qilingan.

Kalit so‘zlar: *Gidrodinamik jarayon, Nyuton suyuqligi, nonyuton suyuqligi, elastik qovushoq suyuqlik, pulslanuvchi oqim, statsionar holat, puls to‘lqini, to‘lqin so‘nishi.*

Аннотация. В этой статье приведены уравнения движения жидкости с использованием реологических закономерностей жидкости. Уравнения движения решены с использованием граничных условий. Получены эффекты, необходимые для движения жидкостей в трубах с проницаемыми стенками. В полученных эффектах проанализированы скорость распространения пульсовой волны и затухание волны.

Ключевые слова: *Гидродинамический процесс, Жидкость Ньютона, жидкость не-ньютона, упругая вязкая жидкость, пульсирующий поток, стационарное состояние, пульсовая волна, затухание волны.*

Abstract. In this article, the equations of fluid motion are given using the rheological laws of the fluid. The equations of motion are solved using boundary conditions. The effects necessary for the movement of liquids in pipes with permeable walls were obtained. In the obtained effects, the pulse wave propagation speed and wave attenuation were analyzed.

Keywords: *Hydrodynamic process, Newton fluid, non-Newton fluid, viscoelastic fluid, pulsating flow, stationary state, pulse wave, wave attenuation.*

Introduction

When studying hydrodynamic processes, the medium under consideration is considered continuous, even if it is molecularly discontinuous. Based on this hypothesis, the main differential equations of fluid motion are derived [1-4]. These equations consist of equations based on the law of conservation of mass and amount of motion of liquids. Equations based on the conservation of mass are defined equally for Newtonian and non-Newtonian fluids, while equations based on the conservation of momentum are not defined equally for Newtonian and non-Newtonian fluids [5-9]. Because for these liquids, the rheological equations of the fluid, which determine the relationship between the voltage and the velocity of the fluid's shear strain, are not the same. Therefore, if for Newtonian fluids the law determining the relationship between stress and the speed of fluid shear strain is Newton's law, then for non-Newtonian fluids this law is determined on the basis of a law that differs from Newton's law depending on the rheological properties of the fluids [10-13]. The main differential equations of fluid motion are defined in the form of "stresses," while the rheological equations of non-Newtonian fluids are presented for viscoelastic fluids [14, 15]. These equations are systematized together to form differential equations of motion for viscoelastic fluids.

Research Methodology

Solve the following differential equation for pulsating flows of elastic viscous fluids:

$$\frac{\partial^2 u_1}{\partial y^2} - \frac{\rho i\omega}{\bar{\eta}(i\omega)} u_1 = \frac{1}{\bar{\eta}(i\omega)} \frac{\partial p_1(x)}{\partial x}. \quad (1)$$

The boundary conditions of the problem are obtained as follows:

$$y = h \text{at} u_1 = 0, \upsilon_1 = \frac{h\gamma^*}{\eta}(p_1 - p_c), y = 0 \text{at} \frac{\partial u_1}{\partial y} = 0, \upsilon_1 = 0,$$

$$x = 0 \text{at} p_1 = p_1^0, x = L \text{at} p_1 = p_1^L. \quad (2)$$

Solving equation (1) using condition (2), we obtain the following expression:

$$u_1(x,y,t) = \frac{h^2}{\eta}\left(-\frac{\partial p_1(x)}{\partial x}\right)\left[real\left[\frac{1}{i\alpha_0^2}\left(1 - \frac{cos\left(i^{\frac{3}{2}}\alpha_0\left(\frac{1}{\eta^*(i\omega)}\right)^{\frac{1}{2}}\frac{y}{h}\right)}{cos\left(i^{\frac{3}{2}}\alpha_0\left(\frac{1}{\eta^*(i\omega)}\right)^{\frac{1}{2}}\right)}\right)e^{i\omega t}\right]\right]. \quad (3)$$

As a result of dividing the resulting solution (3) for the velocity by its maximum velocity in the stationary state, a dimensionless solution of the form is found:

$$\frac{u_1(x,y,t)}{u_1^0{}_{max}\frac{\partial \bar{p}_1(x)}{\partial x}\left[\frac{1}{i\alpha_0^2}\left(1 - \frac{cos\left(i^{\frac{3}{2}}\alpha_0\left(\frac{1}{\eta^*(i\omega)}\right)^{\frac{1}{2}}\frac{y}{h}\right)}{cos\left(i^{\frac{3}{2}}\alpha_0\left(\frac{1}{\eta^*(i\omega)}\right)^{\frac{1}{2}}\right)}\right)e^{i\omega t}\right]} \quad (4)$$

By integrating both sides of the formula (4) found for velocity distribution from $-h$ to h with respect to y and dividing it by $2h$ the following formula for the average velocity of the fluid was obtained:

$$< \bar{u}_1(x,t) >= \frac{< u_1(x,t) >}{< u_1^0 >} = 3\left(-\frac{\partial \bar{p}_1(x)}{\partial x}\right).$$

$$\cdot real\left[\frac{1}{i\alpha_0^2}\left(1-\frac{sin\left(i^{\frac{3}{2}}\alpha_0\left(\frac{1}{\eta^*(i\omega)}^{\frac{1}{2}}\right)\right)}{\left(i^{\frac{3}{2}}\alpha_0\left(\frac{1}{\eta^*(i\omega)}^{\frac{1}{2}}\right)\right)cos\left(i^{\frac{3}{2}}\alpha_0\left(\frac{1}{\eta^*(i\omega)}^{\frac{1}{2}}\right)\right)}\right)e^{i\omega t}\right]. \quad (5)$$

Using the relationships between the average velocity and the pressure gradient using the found formulas, we construct the following system of equations to determine their changes along the longitudinal axis:

$$\begin{cases}\frac{\partial\bar{p}_1(x)}{\partial x}=-\bar{z}<\bar{u}_1(x)>,\\ \frac{\partial<\bar{u}_1(x)>}{\partial x}=-k\bar{p}_1(x).\end{cases} \quad (6)$$

Solving these equations, we get the following solutions:

$$\bar{p}_1(x)=p_1^0\frac{sh\sqrt{\bar{k}\bar{z}_0}L\left(1-\frac{x}{L}\right)}{sh\sqrt{\bar{k}\bar{z}_0}L}+p_1^L\frac{sh\sqrt{\bar{k}\bar{z}_0}x}{sh\sqrt{\bar{k}\bar{z}_0}L}, \quad (7)$$

$$<\bar{u}_1(x)>=\sqrt{\frac{\bar{k}}{\bar{z}_0}}\left(p_1^0\frac{ch\sqrt{\bar{k}\bar{z}_0}L\left(1-\frac{x}{L}\right)}{sh\sqrt{\bar{k}\bar{z}_0}L}-p_1^L\frac{ch\sqrt{\bar{k}\bar{z}_0}x}{sh\sqrt{\bar{k}\bar{z}_0}L}\right). \quad (8)$$

The found formulas (7) and (8) correspond to the formulas for determining the pressure and the average velocity of the fluid along the longitudinal axis in a permeable channel with a permeable wall. By analyzing the properties of the magnitude in the arguments of the hyperbolic sine and hyperbolic cosine functions in these formulas, it is possible to determine the propagation velocity of pulse waves and their attenuation along the longitudinal axis.

Analysis and Results

Formula (7) and Formula (8), obtained as a result of solving the problem of pulsating flow of an elastic viscous fluid in a flat channel, change depending on the parameter $\sqrt{\bar{k}\bar{z}_0}L$. Therefore, to separate the real and imaginary parts of this parameter, it is defined as follows:

$$\sqrt{\bar{k}\bar{z}_0}L=\bar{\chi}^*+\bar{\beta}^*i. \quad (9)$$

here

$$\bar{z}_0=\left[\frac{1}{i\alpha_0^2}\left(1-\frac{sin\left(i^{\frac{3}{2}}\alpha_0(\frac{1}{\eta^*(i\omega)})^{\frac{1}{2}}\right)}{\left(i^{\frac{3}{2}}\alpha_0(\frac{1}{\eta^*(i\omega)})^{\frac{1}{2}}\right)cos\left(i^{\frac{3}{2}}\alpha_0(\frac{1}{\eta^*(i\omega)})^{\frac{1}{2}}\right)}\right)\right]^{-1},\bar{k}=\frac{3\gamma^*}{h^2}.$$

The real and imaginary parts of $\bar{z}_0$ are distinguished as follows:

$$\bar{z}_0=\left[\frac{1}{i\alpha_0^2}\left(1-\frac{sin\left(i^{\frac{3}{2}}\alpha_0\left(\frac{1}{\eta^*(i\omega)}\right)^{\frac{1}{2}}\right)}{\left(i^{\frac{3}{2}}\alpha_0\left(\frac{1}{\eta^*(i\omega)}\right)^{\frac{1}{2}}\right)cos\left(i^{\frac{3}{2}}\alpha_0\left(\frac{1}{\eta^*(i\omega)}\right)^{\frac{1}{2}}\right)}\right)\right]^{-1}=\bar{R}^*+\bar{L}^*i,$$

$$\bar{R}^*=\frac{\alpha_0^2(A_1^2+B_1^2)}{(A_2^2+B_2^2)}B_2,\bar{L}^*=\frac{(A_1^2+B_1^2)\alpha_0^2}{A_2^2+B_2^2}A_2.$$

$$\bar{\chi}^* = \sqrt{\frac{\gamma^*}{h^2}} L(\sqrt[4]{\bar{R}^{*2} + \bar{L}^{*2}}\, cos\frac{\phi}{2}), \bar{\beta}^* = \sqrt{\frac{\gamma^*}{h^2}} L(\sqrt[4]{\bar{R}^{*2} + \bar{L}^{*2}}\, sin\frac{\phi}{2}).$$

here, $\bar{\chi}^*$-is the quantity characterizing wave attenuation; $\frac{1}{\bar{\beta}^*}$ -is a dimensionless quantity that determines the propagation speed of pulse waves.

In that case $\frac{c^*}{c_0} = \frac{\omega L}{c_0 \bar{\beta}^*}$,

$$\frac{c^*}{c_0} = \alpha_0^2 \sqrt{\frac{1}{\gamma^*}} (\sqrt[4]{\bar{R}^{*2} + \bar{L}^{*2}}\, sin\frac{\phi}{2})^{-1}. \quad (10)$$

$$\frac{p}{p_0} = e^{-\chi\lambda}. \quad (11)$$

here, $c_0 = 5\nu/h$– is the base velocity of the pulse wave propagation velocity; ν - the kinematic viscosity coefficient of the fluid; ω - vibration frequency; L - channel length.

Using the identified formulas, it is possible to analyze the change in pulse wave propagation speed and wave attenuation decrement depending on the permeability coefficient of the wall at different values of the elasticity coefficient. The graph below is derived from formula (10).

The change in the velocity of pulse wave propagation depending on the vibration frequency parameter at different values of the elasticity coefficient EL in a pulsating flow of an elastic viscous fluid.

$$\gamma^* = 0.1; EL := 1 - 0.1; 2 - 0.2; 3 - 0.3; 4 - 0.4$$

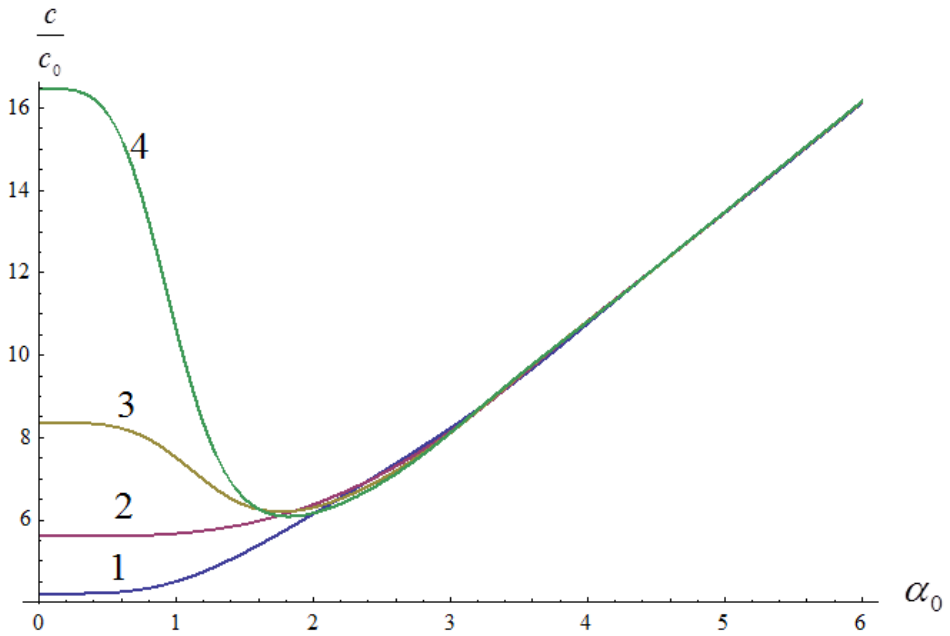

Figure 1. Dependence of pulse wave propagation speed and elasticity coefficient derived from formula (10).

Now let's examine the graph showing the relationship between the oscillation frequency parameter and the inverse of wave attenuation magnitude, which is obtained with respect to wavelength at various values of the elasticity coefficient in a pulsating flow of an elastic viscous fluid.

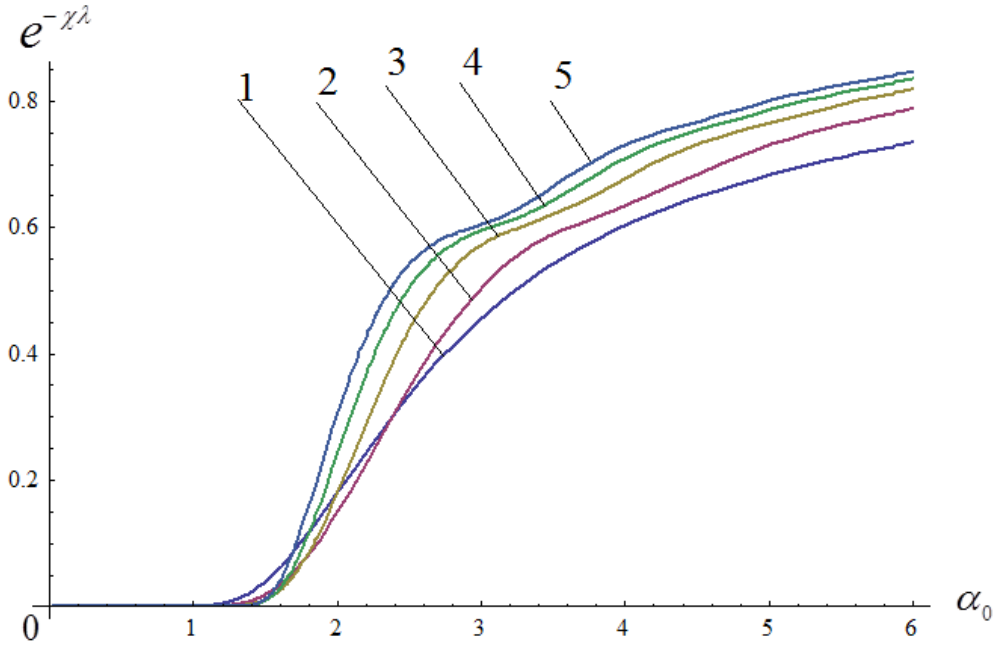

Figure 2. Relationship between the oscillation frequency parameter and the inverse of wave attenuation magnitude, which is obtained with respect to wavelength at various values of the elasticity coefficient.

The change in the elasticity coefficient in a pulsating flow of an elastic viscous fluid depending on the vibration frequency parameter of the magnitude opposite to the magnitude of the wave attenuation obtained with respect to the wavelength at different values of the EL.

γ^*=0.1, 1-EL=0.001; 2- EL=0.1; 3- EL=0,2; 4-EL= 0,3; 5-EL= 0,4.

Conclusions

It has been established that at different values of the elasticity coefficient in a pulsating flow of elastic viscous fluid, the change in the speed of pulse wave propagation depending on the oscillation frequency parameter increases almost independently of the values of the elasticity coefficient at large values of the oscillation frequency parameter. At low values of the vibration frequency parameter, significant deviations were observed compared to the Newtonian fluid, and it was found that this deviation is more pronounced at increased values of the elasticity coefficient.

It has been established that the wave attenuation decrement increases significantly with increasing values of the elasticity coefficient, depending on the large values of the oscillation frequency parameter.

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PHASE MAGNETIC TRANSITIONS IN SILICON DOPED WITH MANGANESE AT LOW TEMPERATURES

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Annotatsiya. Mazkur maqolada past haroratlarda marganets (Mn) bilan legirlangan kremniyning fazoviy magnit o‘tishlari o‘rganilgan. Tadqiqotda magnit tartiblanish mexanizmlari, Mn klasterlarining kremniyning magnit xususiyatlariga ta’siri va spintronik qurilmalarga amaliy potensialiga e’tibor qaratilgan. Materiallarning ferromagnit xususiyatlarini hosil qilish uchun diffuziya usuli qo‘llanilgan. Natijalar an’anaviy kremniy qurilmalariga magnit xususiyatlarni integratsiya qilish imkoniyatini namoyish etib, energiya samarador texnologiyalarni yaratish uchun istiqbollarni ochadi.

Kalit so‘zlar: *kremniy, marganets, magnit o‘tishlar, ferromagnetizm, spintronika.*

Аннотация. В данной статье рассматриваются фазовые магнитные переходы в кремнии, легированном марганцем (Mn), при низких температурах. Исследование посвящено изучению механизмов магнитного упорядочения, влияния кластеров Mn на магнитные свойства кремния и практического потенциала для спинтронных устройств. Использовался метод диффузии для получения материалов с ферромагнитными свойствами. Результаты демонстрируют возможность интеграции магнитных свойств в традиционные кремниевые устройства, что открывает перспективы для создания энергоэффективных технологий.

Ключевые слова: *кремний, марганец, магнитные переходы, ферромагнетизм, спинтроника.*

Abstract. This article explores the phase magnetic transitions in silicon doped with manganese (Mn) at low temperatures. The research focuses on the mechanisms of magnetic ordering, the impact of Mn clusters on the magnetic properties of silicon, and the practical potential for spintronic devices. The diffusion method was employed to create materials with ferromagnetic properties. The results demonstrate the possibility of integrating magnetic properties into

conventional silicon devices, opening up prospects for energy-efficient technologies.

Keywords: *silicon, manganese, magnetic transitions, ferromagnetism, spintronics.*

Introduction

Phase magnetic transitions in silicon doped with manganese (Mn) represent a significant area in semiconductor physics, offering opportunities to integrate magnetic properties into conventional silicon devices. This research lies at the intersection of spintronics and materials science, where the magnetic characteristics of semiconductors can enhance next-generation technologies, including non-volatile memory, quantum computing, and energy-efficient devices.

Literature Review

Semiconductors doped with transition metals such as Mn exhibit properties of diluted magnetic semiconductors (DMS), combining both semiconductor and magnetic characteristics. Previous studies indicate that introducing Mn into silicon through ion implantation followed by annealing not only achieves ferromagnetism but also results in Curie temperatures exceeding room temperature, paving the way for practical applications in spintronic devices [1-3].

Of particular interest is the phase behavior of Mn-doped silicon at low temperatures. Experimental data reveal that Mn atoms can form localized magnetic clusters or integrate into the silicon crystal lattice. These interactions often lead to indirect exchange interactions mediated by charge carriers, enabling ferromagnetic properties even at elevated temperatures. Moreover, annealing processes significantly influence the magnetic and structural properties, allowing precise tuning of material characteristics [4, 5].

This study focuses on magnetic phase transitions in Mn-doped silicon at low temperatures, with an emphasis on the mechanisms of magnetic ordering, the role of Mn clusters, and their impact on the magnetic properties of silicon. Investigating these interactions will deepen our understanding of ferromagnetism in silicon-based DMS materials and their potential for integration into high-performance semiconductor technologies.

Research Methodology

For the diffusion of Mn impurity atoms, single-crystal silicon samples of the KDB–3, 5,100 Ω·cm grade were used, with the boron atom concentration in the initial material ranging from $N_B \sim 10^{14} \div 6{,}7 \cdot 10^{16}$ cm^{-3}. The diffusion temperature and time were selected to ensure that after the diffusion process, the manganese-doped silicon samples remained compensated and exhibited *p*-type conductivity [5].

After the samples were prepared, their electrophysical parameters were measured using the Van der Pauw method on the “Ecopia HMS-7000 Hall Measurement System”. The effect of a magnetic field on the electrophysical properties of Mn-doped silicon was studied using the “Quantum Design EverCool II” system. Magnetization measurements were performed with a “Quantum Design MPMS-3 SQUID VSM” magnetometer.

Analysis and Results

Electrophysical parameters of silicon doped with manganese impurity atoms are given in Table 1. The electrophysical parameters of manganese-doped silicon include characteristics such as charge carrier concentration, mobility, conductivity type, and resistivity [6]. These parameters are essential for understanding the behavior of the material under various physical conditions and its potential application in semiconductor technologies [7].

Table 1. Electrophysical parameters of silicon doped with manganese impurity atoms.

Sample	Diffusion temperature °C	Conductivity Type	Resistivity Ω·cm	Charge Carrier Concentration, *p*, *n*, cm^{-3}	Mobility, μ, $cm^2/(V \cdot s)$
Si<B>	–	*p*	3	$6.7 \cdot 10^{15}$	315
Si<B, Mn>	1090	*n*	$3.3 \cdot 10^{4}$	$3.6 \cdot 10^{11}$	780
Si<B, Mn>	1085	*p*	$1.4 \cdot 10^{4}$	$1.1 \cdot 10^{12}$	90
Si<B, Mn>	1080	*p*	$3.6 \cdot 10^{5}$	$2.3 \cdot 10^{11}$	125

Doping silicon with manganese significantly alters its electrophysical properties. A high diffusion temperature (T_{diff}=1090 °C) enhances the charge carrier concentration $n=3.6 \cdot 10^{11}$ cm^{-3} and mobility μ=780 $cm^2/(V \cdot s)$, leading to the formation of *n*-type conductivity. At lower diffusion temperatures (1085 °C and 1080 °C), *p*-type conductivity is observed; however, the mobility 90–125 $cm^2/(V \cdot s)$ and charge carrier concentration decrease. Compared to undoped Si<B>, manganese-doped samples show reduced resistivity and enhanced electrophysical performance. These results confirm the efficiency of manganese integration into the silicon crystal lattice and open up opportunities for the creation of new semiconductor materials. Such materials are especially relevant for application in spintronic and high-performance electronic devices [8].

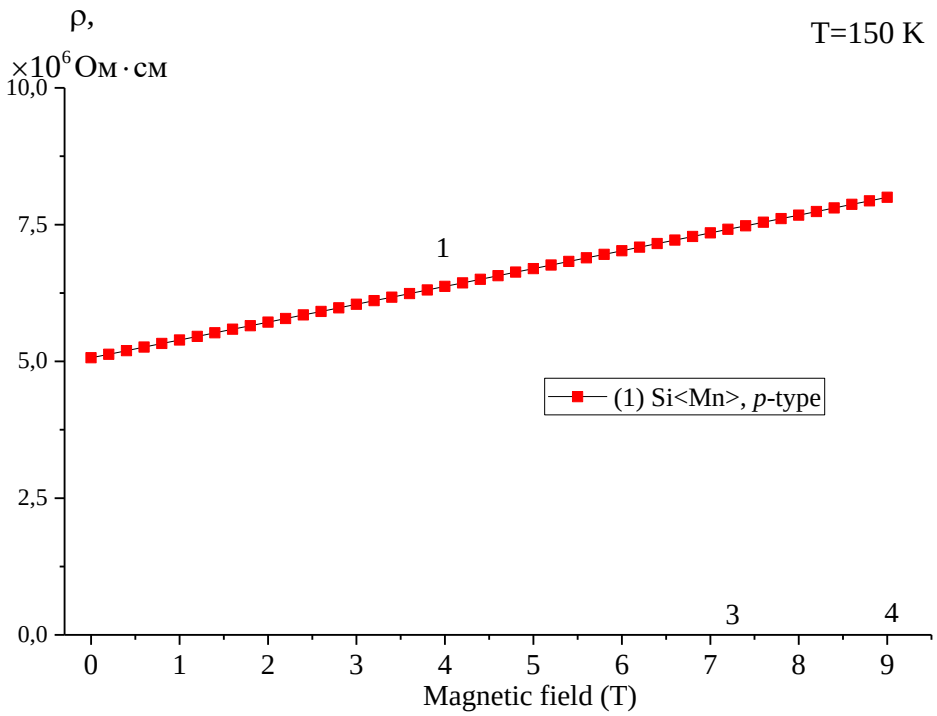

Figure 1. Dependences of resistivity of silicon (*p*-Si<B, Mn>) on magnetic field at temperature *T*=150 K.

Figure 1 shows the dependence of the resistivity of silicon *p*-Si<B,Mn> on the magnetic field at temperature T=150 K. The initial resistivity in the absence of magnetic field is $\rho \approx 1.2 \times 10^4$ Ohm·cm. When the magnetic field is increased up to 9 T, a linear growth of resistivity is observed, which is due to the effect of magnetic resistance caused by the decrease in the mobility of charge carriers in the magnetic field.

As a result, the resistivity increased by about 60%, highlighting the influence of localized magnetic clusters and the interaction of charge carriers with the magnetic field. These results demonstrate the potential of using *p*-Si<B, Mn> materials in the development of spintronics and magnetic electronics devices.

Figure 2 illustrates the temperature dependence of the magnetic moment for the *p*-Si<B, Mn> sample under Zero-Field-Cooled (ZFC) and Field-Cooled (FC) conditions. The graph reveals two critical magnetic transitions: Transition to a Superparamagnetic State T_1=250 K: At T_1=250 K the material transitions from a paramagnetic state to a superparamagnetic state. This change is attributed to the formation of magnetic clusters, where interactions occur over short distances. The clusters exhibit thermal independence at temperatures lower than T_1, leading to superparamagnetic behavior.

Transition to a Ferromagnetic State (T_2=60 K): At T_2=60K, a transition from the superparamagnetic to ferromagnetic state is observed. In this regime, the magnetic moments align collectively due to stronger exchange interactions, resulting in long-range magnetic ordering.

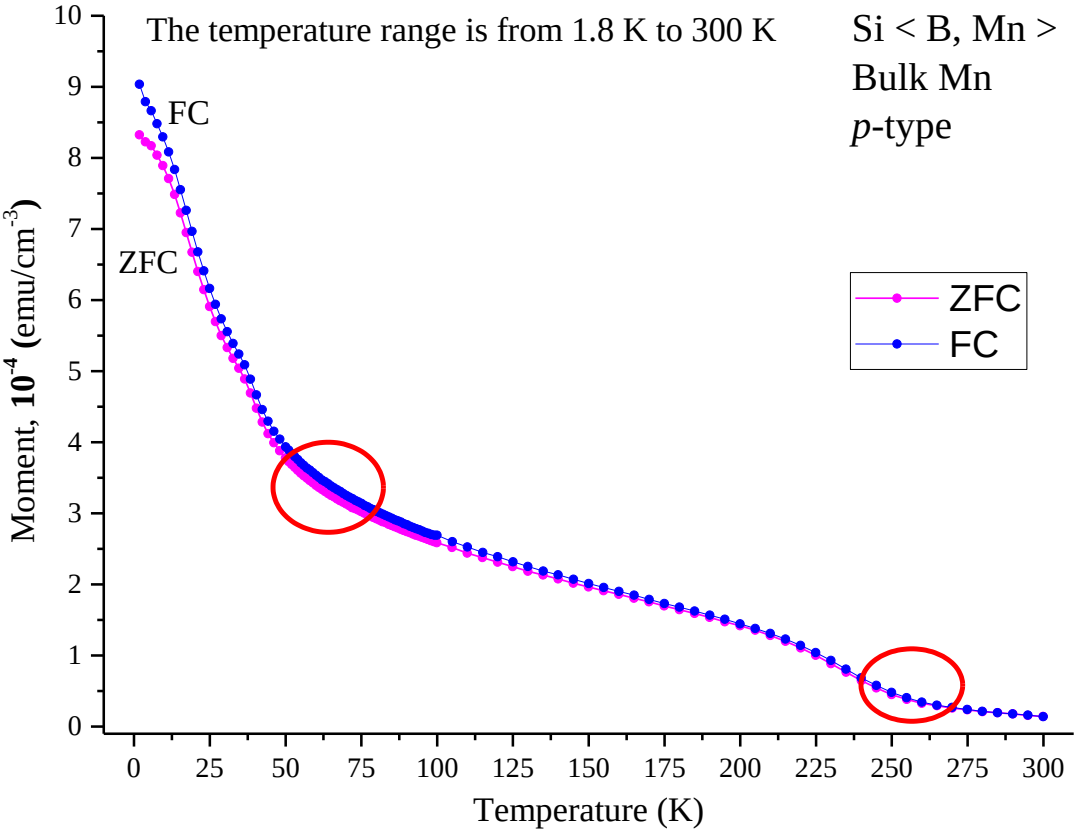

Figure 2. Temperature dependence of the magnetic moment of p-type conductivity silicon doped with impurity manganese atoms in ZFC and FC modes.

The Zero-Field-Cooled (ZFC) Mode involves cooling the sample without an external magnetic field and applying the field during the heating process. This mode highlights the gradual increase in the alignment of magnetic moments as the temperature decreases.

The Field-Cooled (FC) Mode involves cooling the sample in the presence of an external magnetic field. This process results in a higher magnetic moment due to the initial alignment of moments during cooling, which persists even as the temperature decreases.

The differences between the ZFC and FC modes provide insights into the thermal dynamics of magnetic interactions. At T_1>250 K, thermal fluctuations dominate, disrupting magnetic ordering. Below T_2=60 K, ferromagnetic ordering prevails, as thermal energy becomes insufficient to overcome the exchange interactions within the magnetic clusters [9, 10].

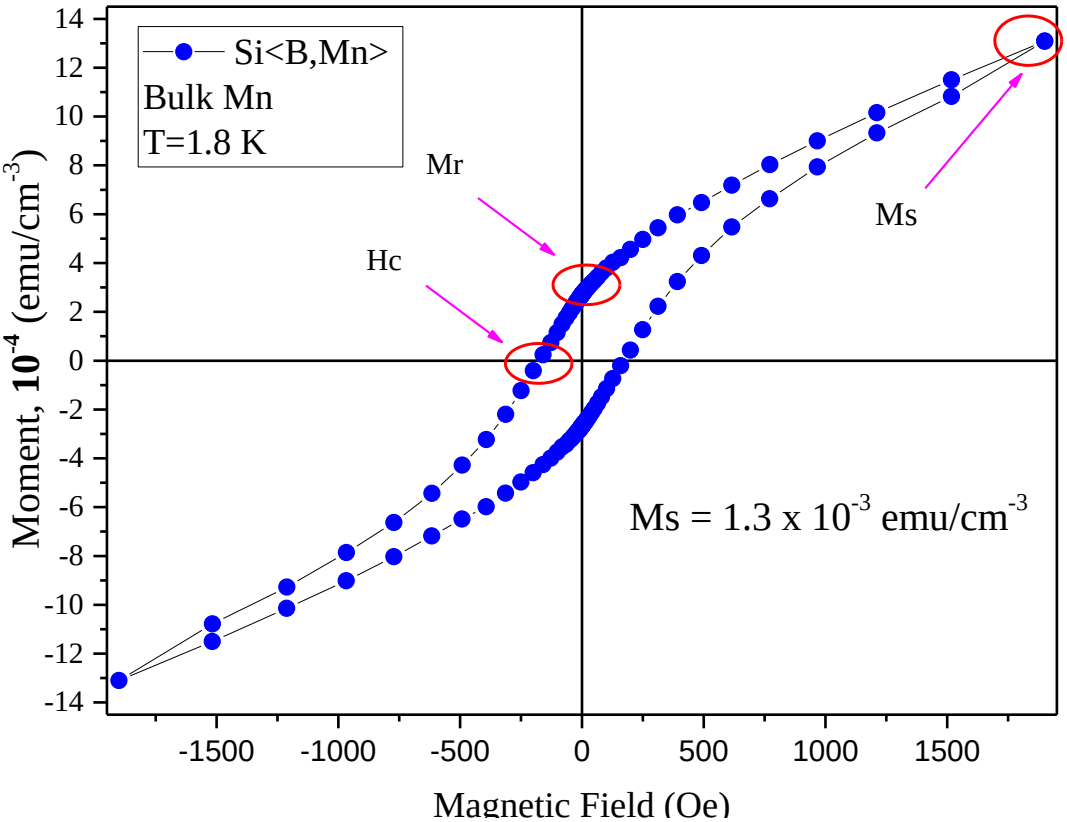

Figure 3. Field dependence of magnetisation (hysteresis loop) of the sample *p*-Si<B, Mn>.

This analysis underscores the significant impact of temperature and external magnetic fields on the magnetic properties of *p*-Si<B, Mn>, demonstrating its potential for applications in magnetic and spintronic devices. The analysis of the obtained results shows that the most known method of stimulating self-assembly of nanoclusters from manganese atoms is additional heat treatment of the obtained silicon sample at a certain temperature and time. The magnetic properties of silicon samples doped with impurity Mn atoms were investigated on a Quantum Design MPMS-3 SQUID VSM brand magnetometer at T=1.8 K. The results show that Si samples doped with nanoclusters of impurity manganese atoms are ferromagnetic at low temperatures $T<T_c$ (Tc is the Curie temperature). Analysis of the results shows that the transition temperature to the

ferromagnetic state shifts with increasing concentration of formed nanoclusters relative to higher temperatures.

Dependence of magnetisation on magnetic field, silicon samples Si<B, Mn>, *p*-type (blue) parameters Ms, Mr and Hc (M_s–saturation magnetisation, M_r–residual magnetisation, H_c - coercive force). Figure 3 shows the magnetisation of silicon samples with nanoclusters of manganese atoms of large sizes. The values of H_c=175 Oe and $M_r=2.6\cdot10^{-4}$ emu/cm^{-3} were determined.

Conclusions

In this study, phase magnetic transitions and physical parameters of manganese (Mn)-doped silicon at low temperatures were investigated. The following main results were obtained:

1. Change in electrophysical parameters: For manganese-doped silicon samples, at high diffusion temperature (T_{diff} =1090 °C), *n*-type conduction with charge carrier concentration of $n=3.6\cdot10^{11}$ cm^{-3}, and mobility of 780 cm^2/V·s was achieved. At low diffusion temperature (T=1080-1085 °C, *p*-type conductivity with mobility in the range of 90-125 cm^2/V·s was observed.

2. Magnetic phase transitions: It was found that at temperature T_1=250 K the material transitions to the superparamagnetic state, and at T_2=60 K the transition to the ferromagnetic state is observed. These transitions are associated with the formation of Mn clusters and their local magnetic interactions.

3. Magnetic properties: magnetometer measurements showed that silicon with Mn clusters has ferromagnetic properties. The coercivity H_c=175 Oe and residual magnetisation $M_r=2.6\cdot10^{-4}$ emu/cm^3 were determined.

4. Magnetoresistance: Experiments at temperature T=150 K showed an increase in the magnetoresistance of silicon samples by about 60% when exposed to a magnetic field, which is due to a decrease in the mobility of charge carriers in the magnetic field.

5. Prospects for technological applications: The results of the study demonstrate that manganese doping of silicon opens new opportunities for the development of materials for spintronics and high-performance quantum technologies. The high-temperature ferromagnetic properties make these materials promising for energy-efficient and stable devices.

The results obtained represent an important achievement at the interface of physics and technology, laying the foundation for the creation of next-generation materials for modern electronics.

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MODERN PROBLEMS OF PEDAGOGY AND PSYCHOLOGY

UDC: 37, 37.09

ACHIEVING EFFICIENCY IN THE EDUCATIONAL PROCESS THROUGH PROFESSIONALLY-ORIENTED TEACHING OF ELECTROTECHNICS AND ELECTRONICS

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Annotatsiya. Mazkur maqolada elektrotexnika va elektronikani kasbga yo‘naltirgan holda o‘qitish jarayonida samaradorlikka erishishning usullari va tajribasi yoritilgan. Tadqiqotda Shuningdek, o‘quvchilarni kasbiy faoliyatga yaqinlashtirish uchun sohaga oid real hayot misollari asosida o‘quv materiallari shakllantirilishga e’tibor qaratish, Ta’lim mazmunini yangilash va o‘quvchilarning mustaqil fikrlash qobiliyatini rivojlantirishga qaratilgan, kasbiy yo‘naltirish uchun zamonaviy pedagogik texnologiyalar, interaktiv metodlar va amaliyotga asoslangan o‘qitish usullari yoritilgan.

Kalit so‘zlar: *Kasbga yo‘naltirilgan ta’lim, o‘quv jarayonining samaradorligi, innovatsion pedagogik texnologiyalar, interaktiv ta’lim metodlari, amaliyotga yo‘naltirilgan holda o‘qitish, kasbiy kompetensiyalarni shakllantirish, real hayotga mos ta’lim materiallari.*

Аннотация. В данной статье освещены методы и опыт достижения эффективности в процессе обучения электротехнике и электронике с профессиональной направленностью. В исследовании уделено внимание формированию учебных материалов на основе примеров из реальной жизни, связанных с профессиональной деятельностью, обновлению содержания образования и развитию навыков самостоятельного мышления учащихся. Также рассмотрены современные педагогические технологии, интерактивные методы и практико-ориентированные подходы к профессионально направленному обучению.

Ключевые слова: *Профессионально-ориентированное обучение, эффективность учебного процесса, инновационные педагогические технологии, интерактивные методы обучения, практико-ориентированное обучение, формирование профессиональных компетенций, учебные материалы, соответствующие реальной жизни.*

Abstract. This article highlights the methods and experience of achieving efficiency in teaching electrical engineering and electronics with a professional orientation. The study focuses on developing educational materials based on real-life examples related to professional activities, updating the content of education, and enhancing students' independent thinking skills. Modern pedagogical technologies, interactive methods, and practice-oriented approaches to professionally focused teaching are also discussed.

Keywords: *Professionally oriented education, efficiency of the educational process, innovative pedagogical technologies, interactive teaching methods, practice-oriented teaching, development of professional competencies, educational materials aligned with real life.*

Introduction

The advancement of modern technologies and industries necessitates further development of knowledge among future specialists in electrotechnics and electronics. Given that this field encompasses numerous sectors of production and the economy, it demands the preparation of highly skilled professionals. Therefore, electrotechnics and electronics should be regarded as an integral part of the educational system in technical higher education institutions [1]. The teaching of specialized subjects should be designed not only to provide theoretical knowledge but also to develop practical skills, emphasizing interdisciplinary connections. By teaching this subject, it becomes a pressing issue to introduce future specialists to modern technologies and equip them with the necessary knowledge to apply these technologies in practice, thus shaping their professional skills.

Teaching electrotechnics and electronics in technical fields, taking into account the professions students aim to pursue, lays the groundwork for adequately forming their professional knowledge, skills, and competencies.

Literature Review

Analyzing the global context, career-oriented education has become one of the most significant directions in modern education systems. This system is focused not only on providing theoretical knowledge but also on enhancing students' skills in their professional fields, fostering independent thinking, and improving practical work efficiency. Career-oriented education stands out for its alignment with contemporary demands, its contribution to preparing students for professional activities, and its provision of the methodological foundation required to involve them in real work processes [2]. Furthermore, this educational model incorporates innovative pedagogical approaches that serve to enhance the quality of education. The primary advantages of career-oriented education include increasing students' interest in their professions, their readiness for work, and their effectiveness in professional performance [3, 4].

Although career-oriented education is developing, several challenges remain in its full implementation. These challenges include the need for teachers to master new pedagogical technologies, insufficient attention to teaching electrotechnics and electronics based on their relevance to specific professions, and inadequate consideration of interdisciplinary connections [5]. Additionally, adapting curricula and teaching materials to current real-life conditions presents certain difficulties. Addressing these issues requires the introduction of innovative technologies and methods in the education system, enhancing students' professional training, and fostering approaches focused on interdisciplinary connections. Implementing strategies aimed at continuous professional development for teachers and improving the educational process in line with evolving demands is also critical [6].

In light of the above, applying career-oriented educational processes in this direction can significantly enhance the effectiveness of the learning process. This involves integrating new pedagogical technologies into the educational process, regularly updating teaching materials to reflect the specific field, and promoting practice-oriented teaching methods based on interdisciplinary connections-factors that play a significant role in modernizing the education system [7, 8].

Scientific research in the field of career-oriented education, aimed at enhancing the efficiency of the educational process through the application of modern teaching methods and pedagogical technologies, has yielded many practical implementations in the teaching of electrotechnics and electronics [9, 10]. Research conducted by both foreign and Uzbek scholars has demonstrated the importance of career-oriented methods in education, the integration of innovative pedagogical technologies, and the enhancement of students' professional training. Below is an analysis of the research carried out in this area.

John Dewey, in his research and the book *Education and Experience*, highlighted the importance of focusing not only on theoretical knowledge but also on practical skills for students. He argued that a learning-by-experience approach in education plays a vital role in enhancing students' engagement in the learning process and improving their professional preparedness [9]. In electrotechnics and electronics education, applying this approach can help develop students' problem-solving skills for real-world scenarios.

Richard Felder, in his works on engineering education, emphasized the necessity of considering students' diverse learning styles. His research suggests that teachers should employ methods that meet the varying needs of students. Additionally, Felder's studies outlined interactive approaches in teaching electrotechnics and electronics that focus on integrating theoretical and practical knowledge for students.

Among Uzbek scholars, Sh. Musayev has conducted extensive research on updating electrotechnics and electronics education, introducing modern pedagogical technologies into the educational process. His works are significant in developing methods aimed at guiding students toward practical applications and enhancing their professional preparation [11].

Similarly, Q. Sodiqov has carried out several studies aimed at advancing career-oriented education in electrotechnics and electronics. His research underscores the critical role of innovative pedagogical technologies in modernizing education in this field. Furthermore, he emphasized the importance of fostering practical skills among students.

Research Methodology

The above studies demonstrate that while the organization of interdisciplinary and career-oriented approaches in teaching electrotechnics and electronics has yielded some results, there remains a gap in fully developing systems that effectively integrate interdisciplinary methods into the educational process. This highlights the need for further development of methodologies that employ interdisciplinary approaches to enhance the efficiency of career-oriented education processes.

Analysis and Results

In order to measure the effectiveness of career-oriented education and to further improve the learning process, a number of methodological approaches can be employed [12, 13] This study aims to analyze the efficiency of the educational process through evaluation criteria, experiments, and observations, as well as to improve teaching methods based on student feedback.

The efficiency of the learning process is assessed using several criteria, including the level of students' knowledge, the formation of professional competencies, the relevance of the educational process to practical applications, and the effective utilization of educational resources. The primary criteria we adopted for evaluating efficiency are as follows:

- **Knowledge Level**: Assessing students' theoretical and practical knowledge, their achievements in the learning process, and their professional skills.
- **Formation of Professional Competencies**: Measuring students' readiness for professional activities and their practical skills suited to their field.
- **Practice-Oriented Education**: Evaluating students' knowledge and experience aimed at solving real-life problems.

Using these criteria allows us to achieve a realistic assessment of the quality of the educational process. In addition, assessing efficiency requires the use of experiments and observations to improve students' practical skills and continuously refine teaching methods.

Experimental studies are also essential in determining the level of students' professional readiness, practical skills, and knowledge acquisition. The experiments we proposed include the following:

Table 1. Information on the stages and format of organizing an experiment.

№	Experiment setup stage	Form of organization of the experiment
1	Establishing experimental groups:	Dividing students into experimental groups to learn theoretical and practical knowledge. These groups can be distinguished from each other by different forms of teaching methods (for example, interactive methods, project-based learning, practical exercises, interdisciplinary learning, competency-based learning).
2	Monitoring and evaluation	Observe students during the experiment, evaluate their performance, and analyze the results. Students' levels of mastery, success, understanding of the questions being asked, and progress in solving problematic issues are monitored.
3	Analysis of the results:	The results of the experiment help to measure the effectiveness of the learning process. This involves analyzing the increase in students' knowledge, the development of professional skills, and the effectiveness of teaching methods.

Among these, the most important aspect is observation, as it allows for the study of students' participation in the educational process, how they perceive teaching methods, and how they adapt to the learning environment. Monitoring students provides significant assistance in evaluating their opinions and decision-making processes [12].

By examining students' feedback, it becomes possible not only to enhance the effectiveness of education and improve teaching methods but also to increase their interest in the subject and their chosen field. Achieving this requires implementation through the following stages, which can greatly improve outcomes.

Table 2. Information on the stages and form of organizing the study of ideas.

№	Transfer stage	Form of organization
1	Surveys and interviews	Collect information about the effectiveness of teaching methods through surveys and interviews with students. Update teaching methods and make them more effective based on student feedback.
2	Evaluation in groups	To determine what changes are needed in teaching methods through group discussion and exchange of ideas among students.
3	Feedback analysis	By analyzing student feedback, determine which elements of the learning process are effective and which need improvement.

The current educational process shows that applying career-oriented approaches in teaching electrotechnics and electronics plays a significant role in increasing the efficiency of the learning process and preparing students for the labor market. Our findings indicate that, to achieve success in training highly competent professionals through teaching electrotechnics and electronics, it is necessary to continuously enrich the subjects being taught with the latest advancements in materials, data, techniques, and technologies [13, 14]. Additionally, the curriculum topics should be structured to align with the specific needs of the profession. Furthermore, incorporating innovative pedagogical technologies, interactive teaching methods, and practice-oriented approaches into the educational process allows for achieving effective results in preparing professionally competent specialists.

The research demonstrates that implementing interdisciplinary connections in teaching electrotechnics and electronics with a career-oriented approach enables achieving the following outcomes:

- The efficiency of the learning process improves;
- Students' level of professional readiness increases;
- Students' interest in the field of study grows.

Using the teaching methods proposed above to instruct electrotechnics and electronics to students at Namangan Institute of Engineering and Technology resulted in the following outcomes:

- Teaching electrotechnics and electronics with an interdisciplinary approach rooted in professional relevance led to the formation of students' professional competencies;
- Organizing the educational process in this way enhanced students' initiative and creativity skills;
- Based on the research conducted, evaluating students' knowledge and practical professional skills according to effectiveness criteria revealed a significant improvement in their knowledge levels.

When teaching related subjects in an interdisciplinary manner, linking topics that are close to each other in the fields of electrical engineering and electronics, based on a certain technology, increases the indicator of achieving positive results. This approach helps students strengthen theoretical knowledge with practical skills, thereby enhancing their professional readiness [10]. Below, we can see an example of the technology for teaching electrical engineering and electronics using a specific topic.

Table 3. The procedure for implementing the technology of forming professional competence through teaching the topic of electrical circuits and their calculation.

№	Technology implementation stage	Implementation procedure
1	Step 1. Defining goals and competencies	To introduce students to the basic elements of electrical circuits. To determine the approach to this topic in future activities, depending on where and for what purpose it is needed. To form the skills of calculating current, voltage and resistance in electrical circuits. To approach the topic in a way that allows the formation of professional competencies.
2	Stage 2. Developing lesson content.	The basic laws of electrical circuits and their importance in solving problems (Ohm's law, Kirchhoff's laws). Current and voltage sources and their influence on the optimal operation of the device. Types of electrical circuits (series and parallel connection). Based on the specialization in work, learn to calculate electrical circuits and work with various software tools.
3	Stage 3. Determining the form and methods of the lesson.	Group work: Small projects on building electrical circuits. Individual approach: Analysis of the results of each student's workbook and practical work. Lecture-style, based on interdisciplinary connections, based on the project principle, using various interactive methods.
4	Step 4. Identify tools and resources.	For example, technical means: measuring instruments, power sources, various simulation programs. Resources or materials: Tutorials, presentations, interactive videos
5	Stage 5. Final stage evaluation and analysis of results.	Assessment is carried out using criteria. For example: 1. Correct solutions to calculation problems by students. 2. According to the indicators of answering questions. 3. According to the accuracy of the model created in simulation programs

Conclusions

Based on the above-mentioned information, teaching each topic of electrical engineering and electronics in an interdisciplinary manner, connecting related subjects to the professional development of future specialists, will increase the effectiveness of teaching and, in turn, help form students' professional competencies.

Based on these points, we propose the following recommendations to prepare students as professionally competent specialists:

1. **Development of Practical Skills:** Focusing on the practical aspects of electrical engineering and electronics during the educational process allows students to adapt their knowledge to real-life situations.
2. **Reliance on Interdisciplinary Connectivity Principle:** This approach helps students integrate their knowledge in electrical engineering, network machinery, network machinery design, and other subjects, and teaches them how to apply this knowledge for practical purposes. As a result, students' interest in scientific research activities increases.
3. **Use of Innovative Approaches:** Introducing advanced technologies in the field of electronics and electrical engineering into the educational process significantly improves the effectiveness of education. The use of simulation software and modern laboratory equipment makes practical exercises interactive and efficient.
4. **Career Guidance Based on Specialization:** Effectively organizing competency-based education increases students' interest, transforming them into professional specialists with high competencies in the field.

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UDC: 37, 378, 61

A METHOD OF USING INTERACTIVE PLATFORMS TO ASSESS STUDENTS’ KNOWLEDGE DURING LECTURES IN HIGHER MEDICAL EDUCATION INSTITUTIONS

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Annotatsiya. Ushbu maqolada tibbiyot oliy ta’lim muassasalarida ma’ruza mashg‘ulotlarida talabalarning bilimini baholashda interaktiv platfomalardan foydalanish va tashkil etishning zamonaviy yondashuvlari hamda olimlarning tadqiqotlarining tahlili keltirilgan. Tibbiyotning umumkasbiy va amaliy fanlaridan axborot ta’lim muhitlaridan va ta’lim platformalari yordamida interaktiv topshiriqlar yaratish hamda baholash usuli keltirilgan. Samaradorlik darajasini aniqlash bo‘yicha tajriba-sinov ishlari olib borilgan hamda uning samaradorlik darajasi Styudent-Fisher kriteriyasidan foydalanib isbotlangan.

Kalit so‘zlar: *ta’lim platformalari, interaktiv, plickers.com, reyting, elektron ta’lim, vizuallashtirish, Styudent-Fisher.*

Аннотация. В данной статье приведены современные подходы к использованию и организации интерактивных платформ для оценки знаний студентов на лекционных занятиях в медицинских вузах, а также анализ исследований ученых. Представлен метод создания и оценки интерактивных заданий по общепрофессиональным и прикладным медицинским наукам с использованием информационных образовательных сред и образовательных

платформ. Проведена экспериментальная работа по определению уровня эффективности и доказана степень его эффективности с использованием критерия Стьюдента-Фишера.

Keywords: *образовательные платформы, интерактивные, plickers.com, рейтинг, электронное обучение, визуализация, Стьюдента-Фишера.*

Abstract. This article presents modern approaches to the use and organization of interactive platforms for assessing students' knowledge in lectures at medical universities, as well as an analysis of research by scientists. The method of creating and evaluating interactive tasks in general professional and applied medical sciences using information educational environments and educational platforms is presented. Experimental work was conducted to determine the effectiveness level and its effectiveness level was proven using the Student-Fisher criterion.

Keywords: *educational platforms, interactive, plickers.com, rating, e-learning, visualization, Student-Fisher.*

Introduction

Creating various questionnaires using educational platforms in conducting the current educational process allows for the individualization and differentiation of the educational process, self-control and correct orientation of the student's learning activities, saving educational time through the use of computer computational capabilities, visualizing learning materials, modeling the learning processes studied, imitating them, forming the ability to make optimal decisions in various pedagogical situations, developing a specific form of thinking (visual-figurative, theoretical), and forming a culture of cognitive activity [1, 2].

Therefore, using online assignments in teaching general medical disciplines, including strengthening lectures on pediatric diseases, can enhance students' creative abilities for independent thinking, and logical thinking, and develop their competence.

Literature Review

Research on the methodology of teaching the creation of electronic educational resources, and improving the system of professional training using information technologies, was conducted by scientists such as Luchaninov D.V., Kondratenko B.A., Kirgizova E.V., Kalitina V.V., Abdurazakov M.M., Danilkevich A.V., Boykov E.V., Krasilnikova V.A., Kulikova N.Yu., and S.A. Sushkov [3-8].

The aforementioned studies are dedicated to the use of distance learning systems, information and educational environments, and educational platforms in enhancing the effectiveness of teaching subjects and organizing students' independent learning, and are effective in enhancing the effectiveness of teaching general medical disciplines and developing students' thinking through the use of educational platforms.

Research Methodology

Currently, there are many educational platforms designed for conducting quizzes, which are widely used in the educational process. An example of this is an educational platform on the global network, located at https://www.plickers.com/ (as given in

Figure 1).

Plickers - is a free online program that allows teachers to quickly assess. This program facilitates multi-stage testing, learning, and evaluation of students' knowledge. Plickers are mainly managed by the teacher through a smartphone or tablet.

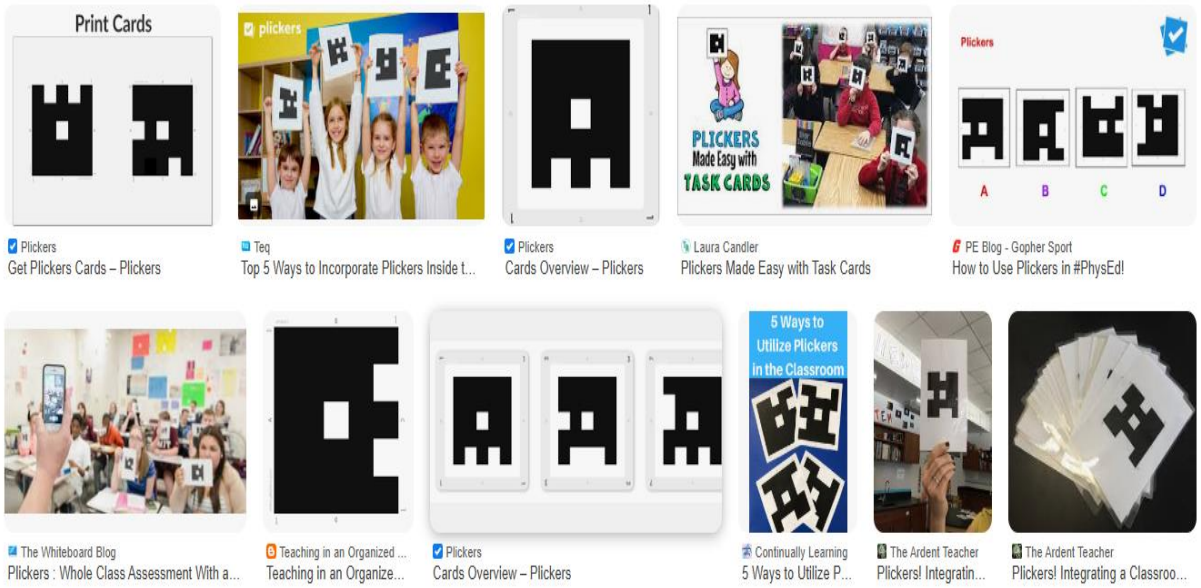

Figure 1. The process of using the web platform (https://www.plickers.com/).

The program operates on the basis of special codes, through which students express their answers, thereby ensuring rapid evaluation [9-11].

1. Register and create questions: First, the teacher registers on the official website or app of Plickers and creates an account. After you register, a library will be created for you (as shown in Figure 2).

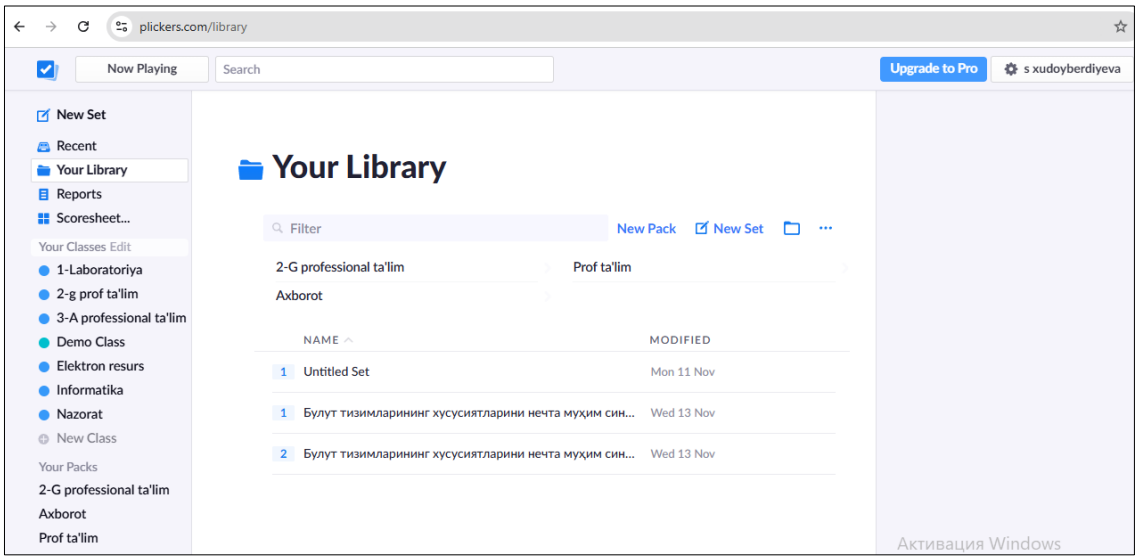

Figure 2. The process of using the web platform (https://www.plickers.com/).

2. After that, you can create questions and enter the necessary questions and answers for them (see in Figure 3).

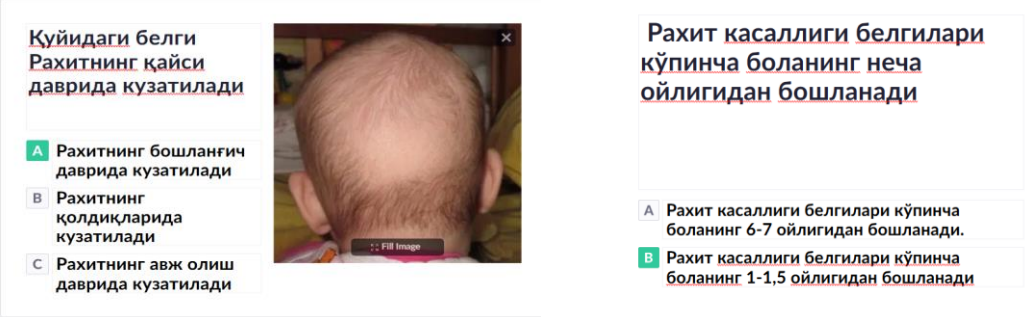

Figure 3. The process of using the platform https://www.plickers.com/ (in uzbek language).

3. After the questions are added, a new class is created and a list of students is written. Give the class a name and click Add Students. The list is generated as shown in Figure 4 and Figure 5.

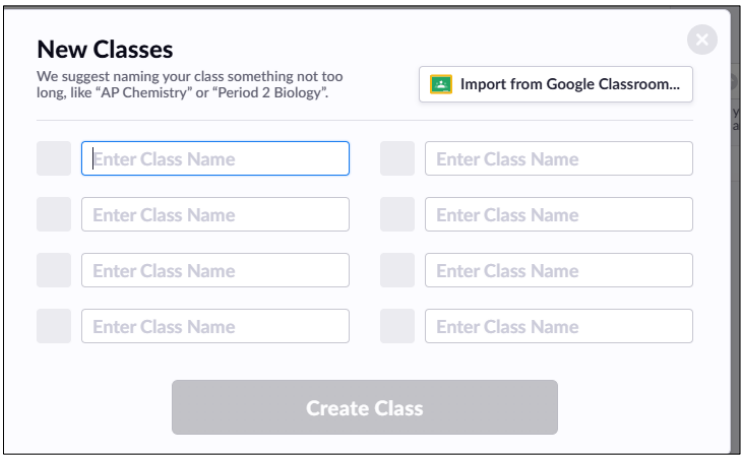

Figure 4. The process of using the platform https://www.plickers.com/

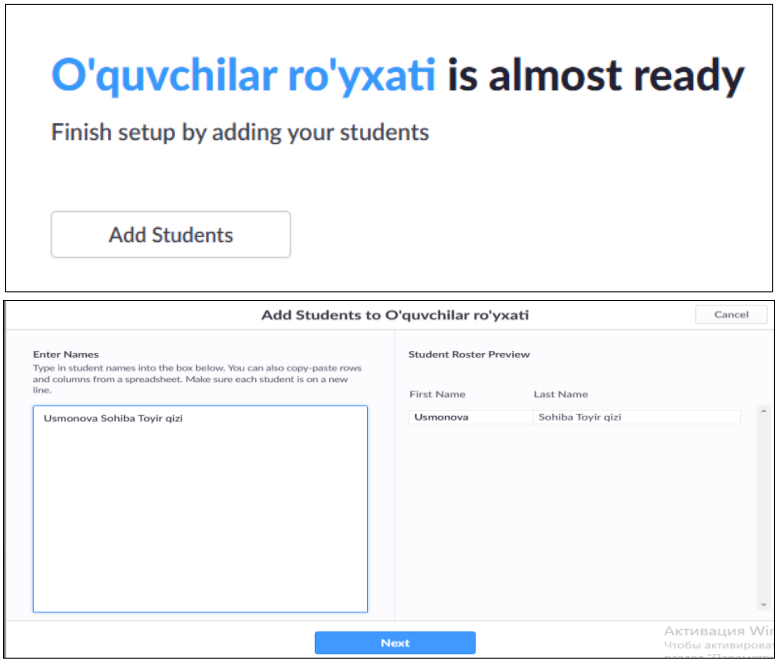

Figure 5. The process of using the platform https://www.plickers.com/

4. Printing special codes: The program provides special codes for each student. The teacher prints these codes and distributes them to each student (see in Figure 6).

Figure 6. The process of using the https://www.plickers.com/ platform

Special codes represent students' answer options, which can be scrolled through to select the desired answer.

5. Assessment process: The teacher presents the questions to the class. Students turn in a special code and indicate their chosen answer, and the teacher scans it through the app. This allows the students' answers to be recorded in the system and processed in real time (see in Figure 7).

Figure 7. The process of using the platform https://www.plickers.com/

6. Generates automatic analysis and reports, which helps in analyzing the level of knowledge of students (as given in Figure 8).

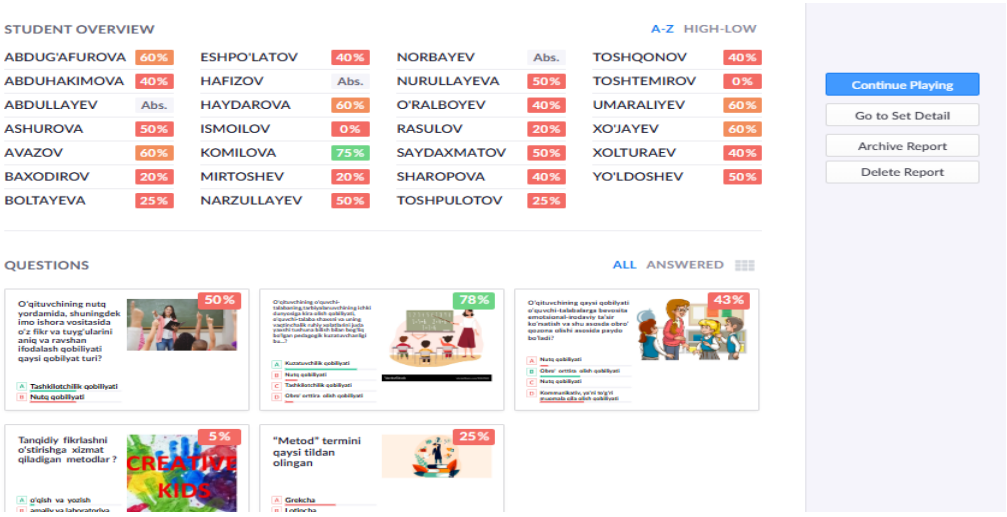

Figure 8. The process of using the platform https://www.plickers.com/

Analysis and Results

To determine the level of effectiveness of methods of using modern information technologies in teaching the subject of "Children's Diseases," pedagogical experimental work was conducted. Students of the "Pediatrics" department of Navoi State University were involved in the experimental work. 32 students of the "Informatics Teaching Methods" department were involved. Of these, 10 were allocated to the experimental group and 22 to the control group.

The experimental group was trained using the model developed as part of the study. The control group was not given this opportunity. The results of the students involved in this experiment were analyzed and mathematical and statistical analysis was performed based on the Student-Fisher criterion to check their reliability. When using this criterion, suitable mean values for the samples were $\overline{X} = \frac{1}{n}\sum_{i=1}^{4} n_i X_i$, tarqoqlik koyeffitsiyentlarini $D_n = \sum_{i=1}^{4} \frac{n_i(x_i - \bar{X})^2}{n-1}$, and in determining the mastery indicators $A\% = \frac{\bar{X}}{3} \cdot 100\% - \frac{\bar{Y}}{3} \cdot 100\%$ The formula was used. According to the calculation results, it turned out that the average mastery index of the experimental group was higher than that of the control group, that is, it increased by 8.6%.

Conclusions

The use of modern information technologies is of great importance for improving the educational process in the medical field. In particular, the effective use of information technologies in teaching general medical disciplines helps to strengthen students' theoretical knowledge and practical skills, as well as develop clinical thinking.

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UDC: 37.04, 37.09, 004.9

USING MOBILE TECHNOLOGY IN ORGANIZING STUDENTS' INDEPENDENT LEARNING

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Annotatsiya. Ushbu maqolada talabalarning mustaqil ta’limini tashkil etishda mobil texnologiyalarning roli va ulardan foydalanish usullari batafsil ko‘rib chiqilgan. Mobil texnologiyalar, internet resurslari va turli ilovalar yordamida talabalar o‘z bilimlarini mustaqil ravishda kengaytirish imkoniyatiga ega bo‘ladi. Maqolada mobil ilovalar, onlayn kurslar, ta’lim platformalari va boshqa raqamli vositalar orqali ta‘lim jarayonining samarali tashkil etilishi mumkinligi tahlil qilingan.

Kalit so‘zlar: *Mobil texnologiya, mustaqil ta’lim, Kahoot, Softr, Draftbit, FlutterFlow, Bubble, Appy Pie's App Builder, Jotform Apps, Zapier Interfaces, GlideAPPS, Bildr.*

Аннотация. В данной статье подробно рассматривается роль мобильных технологий и методы их использования в организации самостоятельного обучения студентов. С помощью мобильных технологий, интернет-ресурсов и различных приложений у студентов появится возможность самостоятельно расширить свои знания. В статье анализируется

возможность эффективной организации образовательного процесса с помощью мобильных приложений, онлайн-курсов, образовательных платформ и других цифровых инструментов.

Ключевые слова: *мобильные технологии, самостоятельное обучение, Kahoot, Softr, Draftbit, FlutterFlow, Bubble, Appy Pie's App Builder, Jotform Apps, Zapier Interfaces, GlideAPPS, Bildr.*

Abstract. This article examines in detail the role of mobile technologies in organizing independent learning of students and methods of their use. With the help of mobile technologies, Internet resources and various applications, students have the opportunity to independently expand their knowledge. The article analyzes the possibility of effective organization of the educational process through mobile applications, online courses, educational platforms and other digital tools.

Keywords: *Mobile technology, independent learning, Kahoot, Softr, Draftbit, FlutterFlow, Bubble, Appy Pie's App Builder, Jotform Apps, Zapier Interfaces, GlideAPPS, Bildr.*

Introduction

The role of mobile technologies in today's education system has increased significantly. With the help of mobile devices, the Internet and modern software, students have the opportunity to independently expand their knowledge. This process is especially important in updating and improving the learning methods of the younger generation. Mobile technologies not only facilitate the acquisition of information, but also allow students to use various resources, which makes the independent learning process more effective. The use of mobile technologies in organizing independent learning of students is of great importance in the modern educational process. With the help of mobile technologies, students have the opportunity to effectively manage their time, quickly find the necessary resources and expand their knowledge.

Literature Review

Research on the methodology and methods of using mobile technology in organizing independent learning of students in higher education institutions has been studied by such scientists as Hayitova Sh.D., Umarova Z.A., Hayitova I.I., Tursunov M.A., Afzalova A.N., Eremin Yu.V., Kirilova Ye.A., Gnevasheva V.A., Saad Butt, Geeta R Thakur, Shazia Zaheer, Yao Francois Michael Kra, Noah Kwaku Baah, Boafoh Kyei Baffour.

In the above-mentioned studies conducted in our country, the Commonwealth of Independent States and foreign countries, research has been conducted on the methodology of using mobile technologies, problem-based learning technologies and game technologies in organizing independent learning of students in educational institutions, but based on the characteristics of the disciplines, ensuring systematicity and consistency in the higher education system. Improving the methodology for using mobile technologies in organizing independent learning through the use of alternative approaches, as well as improving the methodology for forming and developing competencies in students to create various mobile applications using mobile

technologies, has not been sufficiently studied from a scientific and theoretical perspective. Therefore, the ongoing research, namely, improving the methodology for using mobile technologies in organizing independent learning in the higher education system, is considered one of the most urgent problems today.

Research Methodology

Independent learning - forms a mechanism for self-management of the student's educational activity, professional development, is indirectly controlled by the teacher, serves to improve professional competencies, as well as to develop the professional qualities of the future specialist.

Activation of independent learning - based on the current requirements, it means organizing activities to activate independent learning by working with Internet tools, using social networks, mobile technologies, and introducing mobile applications into the educational process [1].

Nowadays, students do all their work on mobile devices, smartphones or tablets. They want to have constant access to educational resources, because they are used to it and take it for granted. Mobile learning has a double advantage: on the one hand, students strive to use mobile access to educational information and systems, on the other hand, this technology can significantly improve and enrich the learning process. The main advantage of mobile learning (m-Learning) is that if it is not possible to obtain information from other sources, when a person is on the street and needs some information or help in solving a problem, he can get it by phone [2].

Mobile technologies have the following significance in education [3]:

- allow the introduction of new technologies into the educational process;
- mobile devices are much lighter and more compact than books, computers, etc.;
- can be used as part of education using various types of activities (blended learning);
- support the learning process.
- can be used by a group of students participating in the training;
- can be used as a tool for students with disabilities;
- allows the student to identify areas where more intensive training is required.

Therefore, it is necessary to form a culture of using mobile technologies, including platforms such as Kahoot, Softr, Draftbit, FlutterFlow, Bubble, Appy Pie's App Builder, Jotform Apps, Zapier Interfaces, GlideAPPS, Bildr, Backendless, and Adalo, when organizing independent learning. Let's briefly get acquainted with the capabilities of these mobile platforms.

Kahoot is an innovative mobile app development platform that allows students to conduct interactive tests, debates, and surveys [4]. The platform combines text, images, and videos to make learning more engaging and effective. Through a user-friendly interface, teachers and students can test their knowledge together, remotely or through direct participation. Kahoot encourages collaboration in the learning environment and makes learning more engaging.

Softr is an innovative platform that allows users to create web applications by dragging and dropping various elements without writing code [5]. This platform allows users to quickly implement their ideas using an intuitive interface, without having to have programming knowledge. With Softr, users can easily deploy and use the

necessary components to create various websites, applications, and databases. This is convenient not only for those who do not have detailed technical skills, but also for professionals who are looking for time-saving and quick solutions.

Draftbit is an intuitive, no-code platform designed to simplify the process of building and launching mobile apps [6]. This platform allows users to quickly and easily create modern and functional mobile apps, even without being a programmer. With Draftbit, you can customize your app by selecting and combining different design elements. This process is not only efficient, but also convenient, since it does not require writing code. Draftbit also comes with advanced integrations and real-time preview capabilities, which provides a more independent and creative approach to building your app. FlutterFlow is a low-code platform that allows users to quickly and easily build native mobile and web apps [7]. This platform provides developers and designers with the ability to design and develop their apps through an intuitive interface, without writing complex code. With FlutterFlow, users can combine different design elements to create interactive and engaging apps. It also offers out-of-the-box integrations, database management, and real-time visualization capabilities, which accelerates software development and ensures a more efficient process.

Bubble is a modern platform for creating interactive, multi-user applications for web and mobile devices [8]. This platform helps users develop complex applications quickly and easily, even for users without programming knowledge, through a user-friendly interface. With Bubble, you can add various functions, manage databases, and customize the design. This gives you great advantages in implementing innovative ideas and creating competitive products.

Appy Pie's App Builder is a no-coding platform that allows users to create mobile applications for Android and iOS devices in minutes [9]. This convenient tool provides an intuitive interface for any user to bring their ideas to life, even without complex programming knowledge. With Appy Pie, you can easily carry out the processes of designing, designing, and launching your application.

Jotform Apps is a no-code app creation tool that allows users to quickly and easily create custom apps [10]. With this no-code platform, you can create apps that include the necessary functionality for your business or personal purposes. Jotform Apps, with its intuitive interface and advanced templates, provides convenience for any user, while offering innovative solutions.

Zapier Interfaces is an innovative platform that allows users to create mobile apps without requiring coding experience [11]. With this platform, any user can quickly and easily implement their ideas through intuitive interfaces. Zapier Interfaces also provides various integrations and automation capabilities, simplifying workflows and increasing efficiency. This helps entrepreneurs and teams operating in any industry to quickly develop their products or services.

GlideAPPS is a no-code platform for building mobile apps, emphasizing user-friendliness and versatility [12]. With this platform, anyone, even those without programming experience, can easily and quickly implement their ideas. With its intuitive interface and various templates, GlideAPPS allows users to easily design and customize their apps. This helps to develop creativity and streamline business processes.

Bildr is an innovative platform for building a variety of applications, including web apps, Chrome extensions, progressive web apps for mobile devices, and blockchain-integrated applications for Web3 [13]. It allows users to quickly and efficiently implement their ideas. By simplifying the app development process with Bildr, developers and creators can create high-quality products using modern technologies.

Analysis and Results

According to the above analysis, the use of mobile technologies in organizing independent learning of students offers a number of advantages. Mobile technologies allow students to effectively manage their time, easily access resources, and facilitate the acquisition of additional information outside of classes. They also support interactive teaching methods, which increases student motivation and activates their participation in the educational process. Through mobile applications and platforms, students can communicate with each other, exchange ideas, and gain experience. As a result, such an approach stimulates independent learning, encourages students to acquire new knowledge, and supports their personal development.

Conclusions

Mobile technologies play an important role in making students' independent learning more effective and efficient. They make the learning process interactive and convenient, while creating opportunities for students to consolidate their knowledge and easily obtain new information. Through mobile applications, online platforms and resources, students have access to course materials anywhere and at any time, as well as the opportunity to self-assess and share ideas. This increases their interest in learning and develops independent thinking skills. Also, with the help of mobile technologies, students can plan their time more effectively and actively participate in the learning process.

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[12] Web page address of the used platform *https://www.glideapps.com/*
[13] Web page address of the used platform *https://www.bildr.com/*

UDC: 37, 378, 61

THE EFFECTIVENESS OF USING INTERACTIVE EDUCATIONAL PLATFORMS IN SHAPING THE PROFESSIONAL ACTIVITIES OF MEDICAL UNIVERSITY STUDENTS

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Annotatsiya. Ushbu maqolada ta’lim platformalari imkoniyatlari, ulardan ta’lim jarayonida foydalanish muammolari va yechimlariga oid ma’lumotlar keltirilgan. Shunungdek, ta’lim platformalaridan foydalanib klinik amaliyotlar bo‘yicha kasbiy ko‘nikmalarini shakllantirish usullari bayon etilgan shuningdek uning samaradorligini aniqlash maqsadida tajriba-sinov ishlari olib borilgan. Tajriba-sinov ishlari natijalarining samaradorlik darajasini aniqlashda Student-Fisher kriteriyasidan foydalanilgan.

Kalit so‘zlar: *platforma, global tarmoq, ta’lim platformasi, msdmanuals.com, gmail.com, Student-Fisher.*

Аннотация. В данной статье представлена информация о возможностях образовательных платформ, проблемах их использования в образовательном процессе и способах их решения. Также описаны методы формирования профессиональных навыков по клинической практике с использованием образовательных платформ, а также проведена экспериментальная работа с целью определения эффективности этих методов. Для определения уровня эффективности результатов экспериментальной работы использовался критерий Стьюдента-Фишера.

Ключевые слова: *платформа, глобальная сеть, образовательная платформа, msdmanuals.com, gmail.com, Student-Fisher.*

Abstract. This article presents information about the capabilities of educational platforms, challenges in their implementation within the educational process, and ways to address these issues. The paper also describes methods for developing professional skills in clinical practice using educational platforms and reports on experimental work conducted to determine the effectiveness of these methods.

The Student-Fisher criterion was employed to assess the effectiveness of the experimental results.

Keywords: *platform, global network, educational platform, msdmanuals.com, gmail.com, Student-Fisher.*

Introduction

The reform of medical education in our country and its development in accordance with curricula that meet international standards have become the foundation for improving the medical education system. Today, our country is paying significant attention to modeling the educational process through software, implementing digitalization in medical education practice, and integrating practice and theory. “Improving the quality of higher education, training competitive personnel, effectively organizing scientific and innovative activities, and developing international cooperation based on ensuring a strong integration of science, education, and production, taking into account the needs of the social sphere and economic sectors.” Therefore, the use of digital tools in teaching subjects, particularly specialized medical subjects, contributes to the development of students’ professional skills.

Literature Review

Use of platforms to master independent learning hours of theoretical, practical and clinical practice exercises allows the student to control and correctly direct his/her educational activities, save study time due to the use of computer computing capabilities, visualize educational materials, model and simulate the educational processes being studied, form optimal decision-making skills in various pedagogical situations, develop a specific form of thinking (demonstrative-figurative, theoretical), and form professional skills. [1, 2, 8-10].

Therefore, teaching the general medical discipline can help students improve their independent theoretical and practical skills and develop their professional competence.

Among the pedagogical-psychological scientists of our country, Ibragimova G.I., Sharipov Sh.S., Usmonboyeva M.H., Nishonova Z.T., Karimova V.M., Sunnatova R.I., Qodirov B.R., Aliev A., Adizov B., Bekmuratova N.A., Vakhidova L.V., Goziev E.G., Zoyirov K.A., Mirzaakhmedov B.M., Kaldibekova S.A., and Davletshin M.G. conducted research on the development of creative abilities, but Kadirova M.R. on the methodological improvement of the professional competence of students in medical higher educational institutions, Kurbanova G.N., Rahimova E.Yu. on the development of professional thinking through pedagogical communication in students of medical higher educational institutions, and on the formation of professional competence in students of medical colleges. Psychologist Kuldasheva G.D. worked on the issues of diagnosing motivation, Akhmedova N.D. on the issues of developing a system for educating professional and spiritual qualities in future doctors, and Ergasheva Sh.P. conducted research aimed at developing communicative competence in preparing medical students for professional activity [3-7].

Among the studies aimed at developing the professional qualities of medical personnel, A.A. Petrov’s study of the ethnopedagogical culture of a general practitioner and Sh.Sh. Akhmadaliyev's monograph “Methodology of developing imitation educational technologies in the process of medical education” were studied [2].

Research and analysis show that the use of educational platforms in the process of teaching general professional subjects in the preparation of medical students for professional activity has not been studied as a problem.

Research Methodology

An experimental study was conducted to determine the effectiveness of theoretical, practical and clinical practical training organized using the https://www.msdmanuals.com/ educational platform in teaching general professional subjects in higher medical education institutions. In order to determine the effectiveness of theoretical, practical and clinical practical training in the subject "Propedietic Internal Diseases" using the msdmanuals.com educational platform, a total of 54 requirements for the "Treatment Work" direction were involved in the experimental and control groups. The training was organized using the methodology recommended within the framework of the study for students allocated to the experimental group. The control group was not given this opportunity. The results of the students involved in this experimental study were analyzed and mathematical and statistical analysis was performed based on the Student-Fisher criterion to verify their reliability. When using this criterion, the appropriate mean values for the samples $\overline{X} = \frac{1}{n}\sum_{i=1}^{4} n_i X_i$, $\overline{Y} = \frac{1}{n}\sum_{i=1}^{4} n_i X_i$ The formula was used. According to the calculation results, it turned out that the average mastery index of the experimental group was higher than that of the control group, that is, it increased by 8.5%.

Analysis and Results

Today, the use of 3D visual graphics is considered effective in increasing the efficiency of teaching subjects, especially general professional subjects, in higher medical educational institutions and in developing the clinical practical activities of students. Currently, there are many educational platforms that are used to conduct practical and clinical practice exercises in teaching general professional subjects of medicine. An example of this is the educational platform located on the global network at https://www.msdmanuals.com/. We give the sequence of use of these platforms in practical and clinical practical exercises:

1. https://www.msdmanuals.com/ - To do this, if you have a gmail.com email address, you can log in to the platform through the "Free Registration" menu.

Figure 1. https://www.msdmanuals.com/ platform usage process screenshot image.

2. A section of general medical disciplines appropriate to practical and clinical practice topics is selected.

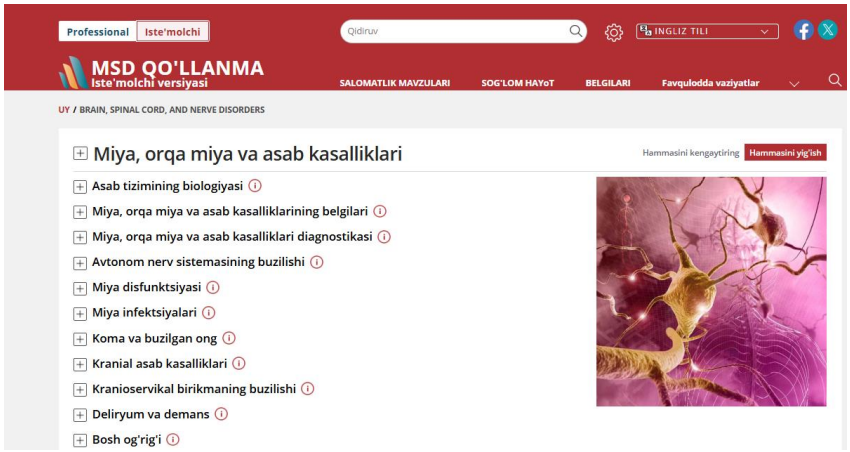

Figure 2. https://www.msdmanuals.com/ platform usage process screenshot image.

3. Theoretical and practical information from the selected section of the platform will be provided during the training.

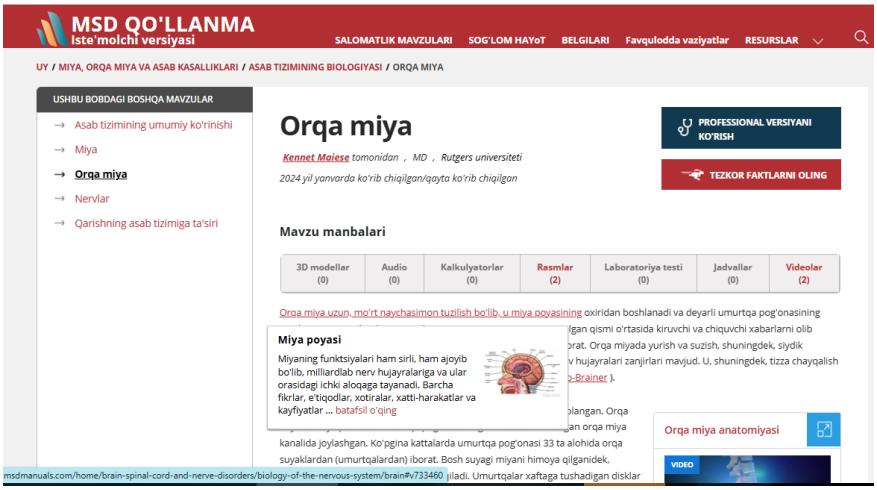

Figure 3. https://www.msdmanuals.com/ platform usage process screenshot image.

In addition, this section develops professional practical skills using a clinical practice video guide.

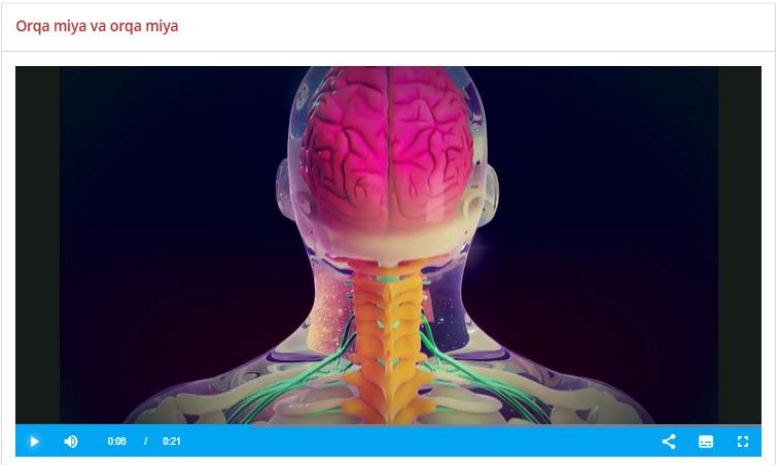

Figure 4. https://www.msdmanuals.com/ platform usage process screenshot image.

4. The Test Your Knowledge section of the https://www.msdmanuals.com/ platform is used to strengthen practical and clinical practice skills on the topic.

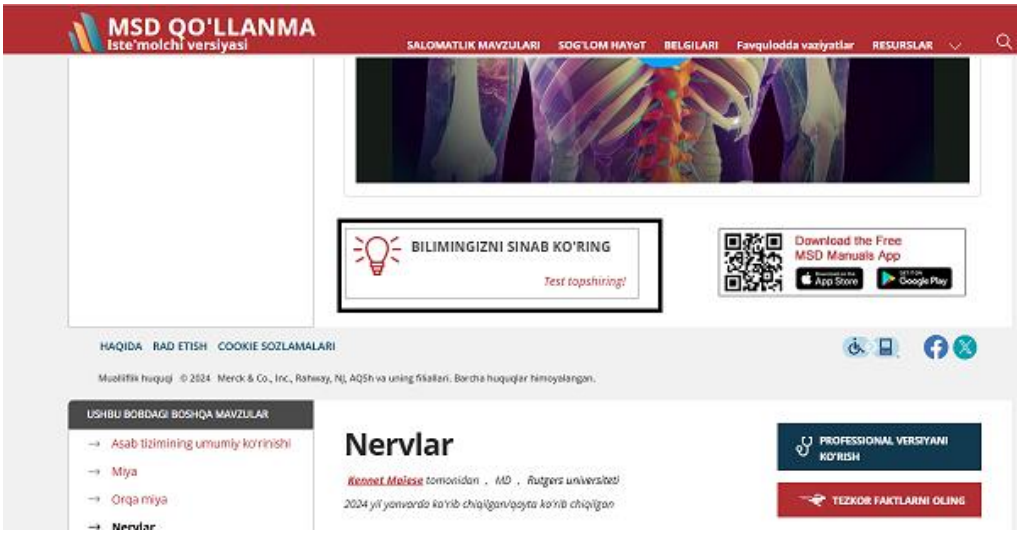

Figure 5. https://www.msdmanuals.com/ platform usage process screenshot image.

5. In addition, the resource section of this platform is presented in the form of a 3D model, which will allow students to gain practical skills and realistic visualization.

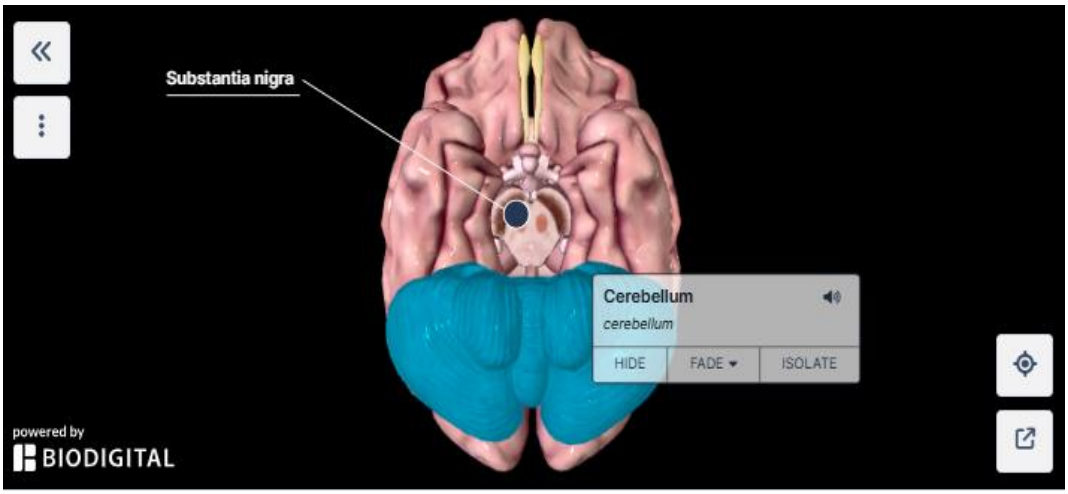

Figure 6. Screenshot image of https://www.msdmanuals.com/ platform usage process.

6. There is also the option to use the platform's mobile applications.

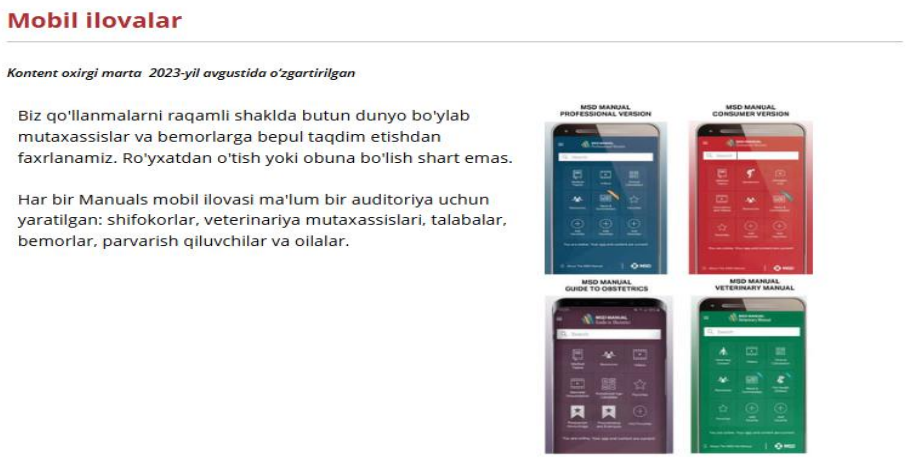

Figure 7. Screenshot image of https://www.msdmanuals.com/ mobile version of the platform.

Students develop professional and practical skills in general medical disciplines through independent learning through practical and clinical practice.

Conclusions

One of the main tasks of today is to create a repository of knowledge that includes various fields of science. That is, the introduction of new information technologies into education ensures the transition from the traditional teaching process to a new process in which students themselves determine the course of the educational process. In particular, the use of general medical disciplines in teaching forms professional skills in students and gives them the opportunity to independently acquire knowledge and self-control.

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INTEGRATIVE TEACHING METHODOLOGY FOR STUDENTS' LANGUAGE ACQUISITION BASED ON LITERARY TEXTS

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Annotatsiya. Ushbu maqola talabalar tomonidan ingliz tilidagi badiiy matnlarni o'zlashtirish samaradorligini oshirishga alohida e'tibor qaratilgan. Shuningdek, Ingliz tilini badiiy adabiyot matnlari asosida integrativ ta'lim orqali o'qitish nafaqat til ko'nikmalarini rivojlantiradi, balki o'quvchilarda tilni madaniy va estetik nuqtai nazardan anglashni shakllantiradi. Bu yondashuv talabalarning bilimlarini tizimlashtirishga, o'ziga ishonchni oshirishga va akademik yutuqlarga erishishga yordam beradi.

Kalit so'zlar: *integrativ o'qitish yondashuvi, integratsiya turlari, badiiy asar, badiiy janr, akademik yutuqlar.*

Аннотация. В данной статье основное внимание уделяется повышению эффективности восприятия студентами литературных текстов на английском языке. Кроме того, обучение английскому языку на основе литературных текстов через интегративное образование не только развивает языковые навыки, но и способствует формированию у студентов понимания языка с культурной и эстетической точек зрения. Такой подход помогает студентам систематизировать свои знания, повышать уверенность в себе и достигать академических успехов.

Ключевые слова: *интегративный подход к обучению, виды интеграции, литературное произведение, литературный жанр, академические достижения.*

Abstract. This article focuses on improving the effectiveness of students' comprehension of literary texts in English. Additionally, teaching English based on literary texts through integrative education not only develops language skills but also fosters students' understanding of the language from cultural and aesthetic perspectives. This approach helps students systematize their knowledge, boost self-confidence, and achieve academic success.

Keywords: *Integrative teaching approach, types of integration, literary work, literary genre, academic achievement.*

Introduction

In the educational process, interest and attention to increasing the effectiveness of education through the use of innovative methods are growing day by day. Lessons that incorporate modern technologies are aimed at enabling students to independently search for, learn, and analyze the knowledge they acquire. In this process, the teacher plays a crucial role in choosing the appropriate forms of education, organizing lessons based on modern technologies, and creating conditions for personal and collective

development, learning, and upbringing. Alongside this, the teacher also fulfills the role of a manager and guide.

Every pedagogical technology is based on teaching methods that, when applied in the learning process, contribute to the effective organization of lessons and help young people express their views on important achievements and challenges in life. Furthermore, they create opportunities for students to communicate freely in English, think critically, and substantiate their perspectives, leading to effective outcomes in teaching the language.

Literature Review

In the integrative educational process, it is important to consider the specific features of forming students' communicative competence. It should be noted that the methodological foundations of this approach have been examined in the works of various scholars.

Abdulla Avloniy, in his works on education and upbringing, promoted elements of integrative teaching. He emphasized the importance of combining the moral, scientific, and practical aspects of education [1-5]. Karimov Sh.Sh. made significant contributions to developing the theoretical foundations of integrative education and focused on enhancing interdisciplinary connections to foster systematic thinking in students. A. Qo'chqorov conducted research on the application of integrative teaching methods in the context of Uzbekistan [6]. Yuldasheva M.E. provided recommendations for the application of various integrative methods in the educational process, based on innovative approaches [7, 8]. Utebaeva A. developed a methodology and system of exercises for teaching English tenses by employing modular technology [9].

An analysis of dissertations and scientific developments reveals that issues related to integrative English teaching through literary texts for effective comprehension of study materials by students have not been fully explored.

Research Methodology

The first step in conducting the pedagogical experimental work was identifying the experimental bases. The experimental work was carried out in three stages, with GSU, TSPU, and FSU selected as the experimental sites. Experimental sessions were organized in these higher educational institutions based on didactic principles, and the composition of experimental and control groups was determined.

The experimental work was conducted during the 2021–2022, 2022–2023, and 2023–2024 academic years in the "Foreign Language and Literature (English Language Direction)" program. A total of 634 students participated in the experimental work, and 12 professors and lecturers from the three universities were involved in implementing the integrative teaching methodology (Table 1).

Table 1. Experimental Sites and Number of Respondents in the Pedagogical Experiment.

Experiment	Experimental Group	Control Group	Total Students	Professors and Lecturers
GSU	105	106	211	4
TSPU	105	106	211	4
FSU	106	106	212	4
Total	316	318	634	12

For the experimental studies conducted in the designated higher educational institutions, practical lessons were organized based on didactic principles.

Analysis and Results

One of the approaches used in language acquisition through literary texts is the integrative-purposeful approach. The main goal in teaching a literary text is to help students derive aesthetic and creative impressions from the works they read, as well as to deeply understand the ideas presented in the text. At every stage, it is essential for the teacher to consider the thoughts and emotions of the students.

In literary texts, repetition among lexical and syntactic devices-such as lexical, pronominal, synonymic, and semantic aspects-plays a significant role. Attention should be given to how repetition serves as a common means of connecting sentences. Additionally, developing students' speech systematically requires the use of visual and auditory word categories. To achieve this, focus should be placed on pronominal relationships, including personal and demonstrative pronouns like he, you, they, this, and that. When the material in literary texts is dynamic, it is easier to remember linguistic facts. For this purpose, teaching speech activity is carried out by "ensuring the communicative nature of the educational process and giving it a communicative form" [7].

Our analysis shows that the stages of integrative teaching consist of several algorithms aimed at developing the ability to understand logical connections within lexical and syntactic means and individual semantic segments, enabling students to effectively master English learning materials:

1. **Motivation Stage** – Based on the materials of literary texts, this involves developing the communicative intention to convey a speech idea (information, messages, requests, etc.).

2. **Analytical and Synthetic Stage** – This focuses on selecting linguistic structures for the grammatical design of speech. For example, the communicative purpose of interrogative sentences lies in obtaining information. Questioning is expressed as follows: a) Question constructions with question words; b) Question constructions without question words; c) Neutral statements; d) Indirect questions; e) Interrogative intonation. The most commonly used constructions are sentences with question words.

3. Execution Stage – This involves the ability to perform speech actions related to expressing thoughts (information, reports, statements, explanations). This stage helps students develop skills in working with literary texts.

In traditional education, students often listen to structured information presented by the teacher and acquire knowledge based on prepared instructions. In such a reproductive learning process, students engage in activities like memorizing dictated information, giving examples based on instructions, and repeating what the teacher has said. This makes them mere observers and listeners in the educational process.

Integrative teaching in English motivates students to think independently, fosters creativity, and enhances the systematization of their knowledge. In this context, an important factor in students' ability to master knowledge thoroughly is the development of creative qualities and training them to think independently.

In experimental research, the students successfully acquired initial skills in logically dividing information into parts, comparing them, identifying objects, and conducting scientific analysis of results. The effectiveness of the methodology was confirmed during English language sessions.

As a result of our research, it was observed that in all selected educational institutions, which served as experimental platforms, the effectiveness of learning English study materials in the experimental group was 1.13 times higher as shown in Table 1. This demonstrates the effectiveness of the conducted research work.

Conclusions

Methodology for studying educational tendencies should rely on the methods for understanding objective integral processes within the system of educational content. On the other hand, be based on the methods and techniques used to improve learning. Thus, in the effective assimilation of educational materials through literary texts, integrative teaching of English focuses on the required speech skills and competencies aligned with selected grammatical, lexical, and phonetic materials. The communicative content of the teaching ensures the active engagement of students in verbal interactions.

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UDC: 308, 316

THE ROLE OF KNOWLEDGE IN HUMAN SPIRITUAL DEVELOPMENT

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Annotasiya. Ushbu maqolada inson ma'naviy kamolotda ma'rifatning o'rni bilan bog'liq vazifalar va inson ma'naviy kamolotida ziyolilik madaniyatini rivojlantirish uning bilimlari doirasini oshirish, turli g'oyalardan voqifligi me'yorini yuksaltirish, qadriyatlari tizimini takomillashtirish niyatida amalga oshirilgan ma'rifiy faoliyat xususida ham fikirlar aytib o'tilgan.

Kalit so'zlar: *ma'rifat jamiyat, inson, savodxonlik, zamon, faoliyat, taraqqiyot.*

Аннотация: В данной статье задачи, связанные с ролью просвещения в духовной зрелости человека и развитием интеллектуальной культуры в духовной зрелости человека, решаются с целью расширения объема его знаний, повышения уровня его знаний различных идей, и совершенствования системы ценностей, были также упомянуты идеи о рифовой деятельности.

Ключевые слова: *Общество Просвещения, человек, грамотность, время, деятельность, развитие.*

Abstract. This article discusses the tasks related to the role of knowledge in human spiritual development and emphasizes the importance of fostering intellectual culture in this process. It highlights the need to expand knowledge, enhance awareness of various ideas, and improve the system of values through educational activities aimed at achieving these goals.

Keywords: *enlightenment, society, human, literacy, time, activity, development.*

Introduction

For centuries, educated and enlightened individuals in our country have been respected, and those eager to acquire knowledge have held a level of respect for their fellow citizens who possess knowledge to the extent of forgiving certain shortcomings. However, it cannot be overlooked that factors capable of negatively impacting the progressive characteristics inherent in intellectual culture are emerging. In the context of the new reality, such negligence may lead to a narrowing of the scope of individual knowledge, a crisis in moral values, a disconnection from humanitarian ideals, and a distancing from national and universal values. Therefore, it is essential to assess this issue as a task of strategic importance related to the spiritual security of society and its social development. Addressing this task begins with the substantive improvement and modernization of cultural enlightenment in our country, clarifying its goals and objectives, establishing its priority directions, and ensuring coherence, systematicity, integrity, and continuity.

Literature Review

In a broad sense, enlightenment refers to the process of disseminating and promoting various forms of knowledge. However, we believe that a slight amendment to this definition is necessary. The point is that not all forms of knowledge dissemination can be considered as enlightenment. Throughout human history, while a collection of positive and constructive knowledge has emerged, there has also been an accumulation of inhumane knowledge and information. Promoting the latter cannot constitute enlightenment and will never be so. Therefore, enlightenment should be understood as a concept that encompasses "the body of knowledge, information, education, and the educational system concerning the nature, society, and essence of humanity" [1]. It is evident that this concept is used to express the aggregate of cultural and educational activities as well as to name organizations engaged in such activities in the country. One use reflects the scientific-theoretical interpretation of the concept of "enlightenment," while the other represents its practical interpretation.

The primary goal of enlightenment is related to the dissemination of ideas and knowledge that lead to the spiritual development of individuals and the progress of society, as well as the cultural achievements associated with these endeavors. Its tasks and components may vary according to the demands of the time. For example, at the beginning of the century, the main task of enlightenment in our country was to increase the literacy of the population, while today, the dissemination of humanitarian ideas and knowledge is at the forefront. The same can be said about the composition of cultural and educational institutions: these establishments are continually evolving in content and structure in accordance with contemporary trends, and their social functions also change accordingly.

Enlightenment is not a process that is carried out in a single direction. Due to the diversity of fields of ideas and knowledge, as well as the variety of material and spiritual values created, it is pursued in multiple directions. In this context, one can encounter concepts in scientific literature such as "political enlightenment"[2], "legal enlightenment" [3], "moral enlightenment" [4], "religious enlightenment" [5], "pedagogical enlightenment" [6], "ecological enlightenment" [7], and "gender enlightenment." Cultural enlightenment is one of these distinctive aspects of enlightenment.

Analysis and Results

Cultural enlightenment refers to educational activities aimed at developing the culture of intellectuals, expanding the scope of their knowledge, raising the level of awareness regarding various ideas, and improving the system of values. This process occurs in harmony with the fundamental needs and interests of society. Its quality and character depend on people's perceptions of culture and the level of individual cultural development. As fundamental needs and perceptions change, the form of cultural enlightenment in society also evolves. For instance, at the beginning of the last century, the issue of increasing population literacy became a social necessity. Consequently, one of the main tasks of cultural enlightenment was related to eradicating illiteracy. Today, the promotion of extremist ideas is becoming one of the most serious factors

negatively affecting an individual's cultural level. As a result, one of the primary tasks of cultural enlightenment is associated with forming ideological immunity.

Cultural enlightenment necessitates the existence of a certain structural framework within society. It comprises various educational institutions, cultural houses, public organizations, creative associations, clubs, information resource centers, and similar entities. One of the main directions of the activities of museums, cinemas, theaters, and other cultural institutions is also related to cultural enlightenment. Throughout historical development, changes in the tasks of cultural enlightenment have correspondingly led to the renewal of this framework, resulting in distinctive characteristics and functions of its structural elements.

The emergence of several social processes and ills that negatively affect the characteristics of the culture of intellectualism in Uzbekistan over the centuries has brought the task of modernizing, systematizing, and optimizing cultural and educational activities to the forefront. To address this socially significant task, we believe it is necessary to develop a "Concept of Cultural Enlightenment in Uzbekistan."

The primary goal of this concept should be to direct all intellectual potential in society towards the optimization and modernization of cultural and educational activities. The devaluation of scientific knowledge, the emergence of norms contrary to ethics, the rise of elements of ideological nihilism, the increase in the promotion of destructive ideas, the proliferation of pseudo-values and counter-values, the deformation of national traditions and rituals, and the development of pseudo-literature and pseudo-art necessitate addressing the following tasks within the framework of the concept:

Firstly, it is impossible to optimize and modernize cultural and educational activities without ensuring the supremacy of science in society. The increasing prevalence of various social ills that lead to a decline in the culture of intellectualism in the new century has brought the issue of enhancing the prestige of science to the agenda. This is because the role of science is invaluable in shaping a secular worldview, developing analytical thinking, and establishing a humanitarian approach to ideas and values. In a society where the prestige of science is high, the cultural development of the individual takes on meaningful content and form, providing protection against various ills, and creating conditions for the formation of a scientific worldview.

Firstly, it is impossible to optimize and modernize cultural and educational activities without ensuring the supremacy of science in society. The increasing prevalence of various social ills that lead to a decline in the culture of intellectualism in the new century has brought the issue of enhancing the prestige of science to the agenda. This is because the role of science is invaluable in shaping a secular worldview, developing analytical thinking, and establishing a humanitarian approach to ideas and values. In a society where the prestige of science is high, the cultural development of the individual takes on meaningful content and form, providing protection against various ills, and creating conditions for the formation of a scientific worldview. pecifically, the state has allocated 8.5 billion Uzbek sums for financing projects implemented within the framework of scientific and technical programs, 1.5 billion sums for financing innovative projects, 7.7 billion sums for the maintenance costs of unique objects and institutions serving science, as well as an additional 2.2 billion sums for other expenses

related to the development of science" [9]. The percentage of allocations from the state budget for science has not exceeded 0.2 percent of the gross domestic product even until the year 2020 [10]. However, in developed countries, such as Germany, 3.02 percent of the gross domestic product is allocated for such purposes [11]. The scarcity of allocations for the development of science has, on one hand, diminished the prestige of science in society, on the other hand, it has harmed the reputation of scientists, and thirdly, it has reduced the number of young people aspiring to pursue science.

In recent years, we have witnessed a significant change in this regard. The development of science has become one of the priority directions of state policy. "The head of state frequently emphasizes that ensuring the priority of science, supporting the activities and research of leading scientists and talented young researchers, and enhancing the prestige and reputation of representatives of science in society are among the top tasks of our nation" [12]. The proposed concept should also include measures aimed at ensuring the priority of science and knowledge in society. Secondly, it is impossible to optimize and modernize cultural and educational activities without ensuring moral precedence in society. This is because "morality is the historically formed behavior, conduct, social and personal interactions of individuals, as well as a stable set of specific norms and rules that regulate relationships with society" [13].

Conclusions

The foundations of morality in Uzbekistan have always been strong throughout all times. The social prestige of individuals and interpersonal relationships have been assessed and regulated based on moral norms. However, as we pointed out upon entering the new century, there has been an increase in norms that contradict morality. As a result, individuals who have a negative attitude towards cultural and educational events that encourage adherence to moral norms have begun to emerge. Currently, such attitudes are hindering the improvement of cultural and educational activities and the adaptation of moral education to modern demands. In recent years, the weakening of attention to social sciences at various levels of the education system in Uzbekistan has also failed to contribute positively to the situation. The number of social sciences taught in educational institutions has been significantly reduced, and their teaching hours have been decreased. This approach has limited the educational impact of social sciences. Yes, it is precisely the social sciences that are considered one of the key factors that enable the maintenance of moral precedence in society, and methodologies such as genetic analysis hold significant methodological importance.

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PROBLEMS AND THEIR SOLUTIONS PECULIAR TO SHASHMAKAM YESTERDAY AND TODAY

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Annotasiya. Ushbu maqolada o‘zbek mumtoz san’at durdonasi Buxoro Shashmaqomi bugunki kun muammolari va uning yechimi xaqida mulohaza yuritiladi. Ta’lim tizimlarida nota matni bilan ishlash va bu orqali bo‘lajak sozanda va xonandalarning nota o‘qish savodini oshirish ko‘zda tutiladi.

Kalit so‘zlar: *Daromad, Namudi Buzruk, Buzruk zamzamasi, Miyonxat, Zamzama, Furovard, Hang, Namudi Uzzol, Avji Chorgoh-Muhayyar, Avji Chorgoh-Muhayyar miyonxati.*

Аннотация. В этой статье рассматриваются проблемы сегодняшнего дня и пути их решения шедевра узбекского классического искусства Бухарский Шашмаком. В образовательных системах предусматривает работу с нотным текстом и тем самым повышение грамотности чтения нот будущих исполнителей солистов и певцов макома.

Ключевые слова: *Даромад, Намуди Бузрук, Замзама Бузрука, Мионхат, Замзама, Фуровард, Ханг, Намуди Уззол, Авджи Чаргач-мухайяр, Мионхат Авджи Чаргач-мухайяр.*

Abstract. In this article, the speech goes on about the today problems of the masterpiece of Uzbek classical art – Bukhara Shashmakom and the ways to solve them. Educational systems are designed to work with musical notation and thereby improve the musical literacy of future musicians and singers.

Keywords: *Daromad, Namudi Buzruk, Buzruk Zamzama, Mionkhat, Zamzama, Furovard, Hang, Namudi Uzzal, Avji Chargah-muhaiyar, Mionkhat of Avji Chargah-muhaiyar.*

Introduction

Modern methods of preserving intangible cultural heritage and the possibilities of their practical application remain one of the urgent problems today. The scientific works of our scientists and researchers working in Uzbekistan about the Bukhara Shashmakam, a masterpiece of classical art that is the national treasure of the Uzbek people, have a lot of theoretical foundations, but they do not harmonize with practice. The study of Shashmakam melodies by musicians and singers in the education system still continues in the traditional teacher-student method. Learning Shashmakam melodies by listening to audio recordings in various formats is in the first place. This cannot be called a bad thing, but the younger generation who are being educated develops only one-sidedly, and this is an approach typical of amateur and artistic and ensemble teams. Today, working with musical notation and thereby improving the

literacy of reading musical notation is one of the main requirements in the modern education system.

Literature Review

The musical texts written during the 20th century is written only in the book of Uspensky V.A. “Six musical poems”, in which the musical notes are written only in a quarter-length, without dividing them into khonas[1] and bazgoys[2] [1-3]. and Sarakhbari Buzruk is numbered only as I.1. 2.; II.1,2 in the Prose I-group Branch “Shashmaqom Buzruk I” of Yu. Rajabi [2-4].

Research Methodology

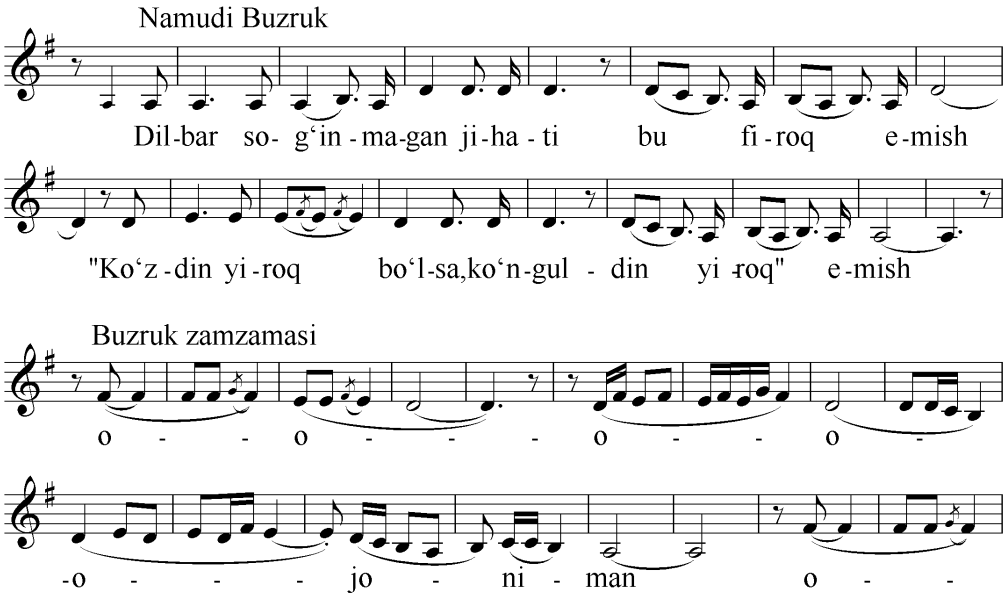
In this article, we will observe the example of Sarakhbari Buzruk, which was created based on the sound recordings of the Yunus Rajabiy makam ensemble under the TV and Radio Company of the Republic of Uzbekistan, which operates today, and is led by the People’s Artist of Uzbekistan Abdukhashim Ismailov.

Analysis and Results

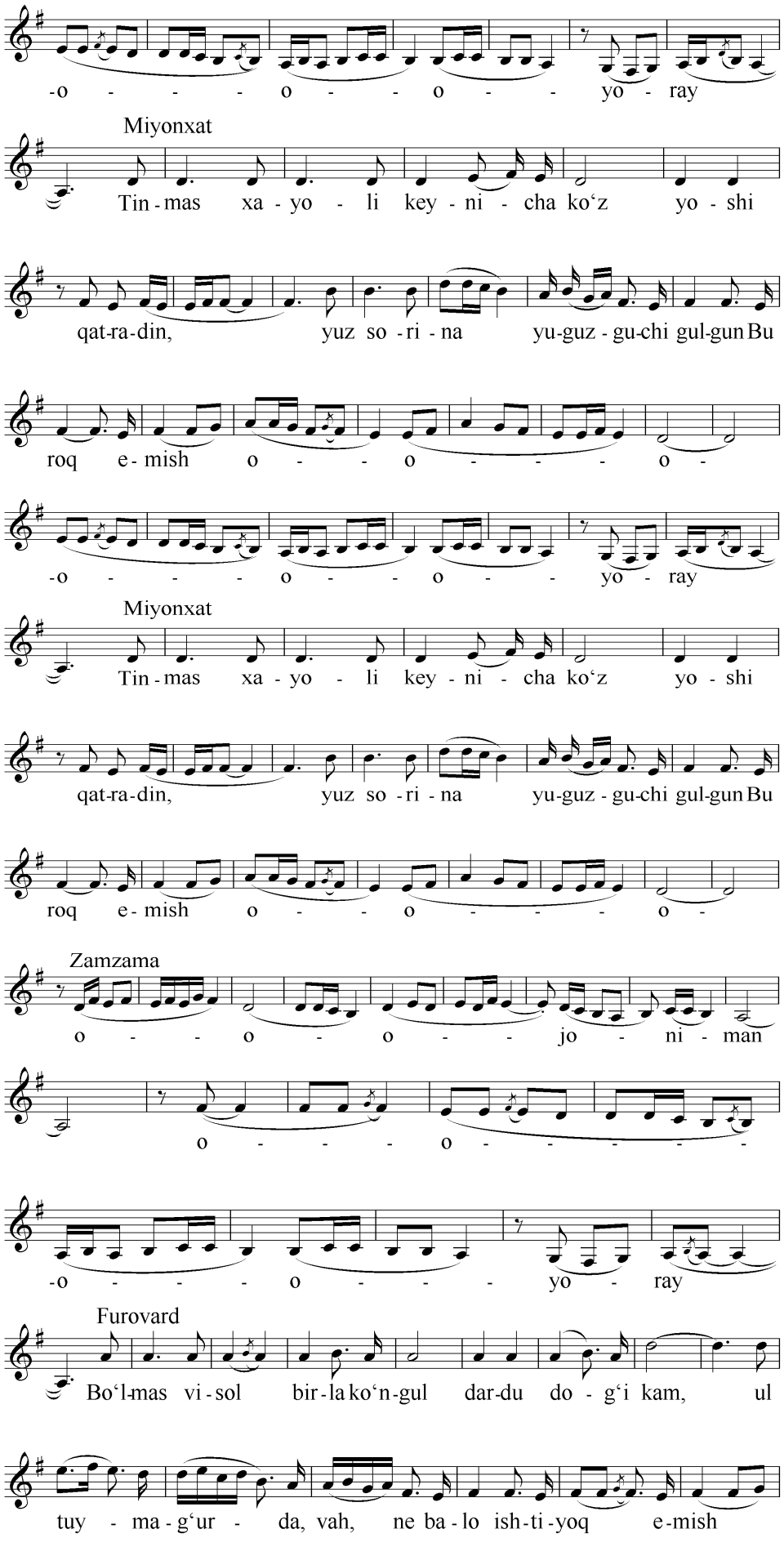
In the musical texts created until the 21st century, only musical notes and lyrics are written. For example, “Shashmaqom Buzruk I” [2]. Further complementing this tradition, if we divide the Daromad section of Sarakhbari Buzruk into sections such as Namudi Buzruk, Buzruk zamzama, Mionkhat, Zamzama, Furovard, Hang, Namudi Uzzal, Avji Chargah-Muhaiyar, mionkhat of Avji Chargah-Muhaiyar, Hang, Zamzama [6-9], it will be easier for the teacher and the student.

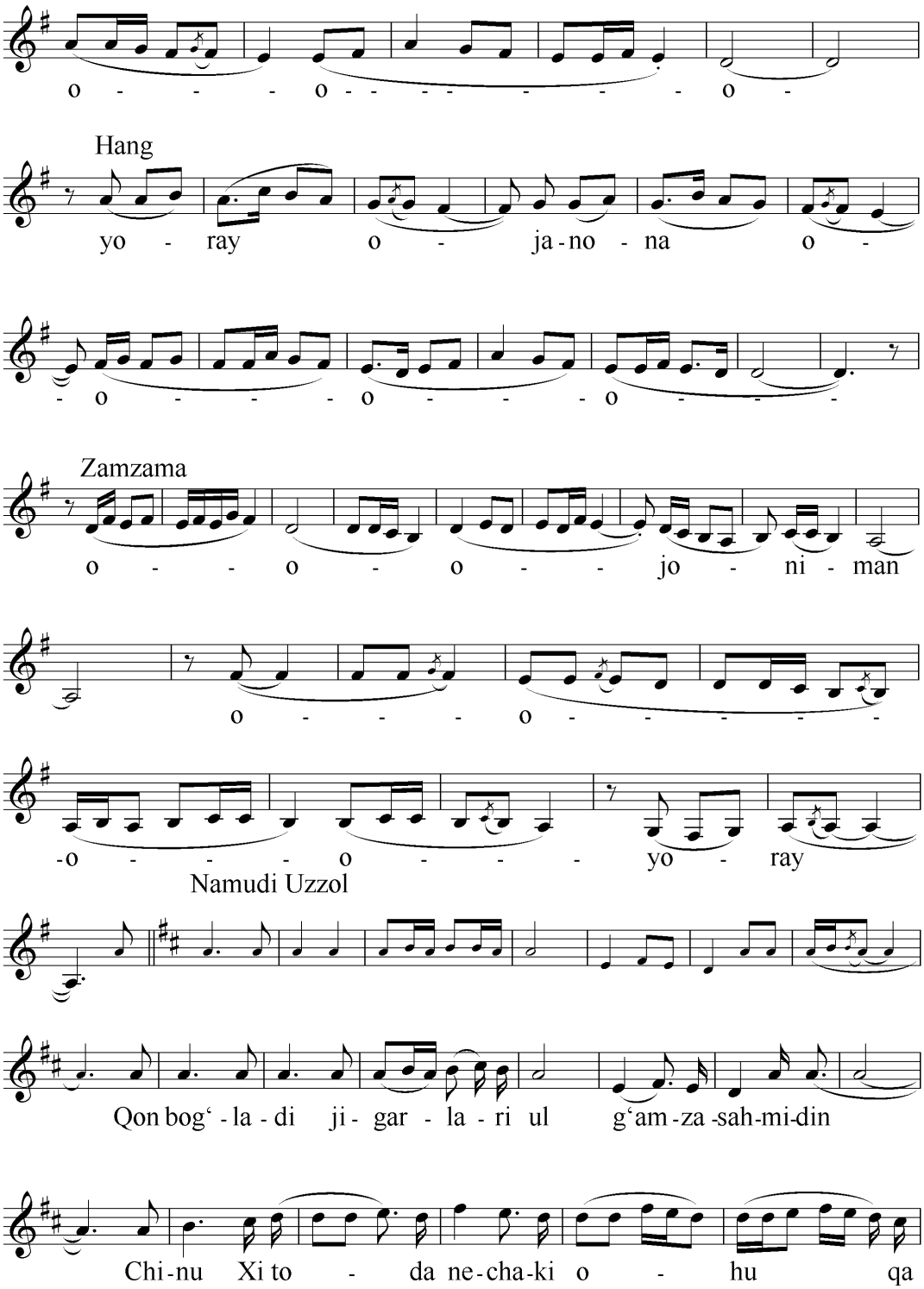
Such divisions are numbered in the score of the Uzbek Folk Instruments Orchestra, and the orchestra can play from this point whenever the number is needed during rehearsal [10]. In this case, it would be appropriate to introduce the terms makam into the traditional performance process.

Examples of the division of Sarakhbari Buzruk:

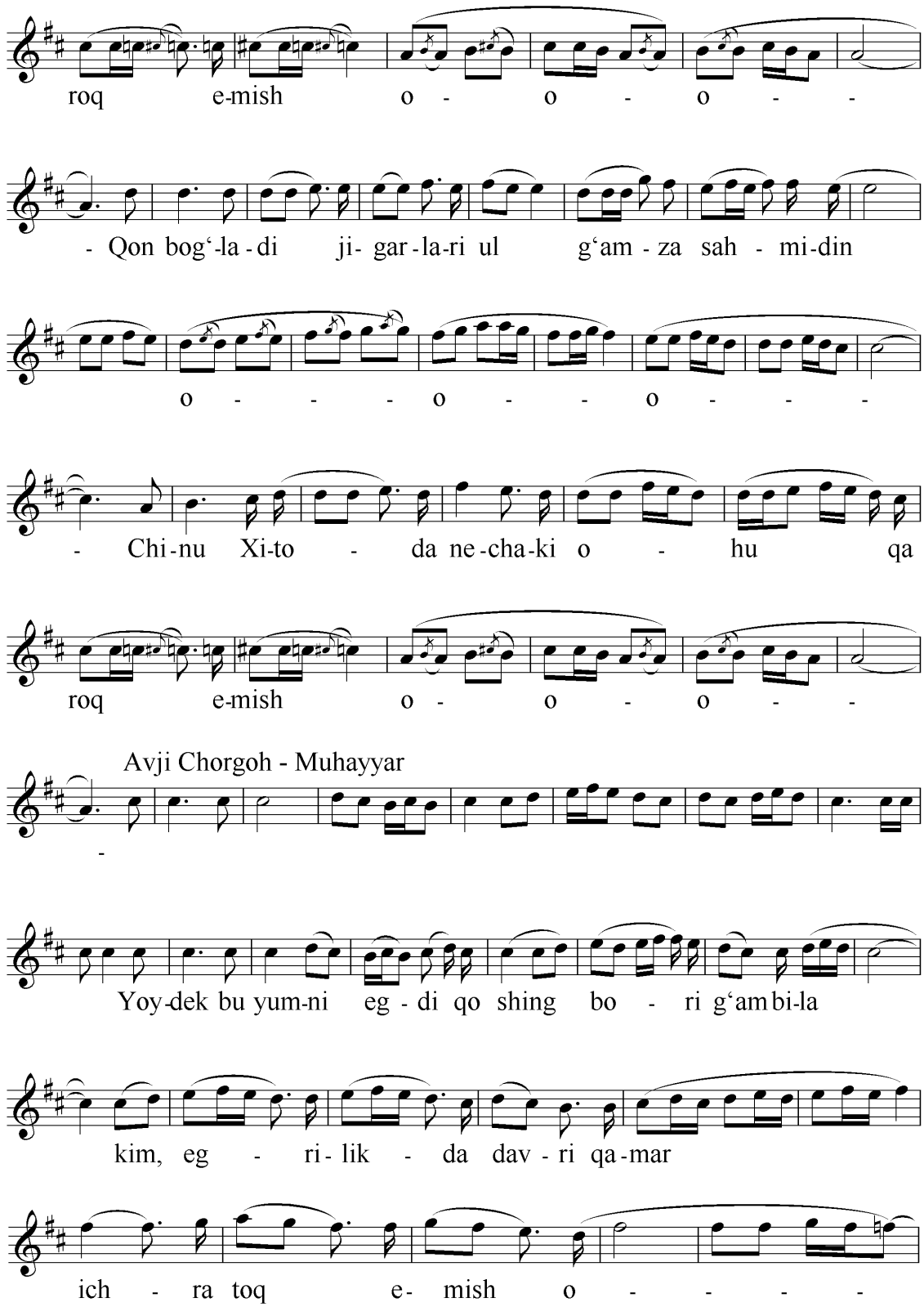


[1] Term meaning couplet in musical text.
[2] Term meaning refrain in musical text.

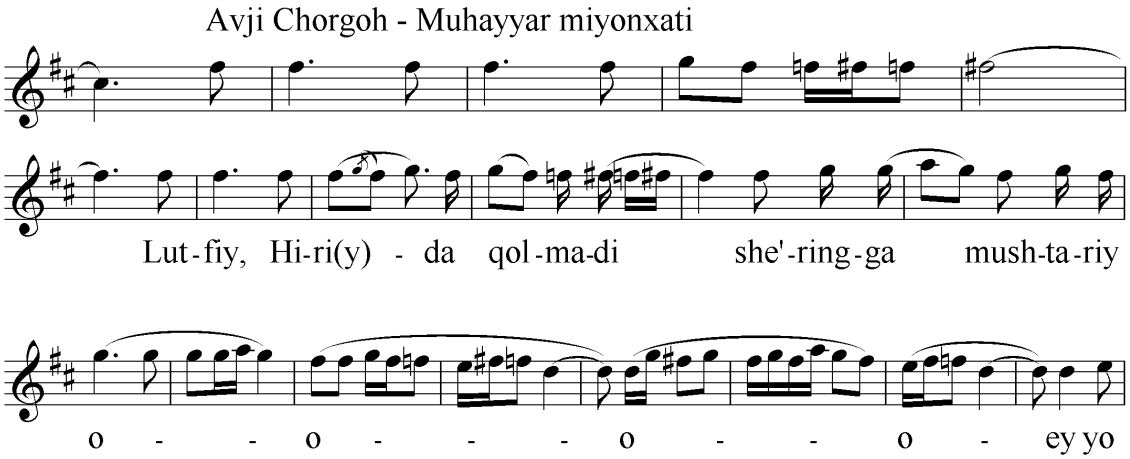

-o - - - o - - o - - yo - ray
Miyonxat
Tin - mas xa - yo - li key - ni - cha ko‘z yo - shi
qat-ra-din, yuz so - ri - na yu-guz - gu-chi gul-gun Bu
roq e - mish o - - o - - - o -
-o - - - o - - o - - yo - ray
Miyonxat
Tin - mas xa - yo - li key - ni - cha ko‘z yo - shi
qat-ra-din, yuz so - ri - na yu-guz - gu-chi gul-gun Bu
roq e - mish o - - o - - - o -
Zamzama
o - - o - o - - jo - ni - man
o - - - o - - - - -
-o - - - o - - - yo - ray
Furovard
Bo‘l-mas vi - sol bir - la ko‘n - gul dar-du do - g‘i kam, ul
tuy - ma - g‘ur - da, vah, ne ba - lo ish - ti - yoq e - mish



The charm of the work is further enhanced by the transition to another key in the “Namudi Uzzal” section after the “Furovard”, “Hang” and “Zamzama” sections of Sarakhbari Buzruk’s Mionkhati. The smooth transition in the “Avji Chargah-Muhayyar” namud used in the last part of the “Namudi Uzzal” section enriches the melodies of the climax of the work.



The epitome of the “Avji Chargah-Muhayyar” genre is the upper “Shakh Parda” section of the Sarakhbari Buzruk song. In this place, the lamentation of the final verses of Lutfi’s gazzelle further enhances the beauty of the work.



In addition to the notes of Sarakhbari Buzruk, it would be easier for the learner to place a QR code on the mp3 format audio recordings and post them on the Internet. In addition, since it is more difficult to understand classical terms in the text, it would be appropriate to provide a text-to-text explanation.

If we look at the development of classical music of the Eastern peoples on the example of Azerbaijan mughams, we can say that this area is well developed in them. Azerbaijan composer Uzeyir Gajibekov was able to find the right path to ensure the theory of mugham art and its practical performance. From children's musical school students to artists in this field, all Azerbaijan mughams have perfectly mastered the structure of the membrane. The structure of the shashmakam membrane is a condition that is characteristic only of a narrow circle of scholars.

In the 21st century, when global changes and rapid development are taking place, why should the Uzbek people's masterpiece of intangible cultural heritage, Shashmakam, which is on the UNESCO Representative List, lag behind? If the opinions of theorists and practitioners in this field do not converge, it will continue to stagnate for many years to come.

Conclusions

In conclusion, it can be said that if new textbooks and manuals were written in mp3 format and musical notation based on octave sounds of the same height, there would be emerged educated, good specialists in the future among the younger generation that is being educated now; it is no wonder that such outstanding, educated musicians and poets as Yunus Rajabiy, Fakhriddin Sadikov, Arif Khatamov and Arif Alimaksumov, who are still revered by our people, have been brought up. They will contribute to the development of makam art and will be responsible for passing it on to the next generation.

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HISTORICAL DEVELOPMENT OF INTERIOR AND DESIGN EDUCATION

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Annotatsiya. Ushbu maqolada interyer va dizayn ta’limining tarixiy rivojlanishi va mamlakatimizda dizayn ixtisosligidan mutaxassislarni tayyorlashdagi global tendensiyalar, xususan, professional dizayn ta’limi sohasidagi samarali loyihalar va tajribalar tahlil qilingan.

Kalit so‘zlar: *Interyer, dizayn, integratsiya, rangtasvir, metodologiya, texnologiya, loyiha, badiiy, tafakkur, grafik dizayn, tasviriy san’at, ilmiy-texnik.*

Аннотация. В этой статье анализируется историческое развитие образования в области интерьера и дизайна и глобальные тенденции в подготовке специалистов по специальности дизайн в нашей стране, в частности, эффективные проекты и опыт в области профессионального дизайнерского образования.

Ключевые слова: *Интерьер, дизайн, интеграция, живопись, методология, технология, проект, Искусство, мышление, графический дизайн, изобразительное искусство, научно-технический.*

Abstract. This article analyzes the historical development of Interior and design education and global trends in the preparation of specialists from the design specialty in our country, in particular, effective projects and experiments in the field of professional design education.

Keywords: *Interior, design, integration, painting, methodology, technology, project, art, thinking, graphic design, fine arts, scientific and technical.*

Introduction

In the context of the integration of the design education system of Uzbekistan into the world educational space, it is natural to be interested in foreign experience in this area. At the same time, an analytical, theoretical and Critical Study of the importance of the foreign experience of countries that significantly influenced the design project culture in the 20th century is considered important. This section attempts to analyze the most interesting examples by the author in the application of global trends in the training of their specialists in the design specialty, in particular, effective projects and experiments in the field of professional design education.

In the 21st century, worldwide design is considered a science with a science-based theory, an ever-evolving field with different schools and concepts, directions and manifestations, and an industry that drives marketing. Globally, Italy, Japan, the Netherlands, China and France are recognized as leaders in industrial design. The issue of training personnel in these countries will be focused on the state scale. While there are 74 training institutions in the UK for training industrial design professionals and more than 50 in France, China has established more than 400 design schools in the last decade.

Modern foreign design schools have rich technical bases. Architecture and design education in England, Italy, Germany, Spain, the United States, France, Japan are designated as the best schools in the world. World-famous names in architecture, fashion, art photography, graphic design, painting and other fine arts come mainly from these countries.

In particular, such qualifications as Analysis, Market Research and product promotion, team work, Corporate economy, modeling user behavior are formed on it. In this way, student-students work in similar directions throughout the educational stages, from year to year mastering the innovations of the field, conceptualizing, project-artistic thinking, analysis and Research, working with material, technology and software, studying the aesthetic and physical properties of objects [1]. This knowledge is considered qualification skills in the effective functioning of design practice.

Literature Review

In Germany, the school of designers was founded in 1955-1960 in Ulm as the Higher School of form building (nem. Hochschule für Gestaltung Ulm). The school was created at a time when the German economy was recovering. It was called the “restored Bauhaus.” The artist, designer and theorist Tomás Maldonado had to once again critically revise the Bauhaus qualification, with the aim of adapting the school to the economic, social and political environment in the modern world. As an educator, Maldonado placed great emphasis on the harmonization of design with scientific and technical progress and aesthetics [2].

Maldonado expresses his concept of art in his”manifesto of Discovery". In his opinion, the real world and the beauty of “clear art” replace the illusory aesthetics created by artists of the previous generation. “The different philosophies of design represent different attitudes towards the universe. It becomes clear in the world how we understand the world based on the place we give to design” [3].

In his 1949 article "Industrial Design and Its Social Importance" published in the journal Sea, he explained that the main goal of the product design process is to create

a form that is not only beautiful but also functional and of good quality [4]. It is this factor that distinguishes “real or realistic form-making” from decorative and stylized forms.

In particular, Tomas Maldonado was one of the first to solve the long-standing debate over the artistic and technical nature of design by separating design into two completely different areas: industrial and art design. According to his concept, industrial design places primary importance on the technical nature of the product, which is directly subordinate to its aesthetic quality.

In Germany, the initial stage of design education consists of six semesters, and students are offered a number of subjects to master. Among them, some subjects continue throughout the entire period of education. For example, in the Design Thinking course, students are taught to think like a designer. The Bauhaus pedagogical program is purposefully organized based on pedagogical rules that determine the professional characteristics, main goals and content, theory and methodology of training future specialists.

Research Methodology

Design education in Italy developed in connection with the need to restore the country's economy after World War II, in particular, to develop industry. An example is the development of small and medium-sized industrial enterprises based on new world technologies. Companies such as Olivetti, Piaggio, and FIAT focused their technological capacity on meeting everyday household needs. The activity in the construction sector further increased the demand for new equipment factories and serial production, which in turn increased the demand for designers working on product designs [5].

The founding of the Industrial Design Association (ADI) in 1956 raised hopes for a systematized design education. In due course, Higher Courses in Industrial Design were established in the schools of fine arts and crafts in Venice (1960), Florence (1962), and Rome (1964). However, a unified strategy for design education did not emerge [6].

The Triennale, which aimed to demonstrate individual creative forces in the field of design, also played a significant role in the development of Italian design. This event was a platform for displaying objects from traditional, folklore to futuristic, rationalistic research in one space. There was no programmatic unity in the two major architectural and art magazines: “Casabella”, which sought rationalism, and “Domus”, which, due to the editor-in-chief Ponti, demonstrated unlimited pluralism. Futurism and rationalism formed a unique design culture in Italy. One of them was the lack of narrow specialization (the universalism of the master, characteristic of the Renaissance, is part of the national culture) and the dominance of random design [7].

The great master of furniture in the post-war period was the architect Carlo Molini, whose unique style was called “flowing surrealism.” The famous designer of the Olivetti firm, Marcello Nicsolli, demonstrates an organic harmony of absurdity and intuition. As a designer, Nicsolli creatively solved the question of which way to go in the design culture, which was important for world and Italian design at that time. He made a choice between the industrial and humanitarian paradigm of design, the

industrial and independent path. Therefore, the "Nicsolli line," the "Nicsolli method" understood the typical Italian style, which contained fantasy, absurdity, direct structural elements, which did not fit into the specific method of industrial design [8].

Analysis and Results

In the 1980s, new trends such as "avant-garde", "transform", "interactive", "minimalism" were identified in the Italian design school. Among them, the "contemporary" style, which is distinguished by its functionality, convenience and affordability, was most prominent. It was the diversity of styles and directions that had a significant impact on determining the teaching methodology. The training of design specialists differed in theoretical and methodological principles in each center, but in all of them the methodology of design based on research was primary. The priority aspect of the teaching methodology of Italian schools is determined by the influence of the teacher's personality on the design concept [9].

Depending on the scope of the task, the project can be carried out individually or in a group. If the final result of the work is of high quality and is practically implemented in production, the company evaluates the costs associated with the intellectual property of the completed project and pays the appropriate amount to the educational institution. Successfully completed creative projects are considered an application for students to become employees of this company and work effectively after receiving a diploma. [10, 11]

Conclusions

As a conclusion, we can say that development of interior was significantly influenced the design projects culture in the 20 century. The effective projects and experiments attempt to analyze in the field of professional design education. Nowadays, there are a lot of design education systems such as schools, concepts, directions and manifestations. Modern foreign design schools have rich technical bases. Architecture and design education in England, Italy, Germany, Spain, the United States are designated as the best schools in the world.

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UDC: 631/635, 633

THE PROCESS OF CREATION OF MELON VARIETIES OF OFTOB, IFTIKHOR AND GANDIMYON BY THE METHOD OF SELECTION

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Annotatsiya. Pitomnikda istiqbolli liniyalar davlat reestriga kiritilgan navlar namunalari bilan taqqoslanadi.

Kalit so'zlar: *Qovun navlari, bargi, erkak va urg'ochi gullari, poyasi, fenologik kuzatish;*

Аннотация. В питомнике перспективные линии испытывались в сравнении с образцами сортов, включенных в государственный реестр.

Ключевые слова: *Сорта дыни, лист, мужские и женские цветки, стебель, фенологическое наблюдение.*

Abstract. Prospective lines were compared to samples of varieties included in the state register in the comparative test garden.

Keyword: *Melon varieties, leaf, male and female flowers, stem, phenological observation.*

Introduction

More than 100 melon varieties stored in the gene pool of the Research Institute of Vegetables, Melons and Potatoes were planted and studied in the experimental fields of the Tashkent and Khorezm scientific experimental stations, and 142 individual selection seeds were obtained [1-3].

Literature Review

A comparative test was conducted on the melon varieties Londa Khandalak, Kara Kashkar, Ak Khandalak, Malika, Namangan bosvoldisi L-160 (IFTIHOR), L-161 (OFTOB) and Ola Zamcha, Suyunchi-2 isolated at the Andijan Scientific Experimental Station with the Kuk Magiz variety [4-7].

Research Methodology

The test was conducted based on the state variety testing method (GSI 1975). Each sample consisted of 20 plants, 4 replicates per 20 m^2 area. As a result of the phenological observations, the germination of the varieties in the comparative experimental garden differed by one or two days compared to the Kuk Magiz variety.

Analysis and Results

It was observed that the opening of the male flowers was 2-5 days earlier or later than the reference variety, and the female flowers were 3-10 days later or more later. The fruit ripened 4-17 days earlier than the comparative variety (see in Table 5).

Creation of a new variety of melon "Gandimiyon"

- In 2017-2019, the collection was studied in the nursery for valuable economic characteristics and a primary source was selected;
- In 2018-2019, it was brought to uniformity (brought to a stable state) in morphological and economic characteristics.
- In 2020-2022, the State Variety Test was conducted. It was included in the State Register of Agricultural Crops Recommended for Cultivation in the Republic of Uzbekistan and a certificate was obtained with reference number № T-6/01-10-655;
- In 2020, it was submitted to the Intellectual Property Agency for an invention patent and on May 23, 2024, an invention patent was obtained under number NAP 480.

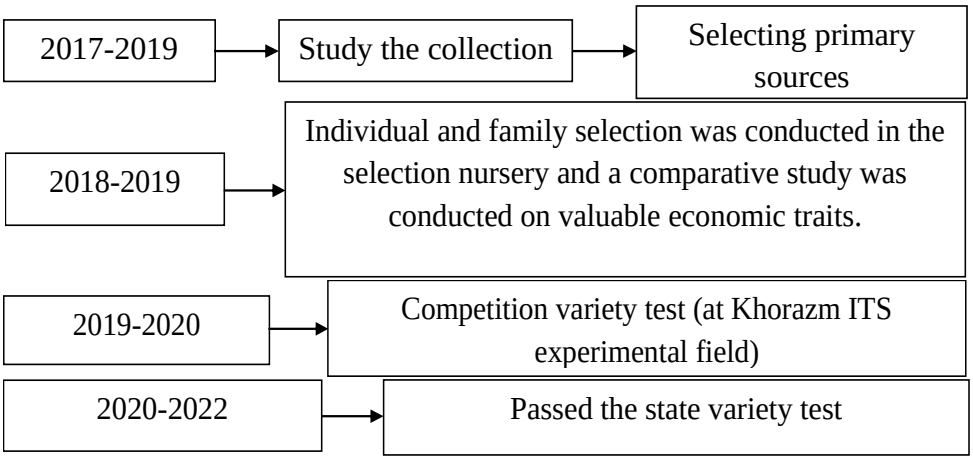
Novelty of the invention patent - for the first time in our republic, a late-ripening, 111-day growing season, drought-resistant, and disease-resistant melon variety with an average yield of 400-450 c/ha, a sugar content of 10-12%, and suitable for transportation was created at the Khorezm Scientific Experimental Station based on individual and family selection by crossing the Zargulobi and Gulobi-Khorezmi varieties. After its creation, the variety was not sold by the author, co-authors, or their heirs until the patent was obtained and was not transferred to other persons for use.

Distinctiveness of the invention patent - the new variety of melon "Gandimiyon" has a yield of 20.0 c / ha compared to the standard variety "Toyana," its marketability is up to 3% higher, the fruit is oblong-oval in shape, the color of the fruit is yellow, with large veins, light brown spots, suitable for transportation and storage.

Similarity of the invention patent - during the propagation of the new variety of melon "Gandimiyon" from seeds, it was observed that the plants are identical in morphological characteristics and biological characteristics (similar).

Stability of the invention patent - even when the new variety of melon "Gandimiyon" is propagated from seeds several times, the main valuable and economic characteristics do not change in their future generations.

Stages of creation of the new "Gandimiyan" variety of melon



Description of the Gandimien variety - the variety was created in 2018-2020 at the Khorezm Scientific Experimental Station of the Scientific Research Institute of Vegetable Melon Crops and Potato Growing by crossing the Zargulobi and Gulobi-

Khorezmiy varieties. Late ripening. The growing season is 111 days, the length of the girdle is 111 meters, branched, resistant to drought and some diseases. The average yield is 400-450 centners. The sugar content is 10-12 percent. Suitable for transportation (as seen in Figure 1).

Figure 1. Digital camera image of Gandmiyan variety of melon.

Creation of a new "sun" variety of melon

- In 2017-2019, the collection was studied in the nursery for valuable economic characteristics and a primary source was selected;
- In 2018-2019, it was brought to uniformity (brought to a stable state) in morphological and economic characteristics;
- In 2020-2022, a competitive variety test was conducted. It was included in the state register of agricultural crops recommended for planting in the territory of the Republic of Uzbekistan and a certificate was obtained under number № 2022-728;
- In 2020, it was submitted to the Intellectual Property Agency for an invention patent and on November 30, 2022, an invention patent was obtained under number NAP 00420.

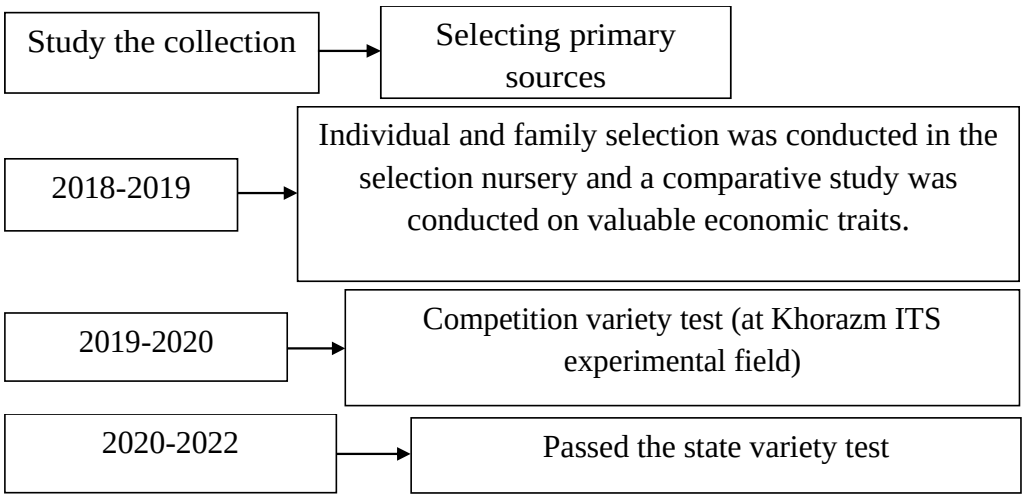
Novelty of the patent for the invention - for the first time in our republic, a variety of melon similar to the Obi Navvot variety, sertor, some of which are greenish-brown in color, with an average fruit weight of 1.6 kg, white flesh, 3.7-4.0 cm thick, very small seeds, an average soluble dry matter content of 13.8 -17.0% (in the comparative variety this indicator is 11.8 - 15.0%), 100% resistant to powdery mildew was created at the Tashkent Scientific Experimental Station based on individual selection from the BC2F11 (Dorado x Obi Navvot) × Obi Navvot hybrid.

Distinctiveness of the invention patent - the new variety of melon "Oftob" has a yield of 18.0 c/ha compared to the standard variety "Kichkintoy," its marketability is up to 2% higher, the fruit is round, greenish-brown, with large veins, and is 100% resistant to powdery mildew.

Similarity of the invention patent - during the propagation of the new variety of melon "Oftob" from seeds, it was observed that the plants were identical in morphological characteristics and biological characteristics (similar).

Stability of the patent for the invention - even when the new "Oftob" melon variety is propagated from seeds several times, the main valuable and economic characteristics do not change in their subsequent generations.

Stages of creation of the new "sun" variety of melon



Description of the Atob variety - the appearance of the variety is similar to the Obi Navvot variety, round, some have a greenish-brown color as shown in Figure 2. The fruit is medium-sized, weighing an average of 1.6 kg, the flesh is white, 3.7-4.0 cm thick, the seed is very small. The soluble dry matter content in it is on average 13.8-17.0%, while in the comparative variety this indicator is 11.8-15.0%. It is 100% resistant to powdery mildew.

Figure 2. Digital camera image of Melon Sun variety.

Creation of a new "iftikhor" variety of melon

- In 2017-2019, the collection was studied in the nursery for valuable and economic characteristics and the primary source was selected;
- In 2018-2019, it was brought to uniformity (brought to a stable state) in morphological and economic characteristics.
- In 2020-2022, a competition was held for variety testing. It was included in the state register of agricultural crops recommended for planting in the territory of the Republic of Uzbekistan and a certificate was obtained under No. T-6/01-10-655;
- In 2020, it was submitted to the Intellectual Property Agency for an invention patent and on April 26, 2024, an invention patent under No. NAP 458 was obtained.

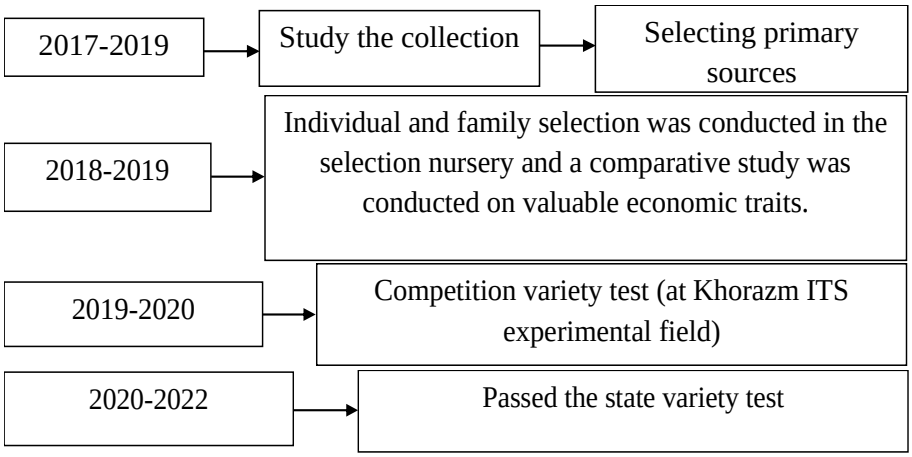
Novelty of the invention patent - for the first time in our republic, the Tashkent Scientific Experimental Station created the Iftikhor variety from the hybrid BC2F11 (Dorado x Obi navvot) × Obi navvot based on individual selection. The fruit weight is 1.3 kg, round in shape, lemon-colored, without flowers, some with white-yellow spots. The fruit of the variety is flat, some are 3/4 covered with a mesh, slightly striated. The flesh is white, 3.6-4.0 cm thick, soft, tender, with a honey taste. The soluble dry matter content in its composition is on average 12.5%, the highest 17.5%. It is 100% resistant to powdery mildew. The yield is 19.3 t / ha, the total yield is 108% higher than the comparative variety, and the marketable yield is 115%. After creation, the variety was not sold by the author, co-authors and their heirs until the patent was obtained and was not transferred to other persons for use.

Distinctiveness of the invention patent - the new variety of melon "Iftikhor" has a yield of 14.0 c / ha compared to the standard variety "Kichkintoy," its marketability is up to 4% higher, the fruit is round, yellow, with a fine mesh, and is 100% resistant to powdery mildew.

Similarity of the invention patent - during the propagation of the new variety of melon "Iftikhor" from seeds, it was observed that the plants were identical in morphological characteristics and biological characteristics (similar).

Stability of the invention patent - even when the new variety of melon "Iftikhor" is propagated from seeds several times, the main valuable and economic characteristics do not change in their future generations.

Stages of creation of the new "Iftikhor" variety of melon



Description of the Iftikhor variety - the fruit weight of the variety is 1.3 kg, round, lemon-colored, without flowers, some have white-yellow spots. The fruit is flat, some are 3/4 covered with a net, slightly scaly. The flesh is white, 3.6-4.0 cm thick, soft, tender, with a honey taste. The soluble dry matter content in the composition is on average 12.5%, maximum 17.5%. It is 100% resistant to powdery mildew. The yield is 19.3 t/ha, with a total yield of 108% and a commercial yield of 115% higher than the comparative variety.

Figure 3. Digital camera image of Iftikhar variety of melon.

Conclusions

The promising L-160 (Iftikhor), 161 and L-oybek lines were tested in the comparative nursery with the Kichkintoy variety included in the state register.

The appearance of the L-160 (Iftikhor) line is similar to the Obi novvot variety, firm, some have a greenish-brown color, the fruit is standard, the average weight is 1.6 kg, compared to the Kichkintoy variety - 0.9 kg. The flesh is white, 3.8-4.0 cm thick, the seed is very small. The soluble dry matter content in the composition is on average 16.4%, the highest 18.0%, compared to the comparative variety - 11.8-15.5%. It is 98% resistant to powdery mildew.

The fruit of the L-161 (Oftob) line is standard, the average weight of a quality fruit is 1.3 kg, the fruit is round, lemon-colored, without flowers, some have white-yellow spots. The fruit is flat, some are 3/4 covered with a mesh, slightly slicing. The flesh is white, 3.7-4.0 cm thick, soft, tender, with a honey flavor. The average soluble dry matter content is 16.0%, the highest is 19.0%. It is 100% resistant to powdery mildew. The total yield is 22.5 t/ha, the quality yield is 19.7 t/ha, which is 121.6% higher than the comparative variety in terms of total yield and 127.9% higher in quality yield.

Proposals - based on the study of the melon collection, use samples selected for valuable economic characteristics as a primary source for various areas of selection in creating new varieties;

Expand the areas under cultivation of the melon varieties “Oftob,” “Iftikhor” and “Gandimyon,” export them to food and local and foreign markets, and use them on a large scale;

Sow seeds of the melon varieties “Oftob,” “Iftikhor” and “Gandimyon” in the open field in the future, on April 25-30, in a 180x60 cm scheme;

It is recommended to cultivate the melon varieties “Oftob,” “Iftikhor” and “Gandimyon” on a large scale in our Republic and export them to Russia, European countries, China and neighboring countries.

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UDC: 91, 910.3, 677, 677.1/.5

DEVELOPMENT OF THE REPUBLIC'S COTTON FABRIC INDUSTRY AND IMPROVEMENT OF THE STRUCTURE OF REGIONAL CLUSTERS

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Annotatsiya. Maqolada respublika ip gazlama sanoati so'nggi yillarda rivojlanishi, hududiy klasterlari tarkibi va uni takoimllashtirishning geografik jihatlari tahlil etilgan.

Kalit so'zlar: *to'qimachilik sanoati, ip gazlama sanoati, ip gazlama, ip kalava, hududiy klaster.*

Аннотация. В статье анализируется развитие хлопчатобумажной промышленности республики в последние годы, состав региональных кластеров и географические аспекты его совершенствования..

Ключевые слова: *текстильная промышленность, хлопчатобумажная промышленность, хлопчатобумажная ткань, пряжа, региональный кластер.*

Abstract. The article analyzes the development of the cotton industry of the republic in recent years, the composition of regional clusters and the geographical aspects of its improvement.

Keywords: *textile industry, cotton industry, cotton fabric, yarn, regional cluster.*

Introduction

The cotton fabric industry is one of the sectors that satisfies the simplest non-consumption needs of humans. Among similar products made from natural cotton fiber, cotton fabrics are unmatched in terms of ecological properties and physical parameters (such as air permeability, resistance to temperature and moisture, and durability), particularly in the production of clothing, especially inner knitwear. Based on its geographical location, the Republic of Uzbekistan is situated in a region where cotton, the source of cotton fiber, is cultivated.

Literature Review

In Uzbekistan, Doctor of Geography, Professor I.I. Iskanderov (1960-70s) and Candidate of Geographical Sciences D.R. Ruzmetov (2000s to the present) have studied the regional aspects of the development and distribution of the cotton fabric industry [1-3]. Currently, the activities in this sector are guided by the Resolution № 733 of the Cabinet of Ministers of the Republic of Uzbekistan, dated December 4, 2021, "On Approving the Regulation on the Organization of Cotton-Textile Clusters."

Research Methodology

State decisions and programs aimed at developing the national industry, including cotton-textile clusters, have utilized geographic analysis, statistical data, and comparative methods to enhance the efficiency of existing and newly created capacities in the cotton fabric industry.

Analysis and Results

Since independence, the sector in the Republic has gone through phases of decline, stagnation, and revival. Currently, it is experiencing rapid growth and is considered the leading branch of the country's textile industry. In this sector, more than 180 enterprises producing yarn and over 130 factories manufacturing various cotton fabrics are operating under the “UzTextile Industry” Association [9].

Based on Resolution No. 230 of the Cabinet of Ministers of the Republic of Uzbekistan dated March 18, 2019, “On Additional Measures for Further Development of Cotton-Textile Production,” 96 clusters were established, encompassing nearly 910,000 hectares of cotton fields, as well as textile, cotton processing, and servicing enterprises. Currently, 134 cotton-textile clusters are operating in the sector, uniting 1,034.2 million hectares of cotton-growing land [6].

Based on Presidential Decree № PQ-4186 dated February 12, 2019, “On Measures to Further Deepen Reforms in the Textile and Garment-Knitting Industry and Expand its Export Potential,” the Concept for the Rapid Development of the Textile and Garment-Knitting Industry for 2019-2025 was developed [7].

Significant changes have been observed in the production dynamics of cotton fabric industry products in the Republic from the 1990s to the present day (Figure 1).

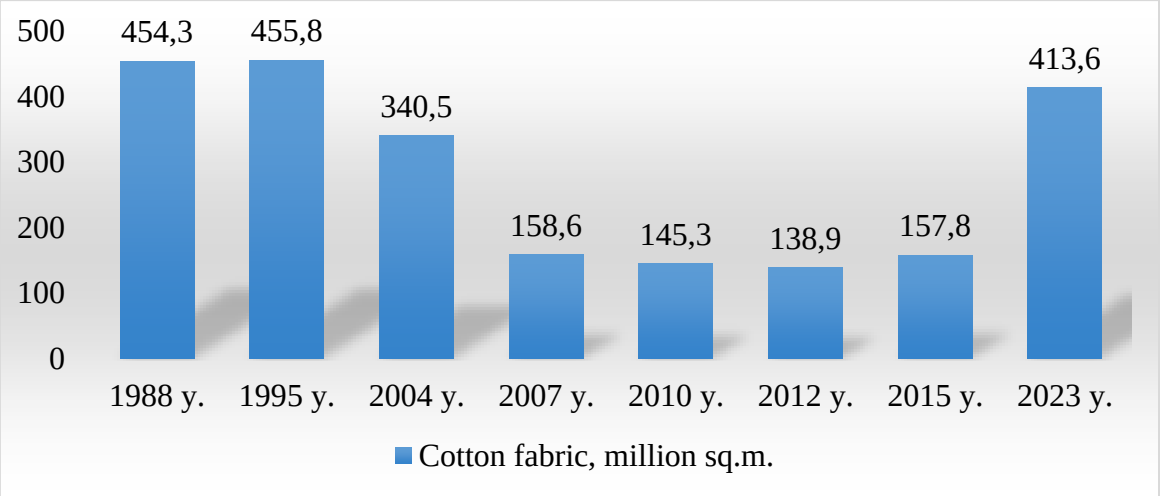

Figure 1. Dynamics of Cotton Fabric Production (1988-2023). The figure was prepared by the author based on data from the State Committee of Statistics of the Republic of Uzbekistan.

As seen in the Figure 1, the production volume in the industry started to change positively after 2015. However, despite this, there have not been significant changes in the product range of the industry. In most of the sector’s enterprises, raw fabrics or knitted fabrics are produced. The former is partially processed for the domestic market (some enterprises, like “Urganch Bakhmal,” engage in processing raw fabrics and printing patterns), but is primarily oriented towards the external market. This is because

processing raw fabrics allows for the production of various finished fabrics, based on the characteristics of the domestic market [2, 3].

The Republic has great potential for the future development of the industry, particularly due to the availability of large raw material resources and relatively inexpensive labor. This situation is reflected in the increasing production and export volumes in the sector in recent years.

Table 1. The number of enterprises in the Republic's cotton fabric industry included in the "UzTextile Industry" Association (2019, units).

№	Regions	Yarn	Fabric	Knitted products	Knitted fabric
1	Karakalpakstan R.	7	3	9	1
2	Andijan	29	4	198	25
3	Bukhara	19	49	19	4
4	Jizzakh	10	1	12	4
5	Kashkadarya	8		11	1
6	Tashkent	15	6	105	21
7	Navoi	4	4	9	1
8	Namangan	17	32	251	10
9	Samarkand	8	6	57	1
10	Syrdarya	9	1	16	6
11	Surkhandarya	8		6	
12	Fergana	22	10	89	18
13	Khorezm	13	3	10	5
14	Tashkent city	18	13	238	55
Uzbekistan		187	132	1030	152

*The table was prepared based on data from the official website of the "UzTextile Industry" Association: https://uzts.uz/uyushma-azolari/.

In the new stage of development of our Republic, the tradition from the 1990s that has been preserved in the industry - the rapid development of the knitting industry - continues. In the sector, nearly 80% of enterprises are specialized in the production of knitted products and fabrics (Table 1).

As seen in the above (Table 2), the cotton fiber processing in the Republic is almost complete (around 95%). It is evident that the processing capacities in Tashkent region and Tashkent city are capable of processing twice the amount of cotton fiber produced in the region. The figures for Bukhara region are even higher, and in Andijan and Fergana regions, they can process much more cotton fiber than what is produced locally. In all other regions, there is still significant potential for cotton fiber processing.

According to the Presidential Decree № PF-71 dated May 1, 2024, "On Measures to Bring the Development of the Textile and Garment-Knitting Industry to a New Level," the Republic aims to transform the textile industry into the "textile hub" of the country and create at least 10 locally recognized international brands. The decree outlines efforts to support enterprises in selling their products in both domestic and foreign markets, implementing effective measures to increase the production of fabrics, knitted fabrics, and dyeing, and creating the necessary infrastructure and financial conditions.

The goal is to gradually increase the cotton yarn processing level to 100% by the end of 2027. In the initial phase, the establishment of small industrial zones specialized in textiles in Andijan and Namangan regions, as well as the complete infrastructure development of the industrial techno-park in Tashkent region, is planned.

Table 2. Regional structure of cotton fiber preparation and processing in Uzbekistan (2023).

№	Administrative units	Cotton fiber processing capacities, thousand tons.	Share in the Republic, %	Cotton fiber	
				thousand tons	Degree of processing, %
1	Karakalpakstan R.	33,5	3,26	77,6	43,2
2	Andijan	83,3	8,11	76,4	109,1
3	Bukhara	249,0	24,23	108,1	230,4
4	Jizzakh	51,1	4,97	88,3	57,9
5	Navoi	13,2	1,28	25,1	52,6
6	Namangan	49,3	4,80	68,8	71,7
7	Samarkand	28,1	2,73	76,5	36,7
8	Syrdarya	47,2	4,59	87,1	54,2
9	Surkhandarya	79,9	7,77	84,2	94,9
10	Tashkent	89,9	8,75	79,2	113,5
11	Fergana	141,9	13,81	83,3	170,3
12	Khorazm	53,0	5,16	94,6	56,1
13	Kashkadarya	33,9	3,30	127,0	26,7
14	Tashkent city	74,4	7,24	0,0	74,4
Total		1027,7	100,00	1076,0	95,5

*The data was prepared based on information from the official website of the “UzTextile Industry” Association: https://uzts.uz/uyushma-azolari/ and the Open Data Portal of the Republic of Uzbekistan: https://data.egov.uz/data/6108023c2a2e256d868e879c.

In the Republic, there are noticeable regional socio-economic and historical differences in the development and specialization of the cotton fabric industry. Specifically, in some regions where large textile combines once existed (Bukhara, Namangan, Fergana, Tashkent city), there is a specialization in finished cotton fabric production [2-4]. With the introduction of foreign investment, raw fabric production and, in the new century, medium and small enterprises with both local and foreign participation have specialized in the production of knitted fabrics and knitted goods, such as socks, in many regions (Andijan, Namangan, Tashkent regions, and Tashkent city). Most of the enterprises in the knitting industry belong to the small business and entrepreneurship sector.

Conclusions

Industry energy production cycle:

- There are regional differences in the utilization of raw materials and labor resources in the establishment of production capacities; these differences should be considered when assessing potential;
- In the knitting industry, small enterprises dominate, which makes it difficult to find consistent buyers in the external market;
-The establishment of energy production cycles in the sector requires taking into account the current state of infrastructure, the availability of skilled personnel, and supporting industries (such as raw material preparation, chemicals, and machinery).

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