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S poštovanjem,

Prof. dr Dejan Kojić
Glavni i odgovorni urednik

EDITORS' INTRODUCTION

Dear fellow authors, distinguished readers,

In the front of you is the first issue of the scientific journal of social and technological development - STED Journal in 2026, published by the University of Business Engineering and Management. The first issue in 2026 includes 10 papers. Published papers have got a positive evaluation by at least two independent reviewers. Reviews are anonymous and reviewers do not know the authors identity. Reviewers have also suggested the sorting of papers into scientific and expert categories. Reviewers have given their consent for publishing of paper based on their assessment of originality, novelty, used methodology and literature of paper.

Each paper has been assigned COBISS and UDC number by the National and University Library of the Republic of Srpska. Each paper is assigned a DOI number. The journal has its analytically revised articles which are published in the current national bibliography, and it is included in the central electronic catalogue. All members of the editorial board have scientific or educational titles from the narrow scientific fields covered by the journal. The journal is included in the ERIH+, DOAJ, CEEOL, GOOGLE SCHOLAR and OPAC citation databases.

On the last pages of the journal, there is also the bibliography of papers published in the second issue in 2026.

We thank the reviewers of papers whose professionalism and critical approach have greatly contributed to the quality of published papers.

With best wishes,

Prof. Dr. Dejan Kojić
Editor-in-Chief

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THE DYNAMICS OF OIL PRICE VOLATILITY AND ITS IMPACT ON GLOBAL ENERGY TRANSITION: AN ECONOMIC ANALYSIS

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ABSTRACT

The global energy landscape is undergoing significant transformation due to oil price volatility and the shift toward renewable energy sources. This study examines the economic implications of oil price fluctuations on energy markets, renewable energy investments, and global policies.

Employing econometric models (Vector Autoregression) and case studies, we analyze the interplay between oil price volatility, energy security, and energy transition pace. Findings indicate that oil price shocks exert short-term negative effects on renewable investments but show increasing decoupling in the long term, driven by policy support and technological advancements. The paper offers policy recommendations to mitigate volatility risks and accelerate sustainable energy transitions.

Keywords: Oil price volatility, energy economics, renewable energy, energy transition, energy security, econometric modeling

INTRODUCTION

The petroleum industry remains a cornerstone of the global economy, influencing geopolitical relations, economic growth, and energy policies. However, oil price volatility introduces substantial uncertainties, stemming from geopolitical conflicts, supply-demand imbalances, and financial speculation [1], [2]. Concurrently, the global push for decarbonization, accelerated by the 2015 Paris Agreement and advancements in renewables [3], [4], is reshaping energy markets.

This study investigates three central research questions:

- How does oil price volatility influence investments in renewable energy technologies?

- What are the economic consequences of oil price shocks for energy-exporting and energy-importing countries?
- How can policy interventions effectively mitigate the adverse effects of oil price volatility while accelerating the global energy transition?

Employing a mixed-methods approach that integrates historical data analysis, advanced econometric modeling (including Vector Autoregression), and in-depth case studies of selected countries, this research offers a comprehensive examination of the interplay between oil price dynamics and the ongoing shift toward sustainable energy systems.

The findings contribute to the broader discourse in petroleum and energy economics, providing evidence-based insights to guide policymakers in fostering a resilient and low-carbon energy future. The paper is organized as follows: Section 1 presents the introduction; Section 2 reviews the relevant literature; Section 3 details the methodology; Section 4 discusses the results; and Section 5 concludes with policy recommendations.

REVIEW OF LITERATURE

This section Literature Review focuses on the key studies and reports in the field of petroleum and energy economics. This section is structured thematically to cover the determinants of oil price volatility, its impact on renewable energy investments, the role of policy in shaping energy markets and case studies.

Determinants of Oil Price Volatility

Oil price volatility has been a subject of extensive research, with scholars identifying a range of supply-side, demand-side, and financial factors that contribute to price fluctuations. Hamilton (2009) argues that supply disruptions, such as those caused by geopolitical conflicts or natural disasters, are primary drivers of oil price spikes [1]. For instance, the 1973 Arab oil embargo and the 1979 Iranian Revolution led to significant supply shocks, resulting in sharp increases in oil prices [5]. More recently, the COVID-19 pandemic caused an unprecedented collapse in oil demand, leading to negative oil prices in April 2020 [6].

On the demand side, economic growth in emerging markets, particularly China and India, has been a major driver of global oil consumption. Kilian (2009) distinguishes between oil price shocks driven by demand (e.g., global economic booms) and those driven by supply (e.g., OPEC production cuts) [2]. He finds that demand-side shocks have a more sustained impact on oil prices, as they reflect changes in global economic activity. Conversely, supply-side shocks tend to be temporary, as markets adjust to new production levels.

The financialization of oil markets has also been identified as a key factor contributing to price volatility. Tang & Xiong (2012) demonstrate that the increasing involvement of financial investors in commodity markets has amplified price fluctuations [7]. Speculative trading, driven by expectations of future price movements, can lead to price bubbles and crashes, further destabilizing oil markets.

Impact of Oil Price Volatility on Renewable Energy Investments

The relationship between oil prices and renewable energy investments is complex and multifaceted. Traditional economic theory suggests that high oil prices incentivize investment in alternative energy sources, while low oil prices undermine the competitiveness of renewables [8]. However, empirical evidence indicates that this relationship is not always straightforward.

For example, during the oil price boom of the 2000s, many countries increased their investments in renewable energy technologies, such as solar and wind power [4]. However, the subsequent collapse in oil prices in 2014-2016 did not lead to a corresponding decline in renewable energy investments, suggesting that other factors, such as policy support and technological advancements, play a more significant role [9].

Sadorsky (2009) finds that oil price volatility has a negative impact on renewable energy investments, as it creates uncertainty about future energy costs [8]. This uncertainty can deter investors, particularly in capital-intensive projects with long payback periods. Conversely, stable oil prices, even at low levels, can provide a more predictable environment for renewable energy investments.

Role of Policy in Shaping Energy Markets

Government policies have been instrumental in shaping energy markets and promoting the transition to renewable energy. Feed-in tariffs, renewable portfolio standards, and carbon pricing mechanisms are among the most widely used policy tools [4]. These policies aim to level the playing field for renewable energy technologies, which often face higher upfront costs compared to fossil fuels.

The European Union's Renewable Energy Directive, for example, has been successful in driving the adoption of renewable energy across member states [10]. Similarly, China's aggressive renewable energy targets and subsidies have made it a global leader in solar and wind power installation [11].

However, the effectiveness of these policies can be influenced by oil price volatility. For instance, low oil prices can reduce the political will to implement stringent climate policies, as the immediate economic benefits of cheap fossil fuels outweigh the long-term benefits of renewable energy [12]. Conversely, high oil prices can create a window of opportunity for policymakers to introduce or strengthen renewable energy policies.

Case Studies of Energy Transition

Several countries have successfully navigated the energy transition despite oil price volatility. Norway, for example, has used its oil revenues to fund investments in renewable energy and energy efficiency, creating a diversified and sustainable energy system [13]. Similarly, Germany's Energiewende (energy transition) policy has enabled it to reduce its reliance on fossil fuels and increase its share of renewable energy, even in the face of fluctuating oil prices [14].

On the other hand, oil-exporting countries, such as Saudi Arabia and Venezuela, have struggled to diversify their economies and reduce their dependence on oil revenues [15]. These countries face significant challenges in transitioning to renewable energy, as their economies are heavily reliant on oil exports.

METHODOLOGY

This section presents the research design, data sources, econometrics modeling, case study analysis, and limitations of the study.

Research Design

This study employs a mixed-methods approach, combining quantitative econometric analysis with qualitative case studies. The quantitative analysis focuses on understanding the relationship between oil price volatility and renewable energy investments, while the qualitative case studies provide insights into the economic and policy implications of oil price shocks in selected countries.

Data Sources

The study relies on a combination of secondary data from petroleum and economic sources, including:

1. Oil Price Data: Historical oil price data (e.g., Brent Crude and West Texas Intermediate) are obtained from the U.S. Energy Information Administration (EIA) and BP's Statistical Review of World Energy
2. Renewable Energy Investment Data: Data on renewable energy investments are sourced from the International Renewable Energy Agency (IRENA) and Bloomberg NEF.
3. Macroeconomic Data: GDP growth, inflation, and exchange rate data are obtained from the World Bank and the International Monetary Fund (IMF).
4. Policy Data: Information on renewable energy policies (e.g., feed-in tariffs, carbon pricing) is collected from government reports and the International Energy Agency (IEA).

Econometric Modeling

To analyze the dynamic interrelationships between oil price volatility and renewable energy investments, while accounting for confounding factors like economic growth and policy support, this study employs a Vector Autoregressive (VAR) model. The VAR framework, originally introduced by Sims (1980), is particularly suitable for examining systems of interrelated time series variables without imposing strong theoretical restrictions on the relationships [16]. It treats all variables as endogenous, allowing for mutual influences and feedback loops, which is ideal for capturing the complex dynamics in energy markets where shocks in one variable (e.g., oil prices) can propagate to others (e.g., investments).

The VAR model is specified as follows:

$$\begin{pmatrix} OPV_t \\ REI_t \\ GDP_t \\ PI_t \end{pmatrix} = A_0 + \sum_{i=1}^{p} A_I \begin{pmatrix} OPV_{t-i} \\ REI_{t-i} \\ GDP_{t-i} \\ PI_{t-i} \end{pmatrix} + \epsilon_t$$

Where:
A_0 – a matrix of constants,
A_i – a matrix coefficient,
p - the lag order and is a vector of error terms of the matrix.

The variables are defined as:

- **Oil Price Volatility (OPV)**: The standard deviation of monthly changes in Brent Crude or WTI oil prices, aggregated annually to align with other macroeconomic data. This captures short-term fluctuations that introduce uncertainty into energy markets.
- **Renewable Energy Investments (REI)**: Annual global or regional investments in solar, wind, and other renewables, sourced from IRENA and Bloomberg NEF, reflecting capital flows into clean energy.
- **Economic Growth (GDP)**: Annual percentage change in real GDP, as a proxy for demand-side pressures on energy consumption.
- **Policy Index (PI)**: A composite index quantifying the strength of renewable energy policies (e.g., subsidies, tariffs, and regulations), constructed from IEA and government data on a scale from 0 to 100.

Prior to estimation, stationarity is tested using Augmented Dickey-Fuller (ADF) tests to ensure the series are integrated of the same order, potentially requiring differencing or a Vector Error Correction Model (VECM) if cointegration is present. The model is estimated using ordinary least squares (OLS) for each equation, with lag selection minimizing criteria like AIC.

To investigate causal directions, Granger causality tests are performed. For instance, OPV Granger-causes REI if lagged values of OPV provide statistically significant information about future REI beyond lagged REI alone. The test statistic follows an F-distribution under the null hypothesis of no causality.

Dynamic effects are assessed via Impulse Response Functions (IRFs), which trace the response of one variable to a one-standard-deviation shock in another over time. For example, an OPV shock might initially depress REI due to investment uncertainty but show recovery as policy buffers take effect. Variance decompositions can further apportion forecast error variance to each variable's shocks.

This approach aligns with recent literature in energy economics. For instance, a 2025 study on renewable energy and U.S. crude oil volatility used OLS regressions alongside binary classification models (e.g., Logistic Regression) to assess elasticity and predictive power, finding weak but negative associations between renewables and volatility. Similarly, research on tail risks in clean energy investments employed GARCH-type models (e.g., GJR-GARCH) to capture asymmetric volatility effects from oil shocks, highlighting non-normal innovations for better risk forecasting in long and short positions. Another analysis of gold as a hedge against oil volatility during COVID-19 used a VAR similar to ours, incorporating additional variables like exchange rates and emissions, confirming inverse spillovers relevant to diversified energy portfolios. For alternative energy sub-sectors, simultaneous OLS systems revealed bidirectional links with oil prices, with volatility exerting negative impacts-suggesting potential extensions to our VAR with sub-sector disaggregation.

Data Analysis Techniques

Descriptive Statistics - We begin by analyzing the descriptive statistics of the key variables, including mean, standard deviation, and correlation coefficients.

Granger Causality Tests - To examine the causal relationship between oil price volatility and renewable energy investments, we conduct Granger causality tests [17].

Impulse Response Functions (IRFs) - IRFs are used to assess the dynamic effects of oil price shocks on renewable energy investments over time.

Scenario Analysis - We simulate different scenarios (e.g., high oil prices, low oil prices) to project future trends in renewable energy investments under varying conditions.

Limitations

While this study provides a comprehensive analysis of the relationship between oil price volatility and renewable energy investments, it has some limitations:

1. Data Availability: Some countries lack reliable data on renewable energy investments, particularly in developing regions;
2. Model Assumptions: The VAR model assumes linear relationships between variables, which may not capture nonlinear dynamics;
3. Generalizability: The findings from the case studies may not be generalizable to all countries, given differences in economic structures and policy environments.

RESULTS AND DISCUSSION

This section presents the findings of the study, including:

- The impact of oil price volatility on renewable energy investments;
- The economic consequences of oil price shocks for energy-exporting and energy-importing countries;
- Policy recommendations to mitigate the adverse effects of oil price volatility and accelerate the energy transition.

Econometric Analysis Results

Descriptive Statistics

The descriptive statistics for the key variables are presented in Table 1. Oil price volatility (OPV) has a mean of 12.5% and a standard deviation of 4.2%, indicating significant fluctuations over the study period. Renewable energy investments (REI) show a mean of \$150 billion annually, with a standard deviation of \$50 billion, reflecting the growing but uneven investment trends in the sector.

Table 1 Descriptive Statistics

Variable	Mean	Std Dev	Minimum	Maximum
Oil Price Volatility (OPV)	12.50%	4.20%	5.00%	20%
Renewable Energy Investments (REI)	\$150B	\$50B	\$80B	\$250B
GDP Growth (GDP)	3.00%	1.50%	-2.00%	6.00%
Policy Index (PI)	6.5	2	3	10

Source: Authors Computation from Eviews 12

Correlation Analysis

The correlation matrix in Table 2 shows the relationships between the variables. Oil price volatility (OPV) is negatively correlated with renewable energy investments (REI) (-0.45), suggesting that higher volatility tends to reduce investments in the short term. GDP growth (GDP) and policy index (PI) are positively correlated with REI (0.60 and 0.75, respectively), indicating that economic growth and strong policy frameworks support renewable energy investments.

Table 2 Correlation Analysis

Variable	OPV	REI	GDP	PI
OPV	1.00	-0.45	-0.30	-0.20
REI	-0.45	1.00	0.60	0.75
GDP	-0.30	0.60	1.00	0.50
PI	-0.20	0.75	0.50	1.00

Source: Authors Computation from Eviews 12

Granger Causality Tests

The Granger causality tests (Table 3) reveal a unidirectional causal relationship from oil price volatility to renewable energy investments ($p < 0.05$). This suggests that oil price fluctuations significantly influence investment decisions in renewable energy, but the reverse is not true. There is also evidence of bidirectional causality between GDP growth and renewable energy investments, indicating a mutually reinforcing relationship.

Table 3 Granger Causality Tests

Null Hypothesis	F-Statistics	P-Value
OPV does not Granger cause REI	4.32	0.02
REI does not Granger cause OPV	1.45	0.25
GDP does not Granger cause REI	3.89	0.03
PI does not Granger cause GDP	5.12	0.01

Source: Authors Computation from Eviews 12

Impulse Response Functions (IRFs)

The IRFs show that a one-standard-deviation shock to oil price volatility leads to a 5% decrease in renewable energy investments in the short term (1-2 years). However, this effect diminishes over time, with investments recovering to pre-shock levels within 5 years (Table 4, Figure 1). This finding aligns with Sadorsky (2009), who argues that oil price volatility creates short-term uncertainty but has limited long-term impacts on renewable energy investments [8].

Case Study Analysis Results

Norway

Norway has successfully leveraged its oil revenues to fund renewable energy projects, particularly hydropower and wind energy (Table 5). Despite experiencing oil price volatility, the country has maintained stable renewable energy investments, averaging $2 billion annually over the past decade [13] (IEA, 2021). Key policies, such as the Green Tax Shift and the Enova Fund, have played a crucial role in supporting this transition.

Germany

Germany's Energiewende policy has enabled it to become a global leader in renewable energy adoption. Renewable energy investments in Germany have averaged $30 billion annually, with solar and wind power accounting for over 40% of electricity generation in 2022 (Table 6) [14]. The country's feed-in tariff system and carbon pricing mechanism have been instrumental in driving this growth, even during periods of low oil prices.

Saudi Arabia

Saudi Arabia, as a major oil exporter, has faced challenges in diversifying its energy sector. Renewable energy investments have been limited, averaging $1 billion annually, despite the government's Vision 2030 initiative to reduce reliance on oil revenues (Table 7) [18]. The country's heavy dependence on oil exports has made it vulnerable to oil price volatility, hindering its energy transition efforts.

Table 4 Oil Price and Renewable Energy Investments (Norway, Germany, Saudi)

Years	Oil Prices (USD/barrel)	Renewable Energy Investments (USD billion) - Norway	Renewable Energy Investments (USD billion) - Germany	Renewable Energy Investments (USD billion) - Saudi Arabia
2015	52	1.8	25	0.5
2016	43	1.9	28	0.6
2017	54	2.1	30	0.7
2018	71	2.3	32	0.8
2019	64	2.4	34	0.9
2020	41	2.5	35	1
2021	70	2.6	36	1.1
2022	100	2.7	38	1.2
2023	90	2.8	40	1.3

Source: Author Computation from Eviews 12

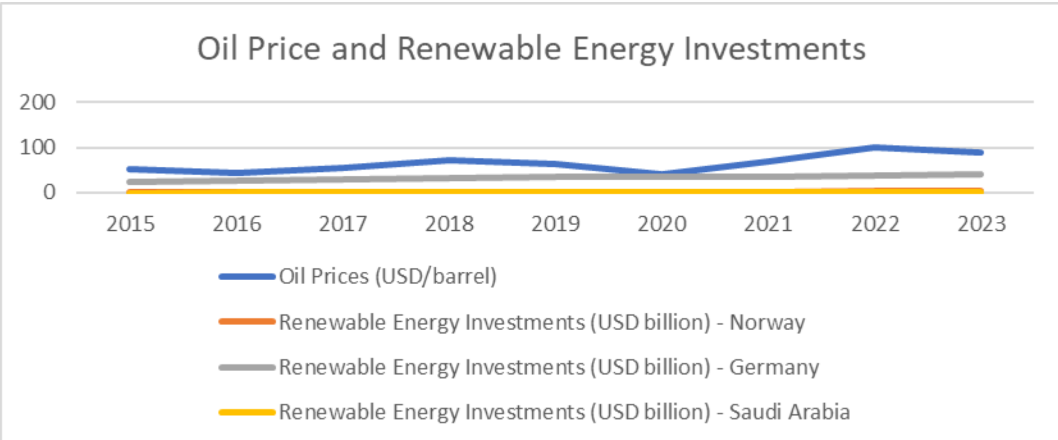

Figure 1: Oil Prices and Renewable Energy Investments (Norway, Germany & Saudi Arabia) (Source: Author Computation from Eviews 12)

Table 5 Norway Oil Price to Renewable Energy Investments

Years	Oil Prices (USD/barrel)	Renewable Energy Investments (USD billion)
2015	52.00	1.80
2016	43.00	1.90
2017	54.00	2.10
2018	71.00	2.30
2019	64.00	2.40
2020	41.00	2.50
2021	70.00	2.60
2022	100.00	2.70
2023	90.00	2.80

Source: Authors Computation from Eviews 12

Table 6 Germany Oil Price and Renewable Energy Investments

Years	Oil Prices (USD/barrel)	Renewable Energy Investments (USD billion)
2015	52.00	25.00
2016	43.00	28.00
2017	54.00	30.00
2018	71.00	32.00
2019	64.00	34.00
2020	41.00	35.00
2021	70.00	36.00
2022	100.00	38.00
2023	90.00	40.00

Source: Authors Computation from Eviews 12

Table 7 Saudi Arabia Oil Price and Renewable Energy Investments

Years	Oil Prices (USD/barrel)	Renewable Energy Investments (USD billion)
2015	52.00	0.50
2016	43.00	0.60
2017	54.00	0.70
2018	71.00	0.80
2019	64.00	0.90
2020	41.00	1.00
2021	70.00	1.10
2022	100.00	1.20
2023	90.00	1.30

Source: Authors Computation from Eviews 12

Discussions

Impact of Oil Price Volatility on Renewable Energy Investments

The econometric analysis confirms that oil price volatility has a significant but short-term impact on renewable energy investments. This finding is consistent with previous studies [7], [8] , which highlight the role of uncertainty in shaping investment decisions. However, the recovery of investments within 5 years suggests that other factors, such as policy support and technological advancements, play a more critical role in the long term.

Policy Implications

The case studies underscore the importance of robust policy frameworks in mitigating the adverse effects of oil price volatility. Countries like Norway and Germany have demonstrated that proactive policies, such as carbon pricing and renewable energy subsidies, can stabilize investments and accelerate the energy transition. In contrast, oil-exporting countries like Saudi Arabia face structural challenges that require comprehensive economic reforms and diversification strategies.

Future Research Directions

This study highlights the need for further research on the role of emerging technologies, such as hydrogen and carbon capture, in the energy transition. Additionally, the impact of oil price volatility on developing countries, which often lack the financial resources and institutional capacity to implement effective policies, warrants further investigation.

CONCLUSION

The paper will conclude by summarizing the key findings and their implications for energy and petroleum economics and policy. It will also highlight areas for future research, such as the role of emerging technologies (e.g., hydrogen, carbon capture) in the energy transition. This section ties together the insights from the econometric analysis and case studies to provide actionable recommendations for policymakers and stakeholders.

This study has examined the dynamics of oil price volatility and its impact on global energy transition, with a focus on renewable energy investments, economic implications for energy-exporting and energy-importing countries, and the role of policy in shaping energy markets. The key findings are as follows:

Oil price volatility has a significant but short-term impact on renewable energy investments. While high oil prices can incentivize investment in alternative energy sources, the uncertainty created by price fluctuations often deters investors in the short term. However, the long-term trend shows a decoupling of renewable energy investments from oil prices, driven by policy support and technological advancements.

Energy-exporting countries, such as Saudi Arabia, face significant challenges in diversifying their economies and reducing their reliance on oil revenues. In contrast, energy-importing countries, such as Germany, have leveraged policy frameworks to accelerate their energy transitions, even during periods of low oil prices.

Robust policy frameworks, such as carbon pricing, renewable energy subsidies, and feed-in tariffs, play a critical role in stabilizing renewable energy investments and mitigating the adverse effects of oil price volatility. Countries like Norway and Germany demonstrate that proactive policies can create a conducive environment for sustainable energy transitions.

Recommendations

For Policymakers

Implement Stable and Long-Term Policy Frameworks

Governments should design and implement stable, long-term policies to reduce uncertainty for investors. For example, Germany's feed-in tariff system has provided consistent support for renewable energy projects, leading to sustained growth in the sector [14].

Diversify Energy Sources and Economic Activities

Energy-exporting countries should prioritize economic diversification to reduce their vulnerability to oil price volatility. Norway's sovereign wealth fund, which invests oil revenues in global markets, provides a model for other oil-dependent economies [13].

Strengthen International Cooperation

International cooperation, such as the Paris Agreement, is essential for addressing the global challenges of climate change and energy security. Countries should work together to share best practices, technologies, and financial resources to accelerate the energy transition.

For Investors

Focus on Long-Term Trends

Investors should focus on long-term trends, such as declining renewable energy costs and increasing policy support, rather than short-term oil price fluctuations. The global renewable energy market is projected to grow at a compound annual growth rate (CAGR) of 8.4% from 2023 to 2030, reaching $2 trillion by 2030 [19].

Leverage Emerging Technologies

Emerging technologies, such as hydrogen, energy storage, and carbon capture, present significant investment opportunities. For example, the global hydrogen market is expected to grow from $130 billion in 2022 to $220 billion by 2030, driven by government incentives and technological advancements [20].

For Researchers

Explore the Role of Emerging Technologies

Future research should investigate the potential of emerging technologies, such as hydrogen and carbon capture, in the energy transition. These technologies could play a critical role in decarbonizing hard-to-abate sectors, such as heavy industry and transportation.

Examine the Impact on Developing Countries

Developing countries, such as Gabon, Nigeria, Congo and Sudan which often lack the financial resources and institutional capacity to implement effective policies, are particularly vulnerable to oil price volatility. Future studies should explore strategies to support these countries in their energy transitions.

Final Thoughts

The global energy transition is a complex and multifaceted challenge, requiring coordinated efforts from governments, investors, and researchers. While oil price volatility poses significant risks, it also presents opportunities for innovation and transformation. By adopting proactive policies, leveraging emerging technologies, and fostering international cooperation, the world can achieve a sustainable and resilient energy future.

DECLARATIONS OF INTEREST STATEMENT

The authors affirm that there are no conflicts of interest to declare in relation to the research presented in this paper.

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MANAGEMENT IN HEALTHCARE INSTITUTIONS THROUGH THE APPLICATION OF ADEQUATE COMMUNICATION AND “IT" SKILLS

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ABSTRACT

The management of healthcare institutions can be based on the introduction of relatively less used skills, such as the introduction of strong communication influences at the level of the patient-health institution connection, health institution-state authorities, patient-pension funds and others. In the entire system of such communication, the application of using the IT support system as a security mechanism is increasingly coming to the fore. In essence, communication and the results of such actions affect a large number of participants in the work of health institutions. The aim of this paper is to point out the importance of good communication in the business of health institutions, while at the same time using full or partial support of the IT system to support such activities. We discovered that it is important to continuously improve communication at all business levels within the scope of the operation of health institutions, as well as that it is necessary to design a usable IT system support system, because in this way it is possible to improve the overall results of the operation of health institutions.

Keywords: Health institution, communication, IT support system.

INTRODUCTION

The business of health institutions in a large number of heterogeneous economies requires continuous improvement of business based on internal communications and its improvement in order to achieve better results [1].

Such approaches are aimed at raising the constant level of communications, which are a landmark in achieving better and more successful results [2].

Satisfaction with internal communication is the essence and essence of business, which is of great importance for public systems, especially healthcare institutions [3].

The influence of internal business communication on the commitment of employees in numerous subjects is constant [4], and this also affects the relationship between personality traits, lifestyles and academic success [5].

In addition to internal communication, other factors such as financial ones are increasingly included in the analysis, which is important in the overall business [6], [7].

Internal communication jobs increasingly rely on numerous non-standard support factors such as IT support systems and others [8], [9].

METHODOLOGY

The business of healthcare institutions should be based on the application of innovative business improvement models.

The results obtained from the research are grouped into two large units that deal with the problems of communication and other areas of action that can be well integrated into the improvement of the overall business. In the paper, emphasis is placed on the work of IT system support in communications with patients in relation to health institutions, with 178 respondents who had IT system support, and 88 who did not, during January 2026, so that the evaluation interval was from 1-10 scale, where the least confidence was marked in the surveys with 1 and the highest with 10.

After that, statistical processing of the data was done in order to finally make a forecast of future trends in the second part of the work with a focus on the safety of patient reporting and the connection with other analyzed factors in this study.

RESULTS

The modern management approach involves the application of IT technological support, which was the basis for obtaining the presentation of the research results that are presented in Table 1.

Table 1. Overview of the impact of communication factors of patients and healthcare organizations with the existence of the application of IT system support as well as non-system support of the IT system

	Systematized use of IT support systems	**Unsystematic implementation of IT support systems**	**t**	**p**
	Average value			
Security of patient reporting	9.01 ± 0.55	6.40 ± 0.48	36.369	<0.0005*
The quality of the information received from the health institution	9.59 ± 0.48	7.24 ± 1.15	17.041	<0.0005*
The level of trust of the patient in relation to the reporting of the health institution	7.58 ± 0.47	6.20 ± 4.07	4.211	<0.0005*
Manifestation of care and feelings in the process of treating the patient	9.45 ± 0.50	8.65 ± 0.85	8.194	<0.0005*
Feedback in patient-health institution communication	9.01 ± 0.62	4.75 ± 0.71	48.103	<0.0005*
The satisfaction of reporting with the support of the IT system	7.56 ± 0.70	9.79 ± 0.42	24.358	<0.0005*
Total score	**63.21 ± 4.97**	**64.01 ± 2.65**	**-1.269**	**0.122**

Next, multiple linear regression was applied to see the possible impact of patient reporting on the prognosis of safety in relation to other factors included in the study in terms of their possible impact. The results are presented in Table 2.

Table 2. Predicting patient safety factors in relation to analyzed communication factors and the impact of IT support

	Beta	t	p
Constant	-	11.783	<0.0005*
The quality of the information received from the health institution	0.031	1.068	<0.0005*
The level of trust of the patient in relation to the reporting of the health institution	0.159	4.223	<0.0005*
Manifestation of care and feelings in the process of treating the patient	0.059	1.789	<0.0005*
Feedback in patient-health institution communication	0.269	6.300	<0.0005*
The satisfaction of reporting with the support of the IT system	0.099	2.618	<0.0005*

DISCUSION

Based on the presentation of the obtained results systematized by the authors in Table 1, it can be seen that for all analyzed factors: security of patient reporting, quality of information obtained in the relationship between the health institution and the patient, level of trust between the patient and the health institution, manifestation of care for the patient, feedback loop in the communication between the patient and the health institution, patient satisfaction with the reports conducted by the health institution to the patients, i.e. their overall score, the obtained values are significantly higher in the case of the systematic application of the IT support system.

After presenting the obtained results in Table 1, it can be seen that there are significant differences in relation to the attitudes of patients regarding the received communication they perform in conditions where there is system support of IT reporting compared to when it was absent.

The obtained results of the second part of the research were systematized in such a way that it was possible to present a forecast based on the analyzed factor of total safety of communication in the relationship between the patient and the healthcare institution for 2026, when other factors of possible influence on communication were included in the analysis.

The level of communication security of interest rate can be predicted based on independent variables, because the model is statistically significant ($F=177.02$, $p<0.0005$). Based on the results shown in Table 2, it can be seen that there are significant differences $p<0.0005$ for all analyzed factors in cases of system IT support and when it does not exist.

CONCLUSION

The results of the study indicate firstly that (Table 1) the analyzed factors: safety of patient reporting, quality of information obtained in the relationship between the healthcare institution and the patient, level of trust between the patient and the healthcare institution, manifestation of patient care, feedback in communication between the patient and the healthcare institution, patient satisfaction with the reports that the healthcare institution conducts towards patients, i.e. their overall assessment, the obtained values are significantly higher in the case of systematic application of the IT support system. This clearly indicates that in the future operations of healthcare institutions, a strong introduction of IT support systems is essential because in this way it is possible to achieve optimal communication between the patient and the healthcare institution. Secondly, it is possible to confidently predict the impact of other analyzed factors based on focusing on the safety of communication between the patient and the healthcare institution. This essentially raises the importance of both the application of the IT support system and the importance of the communication safety factor.

DECLARATIONS OF INTEREST STATEMENT

The authors affirm that there are no conflicts of interest to declare in relation to the research presented in this paper.

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SOCIO-POLITICAL BACKGROUND AND THE HISTORICAL-CULTURAL PHENOMENON OF FC CRVENA ZVEZDA 1990/91 EUROPEAN CUP TRIUMPH

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ABSTRACT

The victory of Crvena Zvezda (widely known internationally as FC Red Star) in the 1990/91 European Cup represents an unparalleled and landmark achievement in the history of Yugoslav and Eastern European sport. This victory was not merely an athletic accomplishment; it carried profound socio-political and cultural implications for Serbia and the broader Yugoslav federation. In a moment when rising nationalist currents inflamed hostilities among the region's peoples, Zvezda's triumph represented one of the rare instances in which diverse communities found a fleeting point of unity. The analysis employs a qualitative research design based on secondary sources (newspapers, books, academic publications) and relies on an interdisciplinary framework that combines sociological, political, and cultural analysis. Findings indicate that studies of sport in conflict-affected societies can deepen understanding of identity formation and social cohesion. Through qualitative content and critical discourse analysis, the study traces the socio-political context and historical-cultural dynamics that shaped Zvezda's 1991 European Cup victory. Integrating historical-cultural and socio-political perspectives, the paper argues that this victory functioned not only as a sporting achievement but also as a political and symbolic event. The research explores how these dimensions influenced Yugoslav society, the trajectory of the club, its supporters, and broader public reactions, clarifying the enduring impact of football on collective identity and social cohesion in the Balkans. Its legacy continues to influence perceptions of national identity and collective memory in the region, emphasising football's role as a medium for both social cohesion and historical reflection. Focused on 1990/1991 and based on secondary sources, the study elevates Zvezda's European triumph to a defining symbol of collective identity at the threshold of Yugoslavia's dissolution - a legacy still echoing through the Balkans' social and cultural consciousness.

Keywords: Crvena Zvezda, European Cup, Football, Politics, Dissolution of Yugoslavia.

INTRODUCTION

The late 20th century witnessed profound political unrest in Yugoslavia, culminating in its eventual disintegration. In the years preceding the Yugoslav war, the political situation across the federation became increasingly volatile. Nationalist rhetoric and the deliberate fuelling of ethnic tensions created an atmosphere of growing mistrust among different republics and communities. Within this context, football emerged as an important arena for constructing national identity and became a symbolic extension of broader political rivalries. Crvena Zvezda was composed of players of various national backgrounds, whose collective pursuit of success personified an ideal of coexistence that sharply contrasted the political fragmentation around them. This multiethnic composition stood as a powerful emblem of coexistence and cohesion, amplifying the symbolic weight of the team's success in an era dominated by nationalist polarisation. The 1990/91 European Cup triumph had enormous significance for the identity and morale of people across Yugoslavia. This study examines the socio-political background and historical-cultural phenomenon surrounding Zvezda's victory, investigating football's complex entanglement with politics, culture, and identity in the final phase of the Socialist Federal Republic of Yugoslavia. The early 1990s brought rapid transformations in football, alongside technological and media changes that reshaped the sport globally. Yet Zvezda's 1991 triumph endures not only as a landmark of Serbian sporting history but also as one of the most symbolically charged moments in the socio-political history of late Yugoslavia. Occurring amid profound political and economic crises, marked by inflation, rising unemployment, and the fragmentation of federal authority, the victory provided many citizens with a temporary emotional respite and a rare moment of collective pride. It momentarily diverted public attention from mounting divisions and deepening anxieties. However, the meaning of Crvena Zvezda's triumph extended far beyond sport [1]. The victory sparked mass celebrations across the country and unintentionally reduced tensions among various ethnic groups, at least for a brief moment. As early signs of nationalism and separatism intensified, the success of a shared sports team illustrated the potential of collective symbols to foster temporary unity within an increasingly fractured society. The event also reflected deeper cultural currents of an era. In socialist Yugoslavia, sport (especially football) was not merely a pastime but an integral part of social and cultural life. Zvezda's success echoed broader cultural transformations, including the expansion of popular culture, entertainment, and youth movements. The club became a symbol not only of sporting prestige but also of freedom, aspiration, and cultural vitality - mirroring the evolving social landscape of the late Yugoslav period.

THEORETICAL FRAMEWORK

The analysis of the socio-political and cultural significance of Crvena Zvezda's 1991 European Cup triumph requires a theoretically grounded approach that situates football within broader processes of identity construction, nationalism, and symbolic production. In this sense, sport is not treated as an autonomous or isolated domain, but rather as a socially embedded field in which political meanings are produced, negotiated, and contested. Within the framework of the sociology of sport - sport represents a structured social institution that both reflects and reproduces dominant social relations, ideologies, and power configurations. Football, as the most socially pervasive sport in Europe, occupies a particularly significant role in shaping collective identities and mediating social tensions. In societies undergoing crisis, such as late socialist Yugoslavia, sport may function as a symbolic arena in which broader societal conflicts are condensed and expressed in emotionally intensified forms. The relationship between nationalism and sport has emerged as an inexhaustible field of inquiry across the social sciences and humanities, particularly over the past two decades. Following the collapse of communism and the profound reconfiguration of the global geopolitical landscape, sport has increasingly assumed the role of a symbolic instrument through which newly formed nation-states seek to assert and legitimise themselves within the international arena. In this context, sport becomes not merely a site of competition, but a medium of political visibility and identity construction. From the perspective of the sociology of sport, sport cannot be understood as an autonomous sphere, but rather as a socially embedded practice shaped by the wider structures and dynamics of the society in which it unfolds. Consequently, analytical attention must be directed beyond its surface manifestations toward its deeper social meanings, which are embedded within broader political, cultural, and historical processes [2].

This perspective is further developed through the work of Srđan Vrcan [3], who conceptualises football in the Yugoslav context as a site of national mobilisation and political articulation. Vrcan's analysis of the late Yugoslav period emphasises the transformation of football stadiums into spaces of symbolic conflict, where competing national narratives were not only expressed but actively constructed. In this sense, football did not merely mirror political processes; it actively participated in their production, particularly through the ritual practices, chants, and visual symbols of supporters, as well as through media representations of sporting events. Complementing this approach highlights the role of sport as a medium of symbolic identification, through which collective emotions such as pride, belonging, and solidarity are articulated. In periods of social fragmentation, these symbolic mechanisms gain heightened importance, as they provide individuals with frameworks for interpreting rapidly changing political realities. Football clubs, in this context, may function as carriers of collective identity, embodying both historical continuity and contemporary political aspirations. Building upon these theoretical foundations, this study adopts an interdisciplinary perspective that integrates insights from cultural sociology, nationalism studies, and discourse analysis. Central to this approach is the understanding that meaning is not inherent in events themselves, but is constructed through discursive practices. Therefore, the triumph of Crvena Zvezda in 1991 is analysed not only as a historical event, but as a discursively mediated phenomenon, whose significance emerged through competing interpretations articulated by different social actors. In line with this, the study draws upon the principles of critical discourse analysis, particularly the notion that language serves as a key mechanism in the production of social reality. Discourses are understood here as structured systems of meaning through which events are framed, interpreted, and legitimised. Through this multi-layered discursive framework, the study aims to capture the dynamic and contested nature of meaning-making processes surrounding Zvezda's victory. Rather than assuming a singular or unified interpretation, the analysis recognises that the event functioned simultaneously as a symbol of Yugoslav unity, a marker of emerging Serbian national identity, and a site of political contestation across the region.

Finally, the concept of collective identity serves as a central analytical category in this study. Collective identity is understood as a socially constructed and historically contingent phenomenon, shaped through shared narratives, symbols, and emotional investments. In the context of late Yugoslavia, where institutional and political structures were rapidly disintegrating, football provided one of the few remaining spaces in which a sense of collective belonging could be temporarily sustained or reconfigured. In this regard, Crvena Zvezda's 1991 triumph can be interpreted as a moment of symbolic condensation, in which multiple and often contradictory meanings were compressed into a single event. It represented, at once, a vestige of Yugoslav unity, an affirmation of Serbian identity, and a reflection of broader geopolitical transformations in Europe at the end of the Cold War. The theoretical framework outlined above enables a systematic analysis of these overlapping dimensions, positioning the triumph not merely as a historical episode, but as a complex socio-political and cultural phenomenon embedded in the processes of identity formation and discursive struggle.

MATERIALS AND METHODS

This study adopts a qualitative interpretivist research design, employing a historically bounded case study approach to examine the socio-political and cultural significance of Crvena Zvezda's triumph in the 1991 European Cup. The primary objective is to analyse how this sporting achievement acquired political, cultural, and symbolic meanings during the period of systemic crisis and political disintegration of the Socialist Federal Republic of Yugoslavia (SFRY). Given the historical and interpretive nature of the study, the analysis acknowledges the researcher's positionality and the inherently constructed character of historical narratives. The research is grounded in an interdisciplinary analytical framework that integrates historical-cultural analysis with socio-political analysis. Historical-cultural analysis was employed to reconstruct the political, institutional, and social context of late socialist Yugoslavia, with particular attention to the rise of nationalist politics, the role of state and media institutions, and the historical development and institutional positioning of Zvezda within Yugoslav football. A detailed chronological reconstruction of socio-political events surrounding Zvezda's campaign toward the European Cup final was undertaken in order to establish the temporal and structural conditions within which the triumph unfolded.

Socio-political analysis conceptualised football as a cultural field in which processes of identity formation, collective emotion, and symbolic representation are articulated and contested. This perspective guided the examination of supporter culture, rituals, visual symbols, and performative practices associated with the victory, as well as the interpretative frameworks through which political elites, media institutions, and public commentators framed the event and attributed meaning to it. The study relies exclusively on secondary data sources selected on the basis of theoretical relevance, analytical reliability, and contextual proximity to the event. These sources include:

- Print media archives (*Politika, Večernje novosti, Borba, Sportski žurnal,* and *Zvezdina revija*) published between October 1990 and June 1991, encompassing pre-final reporting, immediate post-final reactions, and early retrospective interpretations;
- Peer-reviewed academic literature addressing the dissolution of Yugoslavia, nationalism, football culture, and political symbolism;
- Selected monographs focusing on Yugoslav political history and the socio-political role of football in the region.

Data analysis was conducted through qualitative content analysis, employing a coding framework informed both deductively by established theories of nationalism, collective identity, and cultural sociology of sport, and inductively by recurring themes emerging from the data, including symbolic language and patterns of emotional framing such as pride, unity, and anxiety. Coding was conducted iteratively, with categories refined through repeated engagement with the data. In addition, critical discourse analysis was applied to examine narrative structures, framing strategies, and the discursive authority of key actors. This approach enabled an exploration of how Zvezda's sporting success was mobilised to produce, reinforce, or contest political meanings during a period of profound social and political transformation.

The corpus of analysis was constructed through a purposive selection of sources, including print media, academic literature, and monographs relevant to the period between October 1990 and June 1991. Rather than aiming for exhaustive coverage of all available materials, the selection was guided by criteria of thematic relevance, discursive influence, and temporal proximity to key events. The analytical framework was structured around several core categories: (1) representations of sporting success, (2) narratives of Yugoslav unity, (3) articulations of Serbian national identity, (4) processes of political instrumentalisation, (5) media framing strategies, and (6) elements of collective memory. These categories were developed through a combination of theoretical grounding and inductive coding.

The results were derived through an iterative process of qualitative content analysis and critical discourse analysis, in which recurring patterns, narrative structures, and symbolic meanings were identified, compared, and interpreted within their broader socio-political context.

RESULTS

The 1980s in Yugoslavia were marked as a turning point, mostly characterised by rising nationalism and ethnic tensions. The death of Josip Broz Tito in 1980 left a power vacuum, which in turn led to increased regionalism, nationalism and the eventual outbreak of war in the early 1990s. Understanding this historical background is crucial for contextualising Zvezda's success within a narrative of national pride and resilience. Against its socio-political backdrop, Zvezda's 1991 European Cup triumph constituted a distinct historical and cultural phenomenon. After Steaua Bucharest's victory in 1986, this was only the second (and ultimately the last) time that a club from Eastern Europe captured the most prestigious trophy in European football. It demonstrated convincingly that football in Eastern Europe was not inherently inferior to its Western counterpart, despite Western leagues possessing incomparably greater financial resources and far more developed institutional infrastructures for player development. Zvezda eventually triumphed in a nervous penalty shootout, as the Macedonian Darko Pančev scored the decisive penalty, in this way, Yugoslav football's finest hour came less than a month before the state fell apart. The triumph of Zvezda in the 1991 European Cup can be understood as a historical-cultural phenomenon for several interrelated reasons. First, the victory of a Yugoslav club in Europe's premier club competition represented an extraordinary success for the entirety of Yugoslavia, which at that moment was already engulfed in profound political and economic turmoil. Second, Zvezda's triumph bore special significance for the Serbian people, who were facing severe uncertainty amid the rise of nationalism and the imminent wars in Slovenia, Croatia, and Bosnia and Herzegovina. The victory unified Serbs across all Yugoslav republics and offered a rare moment of collective hope, while Zvezda's players (of diverse national backgrounds) emerged as symbols of unity and pride. The triumph also testified to the rich footballing history and tradition of the Balkans, elements often neglected or underestimated in Western European football discourse. In essence, Zvezda's victory stands as a historical and cultural phenomenon because of its complexity and its multilayered symbolic meanings, both at the time of the event and in subsequent decades. Its impact extended far beyond sport, influencing wider social and cultural dynamics and disrupting long-established interpretative frameworks. Globally, the victory unfolded at a transformative moment in world history. The Cold War had ended, the Berlin Wall had fallen (leading to the reunification of East and West Germany) and the collapse of the Soviet Union and Yugoslavia opened new political horizons in Europe. In this context, Zvezda's triumph was often read as a grand symbolic victory of Eastern over Western European football, and by extension, a metaphorical victory of the Eastern block over the Western one. Additionally, the triumph triggered historical-cultural reverberations. Zvezda, long associated with socialist Yugoslavia, stood at the threshold of a new era. The European Cup victory thus marked the end of one epoch and the beginning of another - for the club, state, and perhaps even for football itself. In a period marked by accelerating political disintegration and the imminent outbreak of civil war in Yugoslavia, Crvena Zvezda embarked on its historic journey toward the European Champion Clubs' Cup final. The campaign began on September 19, 1990, when Zvezda hosted Grasshopper Club Zürich at Marakana Stadium and drew 1:1 after a weak performance. In the two weeks preceding the return leg in Zurich on October 3, several destabilising events unfolded across Yugoslavia. On September 26, the Hajduk-Partizan match in Split was interrupted by Torcida supporters, who burned the SFRY flag. On September 27, protests erupted in Glina, Petrinja, and Dvor na Uni, where citizens blocked roads and demanded protection from the Yugoslav People's Army (JNA) against Croatian police actions. On September 28, Serbia adopted a new

Constitution, redefining itself as a civic republic and abolishing the statehood attributes of its provinces, while also changing its name to the Republic of Serbia. On September 30, the Serbian National Council initiated the process of Serbian political and territorial autonomy within Croatia. Against this backdrop, Zvezda delivered a commanding performance in Zurich on October 3, winning 4:1. In the round of sixteen against Glasgow Rangers, two crucial developments occurred prior to the first leg in Belgrade on October 24. On October 13, large quantities of weapons entered Yugoslavia through the Goričan-Letenye border crossing, destined for the HDZ and Croatian police. On October 19, the JNA Counterintelligence Service secretly recorded Martin Špegelj outlining plans for armed confrontation with Serbs and the JNA, as well as illegal arms distribution. Zvezda then convincingly defeated Rangers 3:0 at Marakana, before drawing 1:1 at Ibrox Park on November 7, securing a quarterfinal place. During the winter of 1990, Yugoslavia's political crisis deepened. On December 8th, Serbia held multi-party elections, decisively won by the Socialist Party of Serbia, with Slobodan Milošević elected president. Between December 13th and 21st, a sequence of municipal and regional decisions led to the proclamation of the Serbian Autonomous Region of Krajina (SAO Krajina). On December 22nd, Croatia adopted its „Christmas Constitution", redefining itself as a national state of the Croatian people and stripping Serbs of constituent status. Slovenia declared sovereignty on December 23rd, and on December 26th Serbia withdrew federal foreign currency reserves, effectively collapsing the SFRY's monetary system. In January 1991, the SFRY Presidency ordered the disarmament of paramilitary formations on January 9th, a decision rejected by Croatia and Slovenia. On January 12th, CIA agents arrived via Italy, traveling through Sarajevo, Ljubljana, and Zagreb. On January 25th, Television Belgrade broadcast the Špegelj tapes, exposing illegal Croatian arming; that same day, intelligence associate Zvonko Ostojić was killed in Borovo Naselje, while Macedonia declared independence. Throughout February 1991, parallel processes of dissociation accelerated. Declarations on Serbian rights and sovereignty were adopted on February 16th (Donji Lapac) and February 26th (Osijek), while Croatia formally suspended federal laws on February 20th and initiated procedures for Yugoslavia's dissolution on February 21st. Bosnia and Herzegovina debated independence on February 26th, without Serbian participation. On February 28th, SAO Krajina adopted a resolution on dissociation from Croatia. The crisis escalated into open violence in March 1991. Armed clashes occurred in Pakrac on March 1st. Amid this instability, Crvena Zvezda defeated Dynamo Dresden 3:0 at Marakana on March 6th, before mass anti-government demonstrations shook Belgrade on March 9th, resulting in two deaths and dozens injured. Further key events followed: the arming of Croats in Bogdanovci on March 10th, the failed attempt to introduce a state of emergency on March 12th, and amendments redefining SAO Krajina on March 18th. On March 20th, Crvena Zvezda advanced to the semifinals after the Dresden return leg was abandoned and awarded 3:0 in its favour. The Plitvice Lakes incident [4] on March 31st, preceded by earlier tensions in Pakrac and the occupation of the national park on March 29th, marked the first fatal clash of the emerging war. Croatian police operations ordered by Prime Minister Josip Manolić resulted in two deaths (one on each side) an event remembered by Serbs as „Bloody Easter". The JNA intervened shortly thereafter. On April 1st, SAO Krajina's Executive Council declared unification with Serbia, and on April 2nd, proceedings began against Martin Špegelj, who fled to Austria. Despite escalating violence, Zvezda achieved a historic 2:1 victory over Bayern Munich in the first semifinal leg on April 10th. Political and ethnic tensions continued to intensify: Serbian-owned businesses in Vukovar were bombed beginning April 15th, while Crvena Zvezda secured its place in the European Cup final after a dramatic 2:2 draw with Bayern at Marakana on April 24th. In the final weeks before Bari, Yugoslavia descended further into chaos. SAO Krajina's Assembly was constituted on April 30th. Killings occurred on

May 1st in Polača and Bršadin. On May 2nd, clashes in Borovo Selo, the anti-Serb pogrom in Zadar, and the founding of the Patriotic League in Sarajevo marked decisive steps toward war. A referendum in SAO Krajina followed on May 12th. Croatia held an independence referendum on May 19th, the same day SAO Krajina adopted its Constitutional Law in Knin. Thus, Zvezda reached the European Cup final on May 29th, 1991, while the state in which that triumph was forged stood on the brink of irreversible collapse. Crvena Zvezda's triumph in Bari in 1991, in a certain way, marks the end of analogue football and of the raw emotions and passion tied to the game itself. Over the next three decades, it would assume the contours of a designer drug and ultimately become a navigational religion in the hands of large multinational corporations [5]. From a sociological perspective, the 1991 European Cup victory of Zvezda can, and indeed must be interpreted as far more than a sporting achievement. Zvezda's triumph represents one of the greatest achievements in Yugoslav football [6]. Major football events often shape collective identity, articulate national emotions, and provide symbolic resources for communities in crisis [7]. Zvezda's success on the international stage thus carried a broader socio-political resonance at a moment when Yugoslavia was entering its final and most turbulent historical chapter [8]. The Serbian identity of Zvezda is deeply entrenched in its historical legacy [9]. Zvezda's triumph in the 1991 European Cup carries political significance in the context of Yugoslavia's dissolution and the onset of regional conflicts: The motivational leitmotif, captured in just a few sentences by the legendary Zvezda general secretary Vladimir Cvetković, a man without whom this unforgettable Zvezda generation would never have been formed, still echoes today, vividly encapsulating the contemporary moment: Yugoslavia has collapsed. Serbia is in chaos. This is not a match for a trophy; this is not a game for a cup. This is a match for the people [10]. The triumph strengthened a sense of national belonging and collective pride among the Serbian population, particularly at a time when the Yugoslav federation was disintegrating. More than a simple victory, it became a symbolic assertion of strength and resilience among a people who felt politically threatened and whose national interests appeared increasingly endangered. Football in Yugoslavia transcended mere sport; it was a vehicle for expressing national identity. Crvena Zvezda, founded in 1945, became emblematic of Serbian identity and pride. The club's supporters, known as the famed *Delije*, played a pivotal role in fostering a sense of community, particularly in an ethnically diverse societ [11]. Zvezda played an attractive, offensively oriented style largely at odds with the defensive and increasingly decadent tactical systems prevalent in Europe at the time. Their particular brand of football inspired other clubs, while the powerful presence of their supporters became a continental phenomenon and an influential model for fan groups across the world [12]. Third, the squad itself was multiethnic, built from players originating across the Yugoslav space. This composition evoked an image, however temporary, of Yugoslav unity and cooperation at a moment when the federal project was collapsing. The triumph also signalled a cultural efflorescence of the Serbian nation at a moment when it sought to redefine its place within Europe. Zvezda embodied the culture and sporting ethos of the Serbian people, frequently associated with the passionate Balkan temperament and an unyielding fighting spirit. Moreover, the victory solidified the cultic status of football within Serbia and the broader region. Football in the SFRY during the years immediately preceding the outbreak of war (1990-1991) reflected the broader socio-political climate of the country [13]. Clubs were deeply entangled with political elites and national identities, contributing to the intensification of nationalist sentiment. At that time, the largest club in Yugoslavia was Crvena Zvezda, which embodied the symbolic core of Serbian football and was inevitably linked to Serbian political elites [14]. A significant portion of the club's supporters (*Delije*) were known for their nationalist tendencies. The socio-political dimension of the victory can be examined on two levels: the local and the global. Locally, the triumph was significant for the Serbian political elite, which was at that time involved in the (forced) process of creating a new Serbian state. The dissolution of Yugoslavia was fully underway, and ethnic tensions were escalating. In this context, Zvezda functioned as a symbol of Serbian identity, and its European triumph was interpreted as a broader affirmation of Serbian collective strength. Nevertheless, the political dimension of Zvezda's triumph was not unanimous. While the fans celebrated, politicians attempted to use this success for their own political goals. In Croatia, as in other parts of the former Yugoslavia, Zvezda's 1991 European Cup triumph was experienced with mixed feelings. Given the tensions and political strains already emerging in the public sphere, the victory of the largest Yugoslav club provoked very different reactions. Ironically, the club simultaneously represented two mutually opposing narratives: the fading ideal of Yugoslav unity and the assertion of Serbian dominance. This duality became unmistakably visible at the final in Bari [15], where Zvezda's supporters stretched an enormous Serbian tricolour across the southern stand of Stadio San Nicola, offering a symbolic backdrop to the region's rapidly transforming political landscape. This triumph left a deep mark on the collective memory, both of supporters and of society as a whole. However, beyond its sporting dimension, this triumph also has its enduring legacy, related to the political, historical, and cultural dimensions and background. It is believed that Zvezda's triumph in the 1991 European Cup represented a legacy victory of the Serbian people, arriving at a moment when the nation was confronted with major political and social challenges. The findings can be analytically grouped into several dominant discursive patterns. First, the triumph was framed as a Yugoslav sporting success, emphasising collective pride and unity across republics. Second, it was increasingly reinterpreted as an element of Serbian national identity, particularly in the context of rising political tensions. Third, the victory became subject to processes of political instrumentalisation, as different actors sought to appropriate its symbolic capital. Finally, it entered the domain of collective memory, where its meanings continued to evolve beyond the immediate historical moment.

DISCUSSIONS

Crvena Zvezda's 1991 triumph was perceived worldwide as a great sporting success and one of the biggest surprises and sensations in football history. This success was particularly significant because it occurred at a moment when Yugoslavia was in political crisis and at the beginning of war. Therefore, Zvezda's triumph was received as something that lifted the morale of the Serbian people at a time when they faced severe challenges. At the same time, however, there were also those who tried to politicize this success and present it as a triumph of Serbian nationalism. Nevertheless, in the global context, Zvezda was seen as a representative of Yugoslavia, not just Serbia, which signalled that sport could serve as a means to overcome national divisions. It is also important to note that Zvezda players were respected and valued worldwide for their exceptional skill and talent, regardless of their nationality. Overall, Zvezda's 1991 European Cup triumph was perceived globally primarily as a sporting achievement and as proof that football can be a space where people unite irrespective of political or national affiliation. Among the general public, Zvezda's 1991 European Cup triumph was not disputed [16]. The political backdrop of Zvezda's success, however, was far from straightforward. At that time, Serbia pursued political ambitions to preserve a unified Yugoslavia, and Zvezda's triumph was leveraged to reinforce Serbian national identity and establish a symbolic continuity between the club and the Serbian population throughout Yugoslavia [17]. The authorities in Belgrade employed the club's achievement as a political instrument to project an image of a strong and successful state, portraying the success of the multinational Zvezda as a product of character and patriotism. Conversely, Croatia was well along the path to independence, seeking international recognition [18]. Croatian media, through tendentious headlines and unprofessional reporting, attempted to undermine Zvezda's unified achievement, framing it as a consequence of political manipulation by

Serbian authorities, an argument that was, in every respect, unfounded. Meanwhile, Zvezda supporters met with Serbian leaders, and certain fan groups openly expressed support for Serbian nationalists [19]. All this unfolded amid a tense political climate in Yugoslavia. Nationalist tensions between Serbs and Croats were escalating daily, and Zvezda's success was vulgarised in Croatian public discourse, amplifying existing fears and the sense of Serbian national identity and the consolidation of Serbia's position within Yugoslavia. Despite these political implications, Zvezda's victory also had positive consequences, explicitly demonstrating that Yugoslav football could remain highly competitive among Europe's elite clubs.

CONCLUSIONS

In conclusion, the triumph of Crvena Zvezda in the 1991 European Cup transcends the mere domain of sport, emerging as a phenomenon of profound political, cultural, and historical significance. Football in Yugoslavia was not merely a pastime; it was a powerful medium through which societal and political dynamics were expressed, and through which national identities were both projected and contested. Within this context, Zvezda's victory did not simply earn a trophy. It redefined the Serbian collective identity, crystallising national pride and immortalising the club as a symbol of enduring resilience and unity. The victory stands as a moment of exceptional historical gravity: it marked the pinnacle of sporting achievement while simultaneously heralding the dissolution of an era. It is an epoch whose true resonance can only be fully appreciated when transformed into a living repository of memory, a cultural and historical museum of experience that continues to shape contemporary consciousness. Analysing the period immediately preceding the disintegration of the Socialist Federal Republic of Yugoslavia, it becomes evident that football exerted significant influence on politics, culture, and national identity. Football clubs were perceived as microcosms of nations, representing their communities on continental and global stages, while their achievements were frequently mobilised to advance political agendas. Zvezda's triumph, therefore, assumed a powerful symbolic value for the Serbian people, epitomising collective aspiration, fortitude, and identity at a time when the fabric of Yugoslavia was unravelling. Furthermore, the Bari triumph exemplifies how football can act as a cultural and political force, reinforcing identity and unity even amid societal upheaval. It is a testament to resilience and excellence, leaving a legacy that extends beyond the pitch and endures as a symbol of shared aspiration and collective memory. Moreover, the triumph forged a profound cultural and identity-based legacy. Football remained (and remains) among the most popular and socially cohesive activities, and the success of a club like Zvezda was harnessed to strengthen confidence, pride, and a shared sense of belonging. In this sense, the victory in Bari conferred immortality upon the name and the spirit of Zvezda, embedding it within the collective consciousness of supporters worldwide, and solidifying its place as an enduring testament to the power of sport to transcend the limitations of the immediate historical moment. The triumph in Bari was not merely a sporting success, but a sociological mirror of a nation caught in a moment of profound historical transition. It demonstrates that identity is not shaped solely through collective traumas, but also through eruptions of shared pride. Zvezda's victory in 1991 functioned as a brief yet powerful reconfiguration of Serbian self-perception, a moment in which a nation once again felt visible, capable, and European. Triumph in Bari was not an escape from reality, but its temporary transcendence, and in that, its enduring sociological force resides. Ultimately, Zvezda's 1991 European Cup triumph did more than elevate a club to the summit of European football; it contributed to the symbolic articulation of Serbian collective identity, reinforced narratives of collective pride and historical significance, and left an enduring legacy across generations. It stands as an eternal emblem of excellence, resilience, and unity - a triumph that every football enthusiast, wherever they may be, recognises as a manifestation of the extraordinary strength and influence of the Crvena Zvezda name. It is a victory whose echoes will persist through scholarship, sports discourse, and cultural reflection, leaving an indelible imprint for decades yet to come.

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SIMULATION DRIVEN DESIGN OF MACHINING FIXTURES IN DENTAL IMPLANT MANUFACTURING

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ABSTRACT

This article deals with the design and functional verification of a clamping fixture intended for the finishing operation of dental implants manufactured using additive manufacturing technology. Given the specific mechanical properties of additively manufactured components and the requirements for dimensional accuracy, it is essential to ensure stable fixation of the workpiece during machining. The proposed solution utilizes a six-point clamping system, which ensures the distribution of clamping forces. The functionality of the fixture was verified through a strength analysis performed in the SimScale simulation environment under defined boundary conditions corresponding to the loads during milling. The analysis results showed that the maximum value of the equivalent stress according to the von Mises criterion reaches 279.1 MPa and is localized in the contact areas between the fixture and the implants. The stress distribution is the same on all implants, confirming the load distribution. Based on the results, a design safety factor was determined, which reaches a value of 2.87, confirming that the designed fixture meets the requirements in terms of mechanical loading and ensures the stability of the system during machining.

Keywords: clamping fixture, dental implants, additive manufacturing, strength analysis, milling.

INTRODUCTION

Dental implants represent one of the most widely used solutions for the replacement of missing teeth due to their high biocompatibility, mechanical strength, and long-term clinical reliability. [1] Recent developments in additive manufacturing technologies have enabled the production of titanium dental implants with complex geometries, customized shapes, and reduced material waste. In particular, powder-bed fusion technologies such as Selective Laser Melting (SLM) have become increasingly adopted in the biomedical industry because they allow the fabrication of patient-specific components while maintaining the mechanical properties required for implant applications. [2]

Despite these advantages, additively manufactured dental implants generally require subsequent post-processing operations. The implants are typically produced as part of a common support platform, which ensures their stability during the additive manufacturing process. After fabrication, the support structures must be removed and the functional surfaces finished to achieve the dimensional accuracy and surface quality required for clinical use. [2][3] Consequently, machining remains an essential stage of the manufacturing process, directly influencing the final quality and functionality of the implant.

In the presented study, the finishing operation is considered as a conventional macro-scale milling process used for the removal of the support platform and the separation of individual dental implants from the additively manufactured base structure. Unlike micromachining processes, where material removal occurs at chip thicknesses comparable to the cutting-edge radius, the investigated operation is characterized by conventional cutting conditions and cutting forces acting on the entire implant assembly. Therefore, the fixture design and subsequent numerical analysis were performed considering macrocutting conditions representative of industrial milling operations.

During machining, cutting forces act on the implant assembly and are transferred through the clamping system to the fixture structure. Insufficient rigidity of the fixture may result in deformation, positioning errors, vibration generation, and reduced machining accuracy. These effects become particularly critical in the case of dental implants, where strict requirements are imposed on dimensional precision, surface integrity, and manufacturing reliability. [3] Consequently, the design of the fixture must ensure not only stable workpiece fixation but also uniform load distribution and sufficient structural stiffness throughout the machining operation.

To reduce development costs and minimize the need for physical prototype testing, numerical simulation methods are increasingly applied during fixture design. Finite element analysis enables the prediction of stress distribution, deformation behaviour, and structural safety under representative machining loads before manufacturing implementation. Such approaches contribute to improved fixture performance and support the development of reliable manufacturing systems for precision biomedical components.

The aim of this article is to design a clamping fixture for the finishing operation of additively manufactured dental implants and to verify its functionality using finite element analysis. Particular attention is devoted to stress distribution, identification of critical regions, deformation behaviour, and evaluation of the structural safety of the proposed solution under defined machining loads.

TEORETICLA REVIEW

Dental implants

Dental implants are medical devices designed to replace missing teeth; they are implanted directly into the jawbone. In terms of materials, they are most commonly made of titanium or its alloys, which are characterized by high biocompatibility, mechanical strength, and corrosion resistance. The surface of the implants is treated to promote osseointegration, i.e., the direct bonding of the implant to the bone tissue. [1]

Currently, additive manufacturing is also used in the production of dental implants, enabling the creation of complex geometric structures and customized solutions. Implants are often manufactured on a shared support platform, which ensures their stability during the printing process. However, after additive manufacturing is complete, it is necessary to perform subsequent technological operations, particularly the removal of this platform. [2]

From a technological standpoint, the machining of dental implants is a specific process that requires high precision and surface quality while eliminating the risk of mechanical damage. Implants are characterized by relatively small dimensions and complex geometry, which increases their susceptibility to deformation during clamping and machining. [3]

Particular emphasis is placed on the cleanliness of the manufacturing process.

Since implants come into direct contact with the biological environment, it is essential to minimize contamination of their surface. This can be caused, for example, by the release of particles from the fixture or an inappropriate choice of material. For this reason, the design of the manufacturing system, including the clamping fixture, takes into account not only mechanical stability but also hygienic and material requirements. [4]

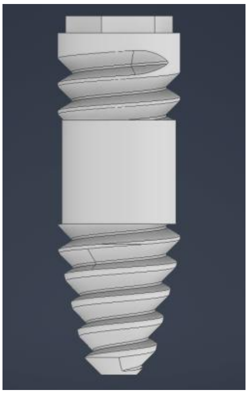

Figure 1. 3D model of a dental implant

Mechanical and dynamic loads in a machining system

During the manufacturing cycle, the clamping fixture is subjected to a system of mechanical and dynamic loads generated by the continuous interaction between the cutting tool, the workpiece, and the fixture body. These forces are primarily caused by the cutting process during material removal, and their nature depends directly on the chosen machining method, the physical and mechanical properties of the workpiece material, and the precise geometry of the tool's cutting edge. At the same time, clamping forces are introduced into the system, the primary function of which is to ensure a stable position of the workpiece, thereby preventing unwanted movement of the platform throughout the entire duration of the machining operation. [5]

The cutting force acting on the workpiece is defined by several vector components. From the perspective of fixture design, its lateral component is the most significant, as it causes a permanent tendency for the workpiece to shift in a direction perpendicular to the machine spindle axis. This factor is identified as critical for the overall stability of the clamping, as it induces a direct load on the clamping elements. These forces are transmitted through the contact interfaces between the workpiece and the fixture, leading to the formation of stress fields that are concentrated primarily in the zones of direct contact and at the points of force transmission. [6]

Contact mechanics and stress distribution in materials

From the perspective of solid mechanics, a fixture is defined as a structural system subjected to a combination of compressive, bending, and, in specific cases, shear stresses. High contact pressures are generated in the clamping zones, which are directly proportional to the magnitude of the applied clamping force and inversely proportional to the size of the contact area. A reduced contact area indicates a nonlinear increase in local stresses, which can lead to micro-deformations or permanent damage to the surface layers of the workpiece. Therefore, during the design process, an in-depth optimization of the contact planes is performed to achieve load distribution across the entire circumference of the platform. [7]

Special attention is paid to the contact mechanics between the individual functional elements of the system. Contact stresses arise at the points of contact, which, if the geometry is improperly selected, can locally exceed the yield strength of the material used. In the case of dental implants, the occurrence of any local surface damage is unacceptable, as these changes could negatively affect the resulting functional properties and aesthetic parameters. The design of the fixture therefore ensures a sufficiently dimensioned and geometrically appropriate contact surface, which effectively minimizes stress concentration at critical nodes. [7]

Static stiffness, accuracy, and dynamic stability of the system

Static stiffness represents one of the key factors affecting machining accuracy and process stability. Insufficient rigidity of the machine tool structure, fixture, or workpiece may result in elastic deformation under cutting loads, leading to dimensional inaccuracies and deterioration of surface quality. Recent studies have shown that topology optimization and finite element modelling can significantly improve the stiffness-to-weight ratio of machine tool structures while maintaining their operational performance. Structural modifications aimed at reinforcing critical load-bearing components contribute to increased rigidity and improved machining accuracy. [8]

Machining accuracy is closely related to the structural behaviour of the machine tool under operational loads. The distribution of deformation throughout the machine structure directly influences the relative position between the tool and the workpiece. Numerical analyses of high-precision machine tools have demonstrated that spindle assemblies, rotary axes, and supporting structures represent the most critical sources of displacement affecting machining precision. Optimisation of these components contributes to reduced positioning errors and improved dimensional accuracy during machining operations. [9]

Dynamic stability represents another essential aspect of machining system performance. During machining operations, cutting forces generate vibrations that affect tool life, surface integrity, and process reliability. Modal analyses and experimental investigations have shown that increasing natural frequencies and reducing structural compliance improve vibration resistance and reduce the likelihood of resonance. The ability to accurately predict the dynamic response of machine structures enables the optimisation of machine tool design and contributes to more stable machining conditions. [9]

The significance of dynamic stability becomes particularly evident during the machining of titanium alloys. Due to their high strength and low thermal conductivity, titanium alloys generate elevated cutting forces and increased thermal loads, which may promote unstable cutting conditions. Recent studies demonstrated that fluctuations in cutting forces, irregular chip formation, and self-excited vibrations may occur under certain cutting conditions, negatively affecting surface quality, dimensional accuracy, and tool wear. Therefore, achieving reliable machining performance requires not only sufficient static stiffness but also adequate dynamic stability of the entire machine–fixture–workpiece system. [10]

Material optimization, durability, and biocompatibility

The material composition of the clamping fixture is a fundamental element in the process of load transfer and distribution. From a mechanical standpoint, the primary parameter is the modulus of elasticity, which defines the material’s ability to resist deformation. The use of materials with a high modulus of elasticity results in minimal elastic deformation, which increases the stability of the system. Strength characteristics, surface hardness, and wear resistance are also taken into account, ensuring the long-term functionality of the fixture without degradation of its technical parameters. [11]

In the specific context of dental implant manufacturing, strict requirements for cleanliness and biocompatibility are integrated into the design. Since these components are intended for implantation into the human body, it is essential to eliminate any form of contamination. Stainless steel is therefore selected as the primary construction material, characterized by exceptional chemical stability and high corrosion resistance. This material selection prevents the risk of releasing metal fragments or oxidation products that could adversely affect the quality of the implants. [11]

The use of stainless steel also contributes to simplifying the maintenance and cleaning processes of the device in accordance with hygiene requirements. The material’s surface is highly resistant to the aggressive effects of chemical cleaning agents and allows for the complete removal of titanium filings and cooling media. This ensures safe repeatability of the device’s use without the risk of undesirable effects between individual production operations. [12]

Specifics of machining additively manufactured titanium components

Additive manufacturing technologies enable the production of complex titanium components with reduced material waste and greater design flexibility. However, components produced by processes such as Selective Laser Melting (SLM), Direct Metal Laser Sintering (DMLS), Electron Beam Melting (EBM), and Direct Metal Deposition (DMD) generally require subsequent machining operations to achieve the dimensional accuracy and surface quality required for functional applications. Surface roughness, dimensional deviations, partially fused particles, and residual stresses generated during layer-by-layer fabrication represent the primary reasons for applying post-processing operations to additively manufactured Ti6Al4V components. Recent studies have shown that the final quality of additively manufactured parts is strongly dependent on both the additive manufacturing process and the subsequent machining strategy. [13]

The machinability of additively manufactured titanium alloys is strongly influenced by their specific microstructure, mechanical properties, and residual stress distribution. Compared with conventionally manufactured Ti6Al4V alloys, additively manufactured components often exhibit anisotropic behavior, heterogeneous microstructures, and variations in hardness caused by rapid thermal cycling during fabrication. Several studies reported that build orientation, process parameters, and thermal history significantly affect cutting forces, tool wear, and surface integrity during machining operations. Furthermore, additive manufacturing-induced anisotropy has been identified as an important factor influencing tool wear mechanisms and machining performance. [14]

Residual stresses generated during rapid melting and solidification cycles remain one of the major challenges associated with machining additively manufactured titanium alloys. High thermal gradients and cooling rates lead to the accumulation of internal stresses that may affect dimensional stability and contribute to distortion during support removal and finishing operations. In addition, the presence of manufacturing defects, surface irregularities, and microstructural heterogeneity may negatively influence the mechanical performance and long-term reliability of the final component. For this reason, considerable attention has been devoted to optimizing post-processing operations aimed at improving surface integrity and reducing the influence of manufacturing-induced defects. [15]

In the case of dental implant manufacturing, where strict requirements are imposed on dimensional accuracy and surface quality, machining operations represent a critical stage of the production process. The achievement of the required geometric accuracy and surface integrity is essential not only for the functional performance of the implant but also for its long-term clinical reliability. Therefore, the understanding of machining behavior and post-processing requirements of additively manufactured Ti6Al4V components remains an important research topic in advanced biomedical manufacturing. [13]

METHODOLOGY SECTION

The design of the clamping fixture is dictated by the need to ensure the stability and precise positioning of the 3D-printed platform with integrated implants during the milling process. Given the specific mechanical properties of parts produced by additive technologies, particularly their reduced stiffness, it is essential to prevent the occurrence of undesirable deformations.

The design ensures an even distribution of clamping forces to eliminate the risk of mechanical damage to the workpiece. The implementation of this fixture enables machining while achieving the defined geometric accuracy. The high quality of the final product is guaranteed by a clamping method that takes into account the structural integrity of additively manufactured components.

The Figure 2 shows a 3D model of the designed fixture.

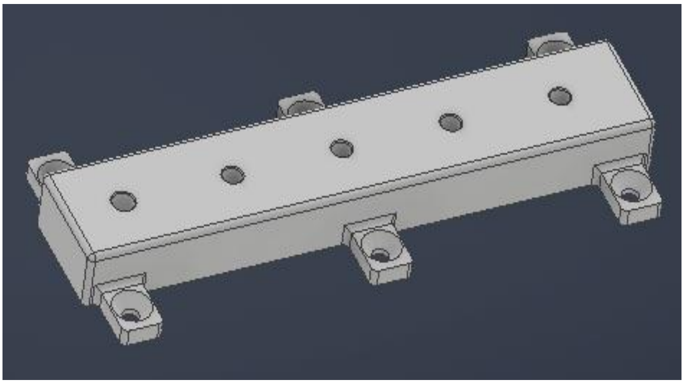

Figure 2. 3D model of the designed clamping fixture

Design characteristics of the clamping mechanism

The main load-bearing part of the structure consists of a section with integrated holes for securing implants. In the design of this body, emphasis is placed on achieving high static rigidity and stability during the machining process. Fixation to the machining center's worktable is achieved via fasteners integrated into the lower part of the body.

The upper surface is defined as a functional clamping plane onto which the workpiece—in the form of a platform with additively manufactured implants—is positioned (see Figure 3). Secure attachment to the worktable is ensured by protrusions with screw holes located on the sides of the fixture. This design prevents vibrations or unwanted movement of the fixture during the cutting process.

The design is focused on functionality and mechanical durability. The fixture enables repeatable and precise positioning of the workpiece, thereby creating conditions for stable machining. The overall solution is optimized to achieve a high degree of operational reliability.

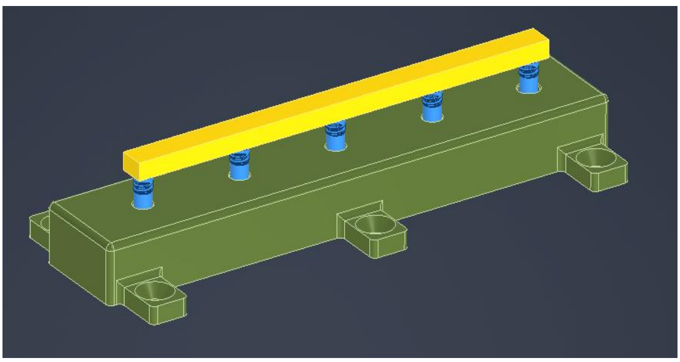

Figure 3. 3D model of a clamped dental implant casting in a clamping fixture

Material Specifications and Manufacturing Processes

The choice of material for the clamping fixture is determined by the need to achieve high tensile strength and static stiffness, while also taking into account the demands arising from the nature of the workpiece and the specific conditions of machining.. The fixture was assumed to be manufactured from precipitation-hardening stainless steel AISI 630 (17-4 PH), which is commonly used in engineering applications requiring high strength and corrosion resistance. The material possesses a yield strength of approximately

800 MPa, which was used as the reference value for the calculation of the safety factor in the finite element analysis. At the same time, this structural material is characterized by high corrosion resistance and chemical stability, which is classified as an essential parameter for applications where emphasis is placed on the sterility and cleanliness of the working environment.

The high surface stability of the selected material ensures that functional surfaces do not degrade during intensive and long-term use, thereby guaranteeing the accuracy and repeatability of the clamping process. In addition, this material allows for subsequent cleaning, decontamination, and sterilization processes without any negative impact on its physical properties.

The workpiece consists of a platform manufactured using additive manufacturing technology, onto which dental implants are integrated. This platform is defined as a temporary support structure that ensures the fixation of the implants during the primary manufacturing process. Due to the nature of selective laser melting, the material may exhibit residual stresses and local structural inhomogeneities that directly affect its mechanical behavior during subsequent subtractive machining. For this reason, it is essential to ensure stable clamping of the entire assembly to prevent deformation during the manufacturing process.

Throughout the entire manufacturing process, the utmost emphasis is placed on eliminating the risk of contamination. Since dental implants are intended for direct contact with the biological structures of the human body, ensuring a high level of cleanliness is a critical parameter. Contamination can be caused not only by direct contact with the body of the device but also by metal microparticles released during the milling process.

The manufacturing operation is primarily focused on removing the abutment platform from the printed dental implants via the milling process. This is a critical phase of production during which the individual components are mechanically separated, and which directly determines the final product quality. During this process, it is essential to ensure the stability of the workpiece and its spatial position relative to the cutting tool. Any form of instability, vibration, or unwanted displacement can lead to irreversible damage to the implants, changes in their geometric specifications, or an unacceptable deterioration of surface roughness.

The design of the clamping mechanism is intended to ensure an even distribution of clamping force across the entire contact surface of the workpiece. This approach eliminates the risk of local overloading and reduces the risk of elastic or plastic deformation. The clamping elements are arranged symmetrically within the assembly, thereby achieving uniform transfer of force flows between the fixture and the platform.

A key aspect of the design is the protection of the functional surface of the implants throughout the entire machining process. Improperly designed clamping could cause microdeformations or damage to the sensitive surface layer, which would ultimately negatively affect the functional properties of the implant after implantation. The fixture therefore ensures a sufficiently secure yet gentle clamping that minimizes mechanical stress in critical areas of dental implants.

The material configuration, in close conjunction with the tool's design, enables the execution of a complex machining process while strictly adhering to requirements for mechanical stability, dimensional accuracy, and technological cleanliness. At the same time, this solution guarantees the preservation of the structural integrity of dental implants and creates suitable conditions for their subsequent processing, including final cleaning and sterilization processes.

Defining the boundary conditions for the simulation

The functional and safety parameters of the proposed clamping mechanism were verified through a comprehensive strength analysis using a simulation method. The simulation was performed using SimScale software. The computational model was created based on the geometric specifications of the fixture. The individual elements included in the analysis are: the fixture's base body, the workpiece defined by a platform with dental implants, and a simplified configuration of screw connections. The model was designed to capture the mechanical responses of the system under force loading and to identify critical zones in terms of local stress concentrations and elastic deformations.

In constructing the computational model, assumptions of linear elasticity and isotropic material behavior were applied, which allows for the evaluation of stress-strain states within the considered operating regime.

The boundary conditions of the simulation calculation were defined to ensure a high degree of agreement with actual operating conditions during the machining process. Fixation was applied to the lower functional surface of the fixture base, thereby simulating a rigid connection to the worktable of the CNC machining center. This methodological approach eliminated all six degrees of freedom of the system, thereby preventing unwanted spatial displacement. The boundary conditions defined in this manner provide a realistic representation of the clamping fixture's behavior during critical phases of the machining operation.

The clamping force is transmitted to the contact interface between the platform and the dental implants, thereby simulating the actual application of clamping pressure to the workpiece. The chosen approach allows for an effective analysis of stress distribution at critical nodes without the need to model microscopic geometric features.

Cutting resistance was expressed in the analysis as a force acting on the workpiece in the direction of tool movement. The magnitude of this force was determined based on milling parameters, with its value accounting for dynamic effects during material removal. The simulation considered a cutting force of 300 N, which represents a conservative load estimate for the given material. The cutting force value of 300 N was selected based on published experimental studies focused on the milling of Ti6Al4V alloys. Petrů et al. reported cutting force components corresponding to a resultant cutting force of approximately 250 N under comparable machining conditions. Considering the variability of machining parameters and to ensure a conservative assessment of fixture performance, a cutting force of 300 N was applied in the finite element analysis. [16]

The modeling accounted for the most unfavorable direction of force application to verify the stability of the clamping even under critical conditions. This approach allows for assessing the fixture's behavior under extreme conditions and verifying that the workpiece remains securely fixed. The fixture is clamped by screw connections at six points. This solution ensures an even distribution of pressure across the entire contact surface and reduces the risk of local deformations. The screw layout is designed symmetrically with respect to the load, thereby increasing the stability of the entire system during machining.

The force acting during machining was concentrated in the model at the point of contact between the tool and the workpiece (see Figure 4). This simplification allows for effective monitoring of how the fixture and workpiece deform under pressure and for identifying the most stressed areas. Despite this simplification, the model provides accurate information on the stress distribution within the structure.

Based on these conditions, it is possible to evaluate whether the designed fixture meets the stiffness and stability requirements necessary for the given machining operation. Part of the analysis involved monitoring deformations caused by clamping and cutting forces. Elastic bending of dental implants was monitored primarily in the section between the fixture and the support platform. The simulation results allow for an assessment of whether the designed structure is sufficiently rigid and stable for precise machining.

The simulation model provides an overall view of the behavior and strength of the designed fixture under real-world operating conditions. Based on the obtained results, the most stressed areas of the structure are identified, which can then be modified to reduce deformations and increase the precision of implant manufacturing.

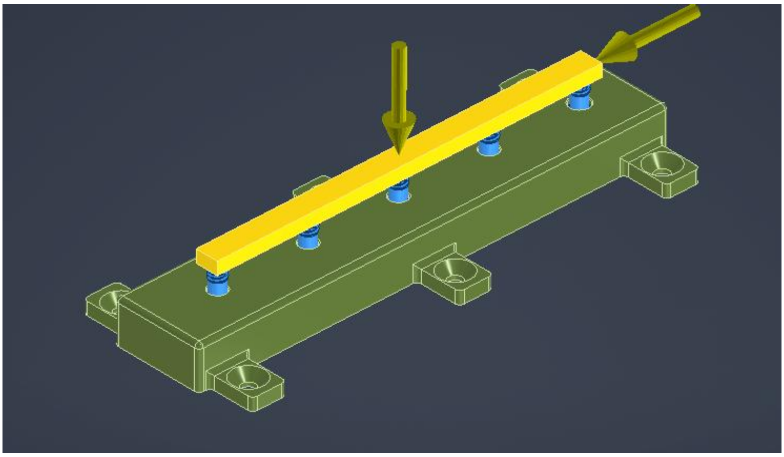

Figure 4. Visualization of simulated machining loads in 3D models

Analysis results

The results of the structural analysis provide a detailed view of the distribution of stresses and strains in the individual segments of the clamping mechanism. Based on the evaluation of the stress state, critical areas of the structure were identified and its overall behavior under operational loads was assessed.

Stress distribution and critical areas

The maximum stress values are concentrated in the contact areas between the fixture and the dental implant platform. This zone represents the primary site of clamping force transmission, which fully corresponds to the expected mechanical behavior of the system. In the visualization of the results, this condition is depicted using a color scale, where increased stress values are indicated by a transition from green to yellow in the immediate vicinity of individual implants. The local increase in stress at these points is a natural consequence of the concentration of forces at the contact points.

Other parts of the mechanism, particularly the massive base body of the fixture, exhibit low stress levels. This confirms the high stiffness of the designed system and the base's ability to effectively absorb and transfer loads without causing undesirable deformations.

Analysis of Deformations and System Stiffness

The deformations observed in the fixture are minimal and do not reach levels that could negatively affect the positioning accuracy of the workpiece. The greatest deviations occur in the area of the plate on which the dental implants are integrated; however, their deformation is negligible compared to the overall dimensions of the system. This result demonstrates that the fixture possesses sufficient rigidity to withstand external loading while maintaining clamping stability.

The stress distribution once again confirms that the load is evenly distributed among all six clamping points. This clamping design eliminates the risk of local overloading, thereby preventing deformation of the platform or damage to the contact surfaces of the dental implants.

RESULTS

The maximum von Mises equivalent stress was measured at 279.1 MPa. This maximum is localized in areas just below the abutment on the dental implant. This is the zone of direct transmission of clamping and shear forces, which is consistent with the expected mechanical behavior of the system.

The stress distribution is shown in Figure 5. The highest values are indicated in red around the contact surfaces and clamping elements.

A detailed view of the stress distribution on a single implant is shown in Figure 6.

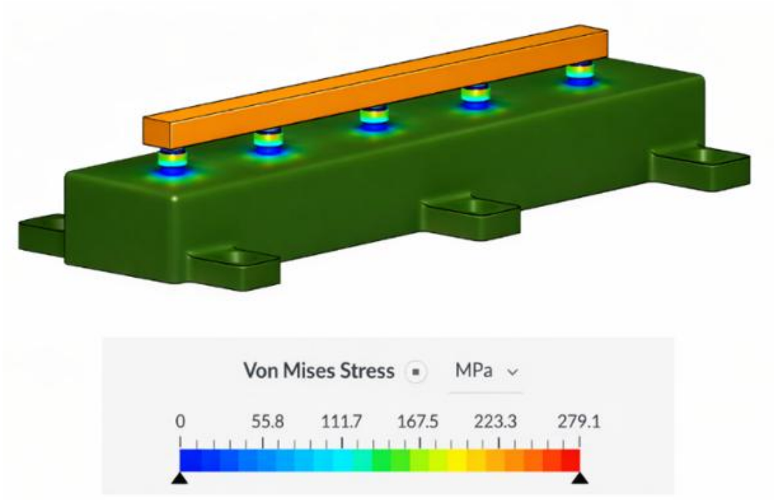

Figure 5. Stress simulation during the machining of dental implants

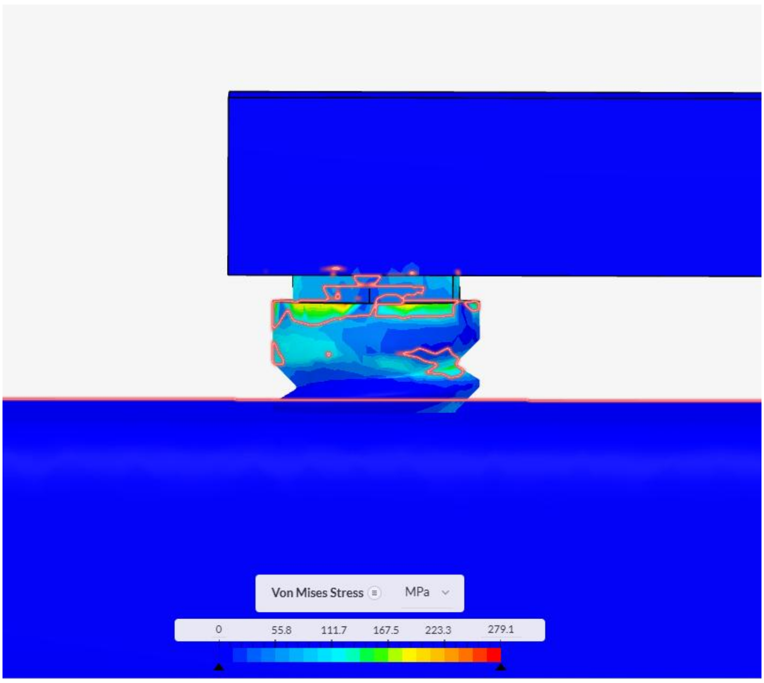

Figure 6. Detailed stress display

The results show that the equivalent stress is distributed evenly across all analyzed implants, confirming the symmetrical load distribution. Significantly lower stress values were recorded in other parts of the structure, confirming the fixture's sufficient stiffness and effective load distribution without the formation of critical stress concentrations.

Based on the results of the numerical analysis, a safety factor for the structure was determined, which expresses the margin of safety against the occurrence of plastic deformation. The safety factor was determined as the ratio of the material's yield strength to the maximum equivalent stress according to von Mises' criterion:

$$FoS = \frac{Re}{\sigma max}$$

FoS – safety factor
Re – yield point of the fixture material
σmax – maximum system load

When considering high-strength stainless steel with a yield strength of approximately 800 MPa and a maximum stress of 279.1 MPa, the safety factor is:

$$FoS = \frac{800\ MPa}{279{,}1\ MPa} = 2{,}87$$

The calculated safety factor is greater than 2, which indicates that the structure has a sufficient strength margin and confirms that the designed fixture is adequate in terms of mechanical loading. The structure is capable of withstanding the applied forces without the risk of plastic deformation.

DISCUSION

The obtained numerical results confirmed that the highest stress concentrations occurred in the contact region between the dental implant and the supporting fixture structure, while the overall deformation of the fixture remained low. Similar findings were reported by Nguyen and Tung, who identified the largest deformations in regions characterized by reduced structural stiffness and increased distance from the clamping locations [17]. These results indicate that the stiffness of the fixture and the arrangement of the clamping elements play a decisive role in maintaining dimensional stability during machining operations. The maximum von Mises stress obtained in the present study reached approximately 279 MPa, which remained below the yield strength of the selected fixture material. This finding confirms the suitability of the proposed fixture design for machining operations involving additively manufactured titanium dental implants. The low deformation values further suggest that the fixture is capable of maintaining the positional accuracy required for precision machining applications. Future research should focus on the experimental validation of the numerical model under real machining conditions. Additional investigations may also evaluate the influence of different clamping configurations, cutting force magnitudes, and fixture materials on stress distribution and deformation behaviour. Furthermore, the integration of real cutting force measurements and process monitoring systems could improve the accuracy of future simulation models and contribute to the development of more robust fixture designs for dental implant manufacturing.

CONCLUSION

This article presented the design and numerical verification of a clamping fixture intended for the finishing operation of additively manufactured dental implants. The proposed fixture was specifically developed for the macro-scale milling process used to remove the support platform and separate individual implants from the additively manufactured structure. A six-point clamping concept was adopted to ensure uniform load transfer and stable fixation of the implant assembly during machining The functionality of the proposed solution was evaluated using finite element analysis under representative machining loads. The simulation results showed that the maximum equivalent stress according to the von Mises criterion reached 279.1 MPa and was localized in the contact regions between the fixture and the implants. The stress distribution was found to be uniform across all analyzed implants, confirming balanced load transfer within the clamping system. Furthermore, the calculated safety factor reached a value of 2.87, indicating that the proposed fixture possesses a sufficient strength reserve and is capable of withstanding the applied machining loads without the risk of plastic deformation. The novelty of the presented research lies in the development and simulation-based verification of a dedicated fixture designed specifically for the post-processing of additively manufactured dental implants produced on a common support platform. Unlike conventional fixture designs, the proposed solution considers the specific geometric arrangement of multiple implants and the load conditions associated with support removal operations. The obtained results demonstrate that the proposed design ensures adequate structural stiffness, stable workpiece positioning, and reliable load distribution throughout the machining process. From a practical perspective, the proposed fixture can contribute to improving machining accuracy, reducing the risk of implant deformation during support removal, and increasing the reliability of manufacturing operations in dental implant production. The use of numerical simulations during the design stage also enables the reduction of development time and costs associated with physical prototype testing. Future research will focus on the experimental validation of the numerical model under real machining conditions. Additional studies will investigate the influence of different cutting force levels, clamping configurations, and fixture materials on stress distribution and deformation behaviour. Furthermore, the integration of measured cutting force data into simulation models will be considered to improve the accuracy of future fixture design methodologies.

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DECLARATIONS OF INTEREST STATEMENT

The authors affirm that there are no conflicts of interest to declare in relation to the research presented in this paper.

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SOCIJALNA DISTANCA PREMA DRŽAVLJANIMA RUSIJE U ZEMLJAMA ZAPADNOG BALKANA NAKON ESKALACIJE ORUŽANOG SUKOBA U UKRAJINI

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APSTRAKT

Rad donosi komparativnu socijalno-psihološku analizu socijalne distance građana pet zemalja Zapadnog Balkana (Bosne i Hercegovine, Srbije, Crne Gore, Sjeverne Makedonije i Hrvatske) prema državljanima Rusije nakon eskalacije oružanog sukoba u Ukrajini. Na uporednom uzorku primijenjena je metodološki modifikovana Bogardusova skala kroz *forced-choice* dizajn dominantnog izbora, čime je instrument prilagođen nominalnom nivou mjerenja. Značajnost regionalnih razlika i intenzitet povezanosti provjereni su adekvatnom statističkom obradom podataka. Nalazi ukazuju na izraženu regionalnu polarizaciju i stabilne razlike u dominantnoj kognitivnoj kategorizaciji spoljne grupe u zavisnosti od konteksta matične države.

Ključne riječi: socijalna distanca, Bogardusova skala, Zapadni Balkan, oružani sukob u Ukrajini.

UVOD

Socijalna distanca konstrukt koji ima duboko ukorijenjeno značenje u sociologiji i socijalnoj psihologiji. Ona se najpreciznije može definisati kao stepen spremnosti prihvatanja ili odbacivanja pripadnika drugih grupa u zavisnosti od njihove društvene, kulturne ili etničke pripadnosti. U uslovima makro-društvenih kriza, poput pandemije ili ratnih sukoba, socijalna distanca dobija izraženiji karakter, transformišući se iz individualne predispozicije u kolektivni, transformišući se iz individualne predispozicije u kolektivni mehanizam emocionalne, kognitivne i identitetske zaštite.

Eskalacija oružanog sukoba u Ukrajini, koji je započeo 2022. godine specijalnom vojnom operacijom Ruske Federacije, imao je snažan uticaj na međunarodne odnose, ali i na unutrašnju percepciju ruskog naroda u brojnim zemljama. Iako u javnom i političkom prostoru dominiraju ekonomsko-političke sankcije i institucionalne mjere, na nivou građana došlo je do značajnih promjena u afektivnim i kognitivnim stavovima prema Rusima kao naciji. U regionu Zapadnog Balkana, specifični istorijski i kulturni odnosi sa Rusijom dodatno komplikuju ovu dinamiku.

Prije izbijanja sukoba 2022. godine, u više istraživanja sprovedenih u regionu Zapadnog Balkana zabilježena je uglavnom pozitivna ili neutralna percepcija Rusije. Na primjer, prema izveštaju Balkanskog barometra, značajan dio građana Srbije i Republike Srpske u Bosni i Hercegovini smatrao je Rusiju prijateljskom državom, dok su stavovi u Hrvatskoj i Crnoj Gori bili ambivalentniji, uz izraženije oslanjanje na Evropsku uniju [1]. Isto tako, istraživanje CEDEM-a u Crnoj Gori pokazalo je da oko 30% građana ima pozitivan stav prema Rusiji, dok mlađe generacije izražavaju nešto veću distancu [2].

Takvi rezultati sugerišu da je Rusija bila relativno pozitivno pozicionirana u kolektivnoj svijesti stanovnika nekih balkanskih zemalja, često kroz prizmu zapadne spoljne politike, NATO alijanse i promovisanja multipolarnog svijetskog poretka. Međutim, trenutni konflikt postavio je ozbiljne izazove pred način na koji se kolektivno procesuiraju i vrjednuju nacionalni identiteti. U tom kontekstu, savremena socijalno-psihološka istraživanja potvrđuju da izbijanje rata u Ukrajini pokreće brzu reevaluaciju i restrukturiranje stereotipa prema ruskom narodu, pomjerajući fokus sa tradicionalnih kulturnih asocijacija na moralnu i bezbjednosnu evaluaciju [3].

Prije izbijanja rata u Ukrajini 2022. godine, više istraživanja ukazivalo je na uglavnom pozitivne ili neutralne stavove građana Zapadnog Balkana prema Ruskoj Federaciji. Ovi stavovi predstavljaju važan reper za razumijevanje potencijalne promjene koje se mogu pojaviti kao posljedica rata, medijske reprezentacije i spoljnopolitičkih orijentacija.

Komparativna analiza unutar ovog geopolitički specifičnog i identitetski podijeljenog regiona, omogućava nam dublje razumijevanje načina na koji spoljnopolitička kretanja i krizni konteksti oblikuju individualne kognitivne kategorizacije i strukturišu distancu prema pripadnicima jedne nacije.

TEORIJSKO-KONCEPTUALNI OKVIR ISTRAŽIVANJA

Socijalna distanca jedan je od najznačajnijih konstrukata u proučavanju međugrupnih odnosa. Danas se, kao teorijski i metodološki alat, široko koristi u proučavanjima etničkih, nacionalnih klasnih, statusnih odnosa, pri čemu se stepen bliskosti ili udaljenosti najčešće mjeri Bogardusovom skalom socijalne distance ili nekom njenom modifikacijom.

Idejni tvorac ovog pojma je sociolog Georg Zimel (Georg Simmel), a dalju teorijsku razradu u sociološkim interpretacijama nastavio američki sociolog Robert E. Park. Za Georga Zimela, socijalna distanca predstavlja formalni oblik društvenosti koji opisuje odnos u kojem su akteri istovremeno povezani i razdvojeni [4]. Društveni odnos, po Zimelu, nikada nije stanje potpune bliskosti niti potpune odvojenosti: u svakom odnosu postoji napetost između „biti zajedno“ i „biti odvojen“, koja upravo proizvodi društvenu interakciju [4]. Po Zimelu, ovaj pojam ima dvostruku prirodu: s jedne strane označava prostornu dimenziju – stepen prostorne (fizičke blizine); s druge strane, ovaj poajm ima metaforičku dimenziju – označava kulturnu, moralnu i psihološku razdvojenost od drugih pojedinaca i društvenih grupa.

Robert Park preuzima Zimelov pojam socijalne distance, ali ga reinterpretira u „metaforičkom“ i psihološko–društvenom smislu, gotovo potpuno odvajajući od Zimelove ideje geometrijske (prostorne) distance [5]. Za Parka, socijalna distanca je stepen simpatije, povjerenja, prihvatanja ili odbijanja.

Emory S. Bogardus je odigrao ključnu ulogu u operacionalizaciji ovog koncepta, transformišući ga iz apstraktne teorijske ideje u empirijski mjerljiv fenomen [6], [7]. Njegov rad predstavlja prelaz od teorije ka metodološkoj primjeni, što je omogućilo da se pojam trajno ustali u sociologiji i psihologiji, ali i drugim srodnim naučnim disciplinama.

U savremenoj socijalnoj psihologiji, socijalna distanca se posmatra kao dinamičan proces, koji u uslovima društvenih kriza i konflikata, aktivira bazične kognitivne i afektivne mehanizme pojedinca. Ovi mehanizmi primarno uključuju:

- Percepciju prijetnje, gdje drugi narod ili grupa može biti viđena kao ugrožavajuća po sigurnost, vrijednosti ili kolektivni identitet [6];
- Dehumanizaciju, kroz koju se smanjuje empatija prema drugoj grupi, što omogućava opravdanje društvene distance [8];
- Kognitivne prečice i stereotipe, koji u kriznim situacijama pojednostavljuju kompleksne socijalne odnose i usmjeravaju individualne stavove na osnovu straha, lojalnosti ili istorijskih narativa [9]. Ovakva kognitivna redukcija blisko je povezana sa konceptom tabu kognicija, koji objašnjava kako pojedinci u uslovima visoke moralne i društvene polarizacije napuštaju nijansirane evaluacije i pribjegavaju rigidnom, jednoznačnom kategorisanju društvene stvarnosti [10].

Za potrebe istraživanja, tumačenje složene dinamike socijalne distance postavlja se u okvir tri komplementarna socijalno-psihološka modela: hipotezu o kontaktu, teoriju socijalne identifikacije i teoriju integrisane prijetnje.

Jedan od najuticajnijih teorijskih okvira za razumijevanje redukcije socijalne distance jeste hipoteza o kontaktu Gordona Allporta, prema kojoj direktni međugrupni kontakt, pod određenim uslovima (jednak status, kooperacija, institucionalna podrška), smanjuje predrasude i socijalnu distancu [11]. Metaanaliza Pettigrewa i Troppa, koja je obuhvatila 515 studija s više od 250.000 ispitanika, potvrdila je da međugrupni kontakt konzistentno smanjuje predrasude ($r = -0{,}21$) [12]. U kontekstu ovog istraživanja, hipoteza o kontaktu nudi objašnjenje za varijabilitet socijalne distance prema Rusima u regionu Zapadnog Balkana: države s istorijski dužim i intenzivnijim kulturnim, političkim i ekonomskim kontaktima s Rusijom, kao što je Srbija, očekivano mogu iskazivati nižu socijalnu distancu, dok države s ograničenijim ili pretežno negativno obilježenim kontaktom, iskazuju višu distancu.

Henri Tajfel i John Turner razvili su teoriju socijalne identifikacije (Social Identity Theory – SIT), koja objašnjava kako proces kategorizacije na „mi“ i „oni“ aktivira mehanizme favorizovanja vlastite grupe i distanciranja od spoljne grupe [13]. Prema SIT-u, pojedinci nastoje održati pozitivnu socijalnu identifikaciju kroz povoljno poređenje vlastite grupe sa drugima, što u uslovima međugrupnog konflikta postaje posebno izraženo. Sukob u Ukrajini deluje kao katalizator koji pojačava istaknutost nacionalnih i civilizacijskih kategorija, generišući povećanu distancu prema naciji koja se percipira kao odgovorna za konflikt. Istovremeno, za grupe koje dijele snažan simbolički identitet s Rusijom, kao što je slučaj s dijelom srpske javnosti kroz narativ pravoslavnog i slavenskog zajedništva, isti mehanizam proizvodi suprotan efekt: identifikacija sa narativom vlastite grupe, koji je istorijski i kulturološki blizak Rusiji, smanjuje percipiranu distancu prema njenim državljanima.

Walter G. Stephan i Cookie White Stephan razvili su teoriju integrisane prijetnje (Integrated Threat Theory – ITT), koja sistematizuje mehanizme putem kojih percipirana prijetnja od spoljne grupe povećava predrasude i socijalnu distancu [14]. Teorija razlikuje četiri tipa prijetnje: realističku prijetnju (ugroženost materijalnih resursa ili bezbjednosti), simboličku prijetnju (ugroženost vrijednosti i kulturnog identiteta), međugrupnu anksioznost (nelagoda u kontaktu) i negativne stereotipe. U kontekstu rata u Ukrajini, simbolička i realistička manifestuje se kroz percepciju da ruska spoljna politika ugrožava evropski politički poredak, vrijednosti i bezbjednosnu arhitekturu, što potencijalno može biti dominantan prediktor povišene socijalne distance u zemljama sa proevropskom orijentacijom, kao što je Hrvatska. Nasuprot tome, u zemljama gdje je Rusija percipirana kao saveznik ili zaštitnik, a ne kao prijetnja, prijetnja izostaje, a distanca ostaje niska ili se smanjuje uslijed solidarnosti i identifikacije.

METODOŠKI OKVIR

Predmet istraživanja

Predmet istraživanja je socijalna distanca kao bazični socijalno-psihološki fenomen u percepciji državljana Rusije među građanima zemalja Zapadnog Balkana (Bosna i Hercegovina, Srbija, Crna Gora, Sjeverna Makedonija i Hrvatska) u specifičnom kontekstu nakon eskalacije oružanog sukoba u Ukrajini.

Istraživanje se fokusira na:

- Stavove i spremnost građana na interakciju sa državljanima Rusije u kontekstu različitih društvenih uloga;
- Socio-psihološke faktore koji utiču na formiranje i strukturisanje socijalne distance;
- Specifičnosti manifestovanja stavova u promijenjenim uslovima koje generišu međugrupni konflikt i globalna polarizacija.

Istraživačke hipoteze

Rad se bazira na dvije alternativne naučne hipoteze:

H1: Postoji statistički značajna razlika u strukturi i nivou socijalne distance prema državljanima Rusije među posmatranim zemljama Zapadnog Balkana (Bosna i Hercegovina, Srbija, Crna Gora, Sjeverna Makedonija, Hrvatska).

H2: Građani zemalja Zapadnog Balkana izražavaju veću socijalnu distancu prema državljanima Rusije u domenu bliskih ličnih odnosa (npr. brak, prijateljstvo) nego u profesionalnim (kolega, komšija) i formalno-institucionalnim odnosima (npr. državljanstvo, uloga gosta, turiste).

Ciljevi istraživanja

Glavni cilj: Ispitati strukturu i intenzitet socijalne distance prema državljanima Rusije u zemljama Zapadnog Balkana nakon eskalacije rata u Ukrajini.

Specifični ciljevi:

1. Utvrditi raspodjelu dominantnih izbira na modifikovanoj Bogardusovoj skali socijalne distance;
2. Analizirati razlike u socijalnoj distanci u zavisnosti od bazičnog nivoa socijalnog odnosa (lični, profesionalni i institucionalni nivo);
3. Uporediti dobijene rezultate između različitih zemalja regiona.

Uzorak

Istraživanje je sprovedeno u pet država regiona Zapadnog Balkana: Srbija, Bosna i Hercegovina, Crna Gora, Sjeverna Makedonija i Hrvatska. Podaci su prikupljeni u periodu od septembra do decembra 2025. godine, u fazi kada su se primarni medijski narativi nakon izbijanja sukoba već stabilizovali.

Ukupan uzorak obuhvata 1619 ispitanika, sa sljedećom distribucijom:

- Srbija 500 (30,9%);
- Bosna i Hercegovina 349(21,5%);
- Crna Gora 170 (10,5%);
- Sjeverna Makedonija 250 (15,5%);
- Hrvatska 350 (21,6 %).

Podaci su prikupljeni CAWI metodom (*Computer-Assisted Web Interviewing*) putem digitalnog upitnika na platformi Google Forms. Svi ispitanici su državljani navedenih zemalja, starosti od 18 do 65 godina, različitog nivoa obrazovanja, urbanog i ruralnog porijekla.

Metod i instrument istraživanja

U radu je primijenjena kvantitativna metoda istraživanja putem standardizovanog upitnika zatvorenog tipa. Kao primarni instrument korišćena je specifično modifikovana verzija Bogardusove skale socijalne distance. Ispitanicima je ponuđeno sedam uloga koje predstavljaju različite oblike socijalne bliskosti i prihvatljivosti državljana Rusije:

- Kao bliskog rođaka (bračnog partnera);
- Kao bliskog prijatelja;
- Kao komšiju;
- Kao kolegu na poslu;
- Kao državljanina moje zemlje;
- Kao gosta (turistu) u mojoj zemlji;
- Ne bih želio da ga vidim u svojoj zemlji.

U pogledu metrijskih karakteristika instrumenta, izvršena je svjesna konceptualna modifikacija. Iako je Bogardusova skala izvorno zamišljena kao kumulativna (Guttmanova) skala, za potrebe istaživanja transformisana je u formu jednostrukog izbora, prisilnog izbora (*forced-choice*) radi detekcije primarnog/dominantnog stava. Umjesto označavanja svih prihvatljivih uloga, od ispitanika je zahtijevano da odaberu samo jednu tvrdnju koja predstavlja njihovu primarnu asocijaciju i dominantan stav prema ciljnoj grupi. Ovom modifikacijom instrument gubi ordinalna svojstva i prelazi na nominalni nivo mjerenja (skala dominantnog izbora), što je teorijski opravdano radi identifikacije kognitivne kategorizacije pripadnika druge nacije u uslovima akutne geopolitičke krize. Statistička značajnost razlika i jačina povezanosti varijabli testirani su primjenom Hi-kvadrat testa nezavisnosti i Cramerovog V koeficijenta.

Pored navedenog, za potrebe testiranja hipoteze (H2), ovih sedam uloga je teorijski sažeto u tri bazična nivoa socijalnih odnosa: lični/intimni nivo (stavke 1–2), profesionalni nivo (stavke 3–4) i institucionalni nivo (stavke 5–7). Ova tripartitna kategorizacija odgovora teorijski je i metodološki opravdamo prelazom sa deskriptivne analize pojedinačnih uloga na konceptualni nivo mjerenja. Grupisanje u tri diferencirana nivoa omogućava precizno testiranje socijalno-psiholoških konstrukata iz teorije socijalnog identiteta i teorije integrisane prijetnje, fiksirajući stavove ispitanika u jasne sfere društvene interakcije (privatnu, poslovnu i javno-pravnu sferu).

U okviru ovako postavljenog istraživačkog nacrta operisalo se sa sljedećim ključnim varijablama:

Nezavisna varijabla − geografsko porijeklo ispitanika, odnosno pripadnost jednoj od pet država regiona Zapadnog Balkana (Srbija, Hrvatska, Bosna i Hercegovina, Sjeverna Makedonija, Crna Gora), što predstavlja kategoričku varijablu nominalnog nivoa mjerenja.

Zavisna varijabla − socijalna distanca prema državljanima Rusije, operacionalizovana kroz dominantni *forced-choice* izbor uloge na modifikovanoj Bogardusovoj skali (nominalni nivo) za potrebe prve hipoteze, odnosno kroz tri sažeta nivoa socijalnih odnosa (lični, profesionalni i institucionalni nivo) za potrebe druge hipoteze.

REZULTATI ISTRAŽIVANJA

U ovom poglavlju prikazani su empirijski nalazi dobijeni primjenom modifikovane Bogardusove skale socijalne distance na uzorku građana pet zemalja Zapadnog Balkana.

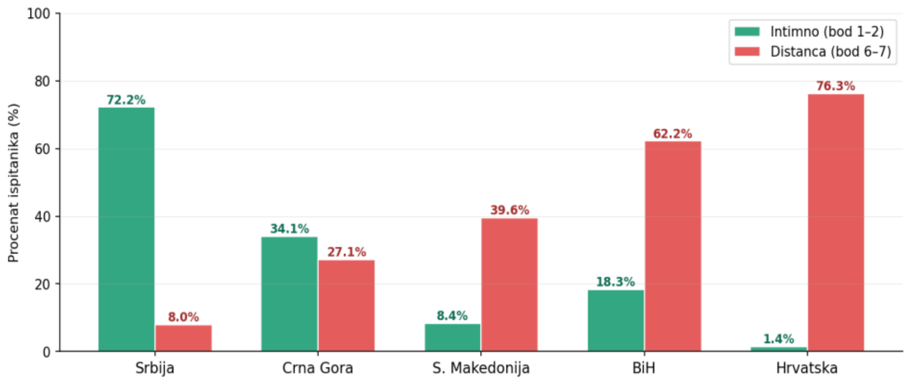
S obzirom na implementirani forced-choice dizajn prisilnog izbora, prikupljeni podaci imaju svojstva nominalnih kategoričkih varijabli, te su prikazani u formi kros-tabulacija frekvencija i pripadajućih procenata. Statistička provjera postavljenih istraživačkih hipoteza i značajnosti odstupanja među posmatranim uzorcima sprovedena je primjenom Hi-kvadrat testa nezavisnosti. Kako bi se neutralisao uticaj ukupne veličine uzorka (N = 1619) na vrijednost samog testa i precizno utvrdio stvarni socio-psihološki intenzitet i snaga povezanosti između geografskog porijekla ispitanika i strukturisanja njihovih stavova, izračunat je Cramerov V koeficijent kontingencije. Rezultati su strukturirani u dvije komparativne cjeline: primarnu analizu svih sedam izvornih uloga (za potrebe testiranja opšte hipoteze (H1) i naknadnu analizu sažetih teorijskih nivoa odnosa (za potrebe testiranja hipoteze (H2)

S ciljem utvrđivanja opštih obrazaca i frekvencija odgovora ispitanika na Zapadnom Balkanu, u Tabeli 1 je prikazana unakrsna tabulacija (kros-tabulacija) sirovih frekvencija i pripadajućih procenata za svih sedam izvornih kategorija modifikovane Bogardusove skale socijalne distance.

Tabela 1. raspodjela odgovora po pojedinačnim kategorijama (%)

Kategorija	BiH (N=349)	Crna Gora (N=170)	S. Makedonija (N=250)	Srbija (N=500)	Hrvatska (N=350)
Blizak rođak	5 (1,4%)	39 (22,9%)	4 (1,6%)	216 (43,2%)	1 (0,3%)
Blizak prijatelj	59 (16,9%)	19 (11,2%)	17 (6,8%)	145 (29%)	4 (1,1%)
Komšija	25 (7,2%)	16 (9,4%)	48 (19,2%)	54 (10,8%)	17 (4,9%)
Kolega	22 (6,3%)	12 (7,1%)	51 (20,4%)	18 (3,6%)	47 (13,4%)
Državljanin	21 (6%)	38 (22,4%)	31 (12,4%)	27 (5,4%)	14 (4,0%)
Gost/turista	210 (60,2%)	37 (21,8%)	86 (34,4%)	27 (5,4%)	178 (50,9%)
Ne želi ih vidjeti	7 (2%)	9 (5,3%)	13 (5,2%)	13 (2,6%)	89 (25,4%)

Kako bi se jasnije uočile radikalne razlike na samim polovima skale, odnosno između ekstremne bliskosti i ekstremne distance, u nastavku je prikazan Dijagram 1. Ovaj vizuelni prikaz direktno suprotstavlja zbirne procente intimnih odgovora (bodovi 1 i 2) naspram distanciranih odgovora (bodovi 6 i 7) za svaku od posmatranih zemalja. Izolacija ovih ekstremnih polova skale i svjesno izostavljanje središnjih kategorija (komšija, kolega, državljanin), primijenjeni su s ciljem analitičkog pročišćavanja vizuelnog prikaza. Na ovaj način se maksimizira kontrast između zone primarne bliskosti i zone striktnog distanciranja, što omogućava neposredan uvid u bazičnu polarizaciju stavova u regionu (hipoteza H1).



Dijagram 1. Intimni vs. distancirani odgovori (%)

Za provjeru statističke značajnosti uočenih razlika između pet zemalja na kompletnoj skali od sedam kategorija primijenjen je Hi-kvadrat test nezavisnosti. Rezultati testa pokazuju da postoji statistički visoko značajna i snažna povezanost između geografskog porijekla ispitanika i nivoa iskazane socijalne distance prema državljanima Rusije, $\chi^2(24) = 1.042,57$, $p < 0,001$, Cramerov V = 0,401.

Ovi indikatori nedvosmisleno potvrđuju prvu alternativnu hipotezu (H1 − zemlja porijekla ispitanika presudno i stabilno determiniše stepen prihvatanja ili odbijanja ciljne grupe).

Iz dobijenih podataka je vidljivo da Srbija generiše izrazitu dominaciju intimnih odgovora (72,2%), dok Hrvatska i BiH pokazuju radikalno suprotan trend sa koncentracijom u zonama visoke distance i institucionalnog kontakta (76,3) i (62,2%).

Radi dublje teorijske analize i testiranja druge hipoteze (H2), izvornih sedam kategorija skale sažeto je u tri teorijska nivoa socijalnih odnosa: lični/intimni nivo (bodovi 1–2), profesionalni nivo (bodovi 3–4) i institucionalni/ekskluzivni nivo (bodovi 5–7).

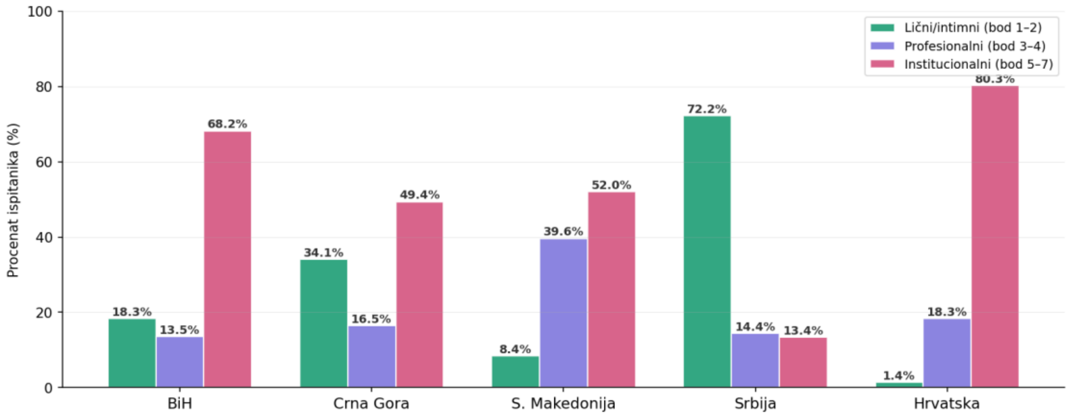
U Tabeli 2 su sumirani ovi odnosi.

Tabela 2. Raspodjela odgovora po nivoima socijalnih odnosa

Nivo socijalnih odnosa	**BiH (N=349)**	**Crna Gora (N=170)**	**S. Makedonija (N=250)**	**Srbija (N=500)**	**Hrvatska (N=350)**
Lični/intimni nivo *(bod 1-2)*	64 (18,3%)	58 (34,1%)	21 (8,4%)	361 (72,2%)	5 (1,4%)
Profesionalni nivo *(bod 3-4)*	47 (13,5%)	28 (16,5%)	99 (39,6%)	72 (14,4%)	64 (18,3%)
Isnstitucionalni nivo *(bod 5-7)*	238 (68,2%)	84 (49,4%)	130 (52,0%)	67 (13,4%)	281 (80,3%)

Kako bi se unutrašnja struktura i unutar-grupni balansi ova tri teorijska nivoa odnosa lakše vizuelno uporedili među posmatranim društvima, u nastavku je prikazan Dijagram 2.

Grafički prikaz sadrži tri diferencirana stuba po svakoj zemlji, omogućavajući direktan uvid u sferu (ličnu, profesionalnu ili institucionalnu) u kojoj se stavovi ispitanika dominantno koncentrišu ili prelamaju.



Dijagram 2. Distribucija odgovora kroz tri nivoa socijalnih odnosa (%)

Ponovljenim Hi-kvadrat testom nezavisnosti nad sažetom kontingencijskom tabelom 5 x 3 provjerena je stabilnost povezanosti nakon grupisanja podataka. Rezultati i u ovom slučaju pokazuju ekstremno visoku i stabilnu statističku značajnost odstupanja $\chi^2(8) = 751{,}20$, $p < 0{,}001$. Vrijednost Cramerovog V koeficijenta iznosi V = 0,482, što implicira još snažniji (supstancijalan) intenzitet povezanosti i potvrđuje da makro-društveni (državni) kontekst objašnjava skoro polovinu ukupnog varijabiliteta u stavovima.

Ovi rezultati pružaju djelimičnu potvrdu druge alternativne hipoteze (H2). Pravilo da građani izražavaju veću distancu u ličnim nego u institucionalnim odnosima potvrđuje se kao stabilna zakonitost u Hrvatskoj (gdje je institucionalni nivo na 80,3%), Bosni i Hercegovini (68,2%) i Sjevernoj Makedoniji (52,0%). Međutim, hipoteza gubi univerzalni karakter na nivou cijelog regiona zbog potpunog drugačijeg obrasca u Srbiji, gdje uprkos postavljenim očekivanjima dominira lični nivo odnosa (72,2%), kao i specifičan nalaz zvog polarizacije u Crnoj Gori.

DISKUSIJA

Sprovedena empirijska analiza i dobijeni statistički indikatori pružaju osnovu za testiranje postavljenih alternativnih hipoteza, kao i za dubinsku psihološku, sociološku i geopolitičku interpretaciju uočenih fenomena unutar društava Zapadnog Balkana.

Prva alternativna hipoteza (H1) pretpostavljala je postojanje značajne razlike u nivou socijalne distance prema ruskom narodu u zemljama Zapadnog Balkana. Rezultati Hi-kvadrat testa nezavisnosti sprovedenog nad kompletnom kontingencijskom tabelom svih sedam kategorija Bogardusove skale nedvosmisleno i sa maksimalnim statističkim povjerenjem potvrđuju ovu hipotezu: $\chi^2(24) = 1.042{,}57$, $p < 0{,}001$. S obzirom na to da vrijednost Hi-kvadrata raste sa veličinom uzorka ($N = 1619$), ključni uvid u stvarnu supstancijalnost ove veze pruža izračunata vrijednost Cramerovog V koeficijenta koja iznosi $V = 0{,}401$. U metodologiji društvenih nauka, koeficijent ove veličine pokazuje snažan (visok) intenzitet povezanosti. Ovaj nalaz naučno dokazuje da stav prema državljanima Rusije nije univerzalan niti homogen na prostoru Zapadnog Balkana, već je primarno i stabilno determinisan makro-društvenim i geopolitičkim okvirom države kojoj ispitanici pripadaju.

Druga alternativna hipoteza (H2) pretpostavljala je da građani zemalja Zapadnog Balkana izražavaju veću socijalnu distancu prema Rusima u domenu bliskih ličnih odnosa (brak, prijateljstvo) nego u profesionalnim i institucionalnim odnosima (kolega, komšija, gost/turista). Ponovljeni Hi-kvadrat test nezavisnosti nad sažetom tabelom teorijskih nivoa odnosa 5x3, potvrdio je stabilnost i visoku značajnost razlika: $\chi^2(8) = 751{,}20$, $p < 0{,}001$, uz rast intenziteta povezanosti na Cramerov $V = 0{,}482$. Uprkos visokoj statističkoj značajnosti, detaljna unutar-grupna analiza procenata pokazuje da se hipoteza (H2) može prihvatiti samo djelimično. Naime, klasična logika unutrašnjeg gradijenta Bogardusove skale – prema kojoj je distanca niska u formalnim, a visoka u intimnim sferama – potvrđuje se kao stabilna zakonitost isključivo u Hrvatskoj (gdje institucionalni i ekskluzivni nivo obuhvata radikalnih (80,3%), Bosni i Hercegovini (68,2%) i Sjevernoj Makedoniji (52,0%). Nasuprot tome, Srbija demonstrira potpuno drugačiji i teorijski neočekivan obrazac sa ekstremnom koncentracijom odgovora na ličnom i intimnom nivou (72,2%), dok su profesionalne (14,4%) i institucionalne kategorije (13,4%) zastupljene u znatno nižim procentima. Istovremeno, Crna Gora reflektuje specifičnu unutrašnju polarizaciju i balans između ličnog (34,1%) i institucionalnog nivoa (49,4%). Shodno tome, hipoteza (H2) gubi svoj univerzalni karakter na nivou cijelog regiona, s obzirom na to da su specifični istorijski i spoljnopolitički narativi pojedinačnih država nadjačali teorijske pretpostavke o linearnom rastu distance na skali.

Radikalno diferencirani profili socijalne distance, unutar analiziranih društava, mogu pronalaziti svoje duboko eksplanatorno utemeljenje u tri teorijska modela postavljena u uvodu rada:

1. Restriktivno-institucionalni obrazac (Hrvatska i BiH) kroz prizmu Teorije integrisane prijetnje (ITT): Ekstremno visoka distanca u Hrvatskoj i visok procenat potpunog odbacivanja kontakta (kategorija "ne želi ih vidjeti" iznosi čak (25,4%) direktna su refleksija visoke simboličke prijetnje. Kao članica Evropske unije i NATO-a, Hrvatska je u potpunosti integrisana u zapadni bezbjednosni i vrijednosni diskurs, te se oružani sukob u Ukrajini percipira kao direktan napad na demokratske vrijednosti i evropski poredak. U Bosni i Hercegovini, takva dominacija institucionalne uloge gosta/turiste (60,2%) i ukupna distanca (68,2%) potenijalno

ukazuju na aktivaciju realističke prijetnje.Stephan i Stephan (2000) postuliraju da socijalna distanca ne nastaje iz izolovane lične netrpeljivosti, već funkcioniše kao odbrambeni socio-psihološki mehanizam: pojedinci i grupe podižu distancu kako bi kreirali psihološku i institucionalnu barijeru prema grupi koja se percipira kao nosilac realističke (bezbjednosne) ili simboličke (vrijednosne) opasnosti. Uslijed sopstvenog istorijskog iskustva rata i kompleksnih, identitetski podijeljenih unutrašnjih političkih odnosa, ruski uticaj se može percipirati kao potencijalni faktor destabilizacije, što rezultira fiksiranjem ruskih državljana na bezbjednu, formalnu udaljenost – oni su prihvatljivi kao prolazni ekonomski akteri (turisti), ali bez prava na društvenu integraciju;

2. Emotivno-identitetski obrazac (Srbija) kroz prizmu Teorije socijalnog identiteta (SIT) i hipoteze o kontaktu: Rezultati u Srbiji narušavaju opšti regionalni trend. Prema Tajfelovoj teoriji (SIT), proces kategorizacije je usmjeren ka unutra, a ne ka vani: ovdje kroz duboko ukorijenjen narativ o slovenskom i pravoslavnom bratstvu, državljani Rusije se ne percipiraju kao spoljne grupe ("oni"), već se apsorbuju u krug proširene vlastite grupe ("mi"). Shodno Allportovoj hipotezi o kontaktu, možemo reći da ovaj dugotrajni, istorijski i medijski snažno afirmisan pozitivan kontakt, doveo do ovako niske socijalne distance u privatnoj sferi (72,2%);
3. Pragmatično-profesionalni obrazac (Sjeverna Makedonija): Sjeverna Makedonija bilježi jedinstven profil sa najvišim profesionalnim nivoom u regionu (39,6%), gdje kategorije kolege i komšije čine okosnicu stavova. Ovo društvo demonstrira obrazac "funkcionalne prihvatljivosti", što može biti odraz kognitivne kohabitacije dvije struje: zvanične euroatlantske političke orijentacije države (članica NATO-a) i bazičnih kulturno-religijskih veza koje dijela stanovništva dijeli sa slovenskim narodima. Rezultat je pragmatična otvorenost za saradnju u javnoj sferi, uz zadržavanje jasne rezerve prema intimnom prožimanju;
4. Polarizovan i ambivalentan obrazac (Crna Gora): Rezultati u Crnoj Gori odražavaju bazični identitetski rascjep unutar samog društva. Oštra podijeljenost između visokog prihvatanja na ličnom nivou (blizak rođak – 22,9%) i striktnog institucionalnog distanciranja, oslikava unutrašnju političku kohabitaciju istorijskih i kulturnih veza sa Rusijom naspram zvanične pro-evropske i NATO političke i bezbjednosne agende države.

ZAKLJUČAK

Sprovedeno komparativno istraživanje uspješno je mapiralo složenu geografiju socijalne distance na Zapadnom Balkanu prema državljanima Rusije u specifičnom kontekstu nakon eskalacije oružanog sukoba u Ukrajini. Rezultati studije nude naučni, metodološki i teorijski doprinos razumijevanju međugrupnih odnosa u kriznim geopolitičkim vremenima.

Metodološki doprinos rada ogleda se u uspješnoj modifikaciji Bogardusove skale kroz implementaciju *forced-choice* dizajna (nominalna skala dominantnog izbora). Dok tradicionalni kumulativni model mjeri hipotetičku maksimalnu spremnost na bliskost, ovaj inovativni pristup omogućio je identifikaciju primarne kategorizacije i dominantnog stava ispitanika. Primoravanje ispitanika na jedan izbor eliminisalo je efekat mehaničkog odgovaranja i ponudilo čistu bazu podataka za obradu. Dodatnu naučnu težinu i reprezentativnost radu daje obiman uzorak (N = 1619), sistematično prikupljen iz pet država regiona.

Teorijski doprinos rada ogleda se u jasnom dokazu da socijalna distanca u epohama velikih globalnih potresa prestaje biti samo individualni psihološki fenomen ili manifestacija ličnih predrasuda. Ona se transformiše u kolektivni politički stav i direktan indikator geopolitičkog svrstavanja cijelog društva. Tri primijenjena teorijska modela (Allport, Tajfel, Stephan) integrisana su u jedinstven eksplanatorni okvir koji dokazuje da su stavovi građana duboko ukorijenjeni u širi bezbjednosni, istorijski i religijski kontekst države kojoj pripadaju.

Kao preporuka za buduća istraživanja, nameće se potreba za sprovođenjem longitudinalne studije koja bi pratila dinamiku socijalne distance nakon eventualnog završetka ili transformacije sukoba u Ukrajini. Takođe, uvođenje dodatnih demografskih i ideoloških varijabli, poput političke afilijacije ispitanika, medijske pismenosti i izvora informisanja, omogućilo bi još preciznije modelovanje faktora koji oblikuju socijalnu distancu na Balkanu.

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SOCIAL DISTANCE TOWARD RUSSIAN NATIONALS IN THE COUNTRIES OF THE WESTERN BALKANS AFTER THE OUTBREAK OF THE WAR IN UKRAINE

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ABSTRACT

This paper presents a comparative social-psychological analysis of social distance among citizens of five Western Balkan countries (Bosnia and Herzegovina, Serbia, Montenegro, North Macedonia, and Croatia) toward citizens of Russia following the escalation of the armed conflict in Ukraine. Utilizing a comparative sample, a methodologically modified version of the Bogardus Social Distance Scale was administered using a forced-choice design of dominant preference, thereby adapting the measurement instrument to a nominal level. The significance of regional differences and the intensity of the association were verified through appropriate statistical data analysis. The findings indicate a pronounced regional polarization and stable differences in the dominant cognitive categorization of the outgroup, depending on the specific sociopolitical and historical context of the home country.Keywords: social distance, modified Bogardus scale, forced-choice design, Western Balkans, armed conflict in Ukraine, intergroup relations.

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ADOLESCENCIJA I DRUŠTVENE MREŽE: PSIHO-SOCIJALNI RIZICI I ULOGA ŠKOLSKOG SISTEMA U PREVENCIJI

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APSTRAKT

Savremeno digitalno okruženje značajno je transformisalo razvojni kontekst adolescencije, utičući na procese socijalizacije, formiranja identiteta, emocionalne regulacije i interpersonalnih odnosa mladih. Predmet rada odnosi se na analizu uticaja društvenih mreža i savremenog digitalnog okruženja na psihološko zdravlje adolescenata, sa posebnim osvrtom na anksioznost, depresiju, fenomen straha od propuštanja (FoMO) i elektronsko nasilje, kao dominantne psiho-socijalne rizike digitalnog doba. Pored toga, rad analizira ulogu školskog sistema u prevenciji elektronskog nasilja. Cilj rada je da se, kroz pregled relevantne savremene literature, sagleda na koji način digitalno okruženje utiče na zadovoljenje osnovnih psiholoških potreba i posljedične psihološke ishode. Rad je metodološki zasnovan na preglednoj analizi naučnih izvora iz oblasti psihologije i digitalnih studija. Nalazi ukazuju da je upotreba društvenih mreža potencijalno povezana sa smanjenim psihološkim blagostanjem, što potvrđuje značaj unutrašnjih motivacionih mehanizama u razumijevanju digitalnog ponašanja adolescenata.

Ključne riječi: Adolescencija, anksioznost, elektronsko nasilje, škola, društvene mreže.

UVOD

Digitalne tehnologije predstavljaju integralni dio savremenog života adolescenata. Želja za stalnom prisutnošću na društvenim mrežama dovodi do mnogih poslijedica po mentalno zdravlje adolescenata. Jedan od ključnih problema u vezi sa mentalnim zdravljem adolescenata jeste anksioznost i depresija. Mnoga istraživanja ukazuju na povezanost prekomjernog korištenja društvenih mreža sa simptomima anksioznosti i depresije kod adolescenata [11] [19] [5].

Anksioznost u digitalnom dobu kod adolescenata predstavlja stanje pojačanog straha, napetosti i intenzivne brige, koja svoj primarni izvor može imati i u strahu od propuštanja i odobravanja. Primarni izvor ili generator anksioznosti u sadašnjem društveno-istorijskom kontekstu može biti relociran na područje virtuelne stvarnosti. Potrebno je naglasiti da anksioznost kod adolescenat u savremenom digitalnom dobu nije samo prolazni osjećaj, već dugotrajni poremaćaj koji je uslovljen pritiskom virtuelne realnosti. Negativni komentari, elektronsko nasilje i izloženost kritici, dodatno utiču na razvoj socijalne anksioznosti. Adolescenti najčešće preispitivaju svoje sposobnosti smatrajući da nisu dovoljno dobri, dok stalno poređenje sa drugima dovodi do kompleksa manje vrijednosti. Upravo zbog ove konfuzije, uloga roditelja i nastavnika je presudna. Uz njihovu pomoć mladi mogu lakše da nađu balans između virtuelnog i stvarnog svijeta.

Dominantan broj adolescenata većinu svog vremena provodi na društvenim mrežama, bilo da su aktivni ili pasivni korisnici mreža. Nezavisno o načinu korištenja, postoji rizik po mentalno zdravlje adolescenata u većoj ili manjoj mjeri. Jedan od bitnijih razloga korištenja društvenih mreža kod adolescenata jeste strah od propuštanja ili FoMO efekat (Fear of Missing Out - strah da propuštamo neka važna, uzbudljiva ili zabavna iskustva koja drugi doživljavaju i da nismo dio toga) [30]. Još jedan, ne manje važan problem sa kojim se adolesceniti susreću prilikom korištenja društvenih mreža, jeste elektronsko nasilje (cyberbullyng). Istraživanja pokazuju da se povećava broj adolescenata koji su barem jednom u životu bili žrtve ovakvog oblika nasilja. Nasilje se sprovodi putem interneta, raznih platformi i društvenih mreža, a oblik ovakvog nasilja je najčešće namjeran, iako postoje jasne indicije da putem savremene algoritamske logike ovakav tip nasilja ima difuzni karakter - i nasilnici i žrtve postaju dio zatvorenog ekosistema nasilja.

Škola, kao jedan od glavnih agensa socijalizacije, igra važnu ulogu u prevenciji nastanka malignih posljedica po mentalno zdravlje adolescenata. Uključivanje ovih institucija može doprinjeti smanjenju intenziteta korištenja društvenih mreža, kroz edukacije učenika o posljedicama po mentalno zdravlje samih adolescenata, kao i posljedica elektronskog nasilja.

ADOLESCENCIJA I DIGITALNO DOBA

Razvojna psihologija sagledava adolescenciju kao jedan od najosjetljivijih perioda razvoja čovjeka. Naučna klasifikacija o adolescenciji koju imamo danas nastala je tek početkom dvadesetog vijeka, a nešto kasnije, etablirana je kao dio naučne paradigme. Taj period obuhvata predpubertet, pubertet, srednju i kasnu adolescenciju, a karakteriše ga intenzivan psiho-fizički, kao i emocionalni i socijalni razvoj.

Razvojni psiholozi adolescenciju obično dijele na: a) ranu adolescenciju (do približno 14. godine), b) srednju adolescenciju (do približno 17. ili 18. godine) i c) poznu adolescenciju (do približno 22. ili 24. godine) [8]. Jedan od osnovnih razvojnih zadataka adolescencije je formulisanje jasne i koherentne slike o sebi, koja uključuje svijest o vlastitim unutrašnjim stanjima, kao i znanje o relativnim socijalnim ulogama koje su emocionalno značajne za pojedinca, poput uloge člana porodice, vjerskih opredjeljenja i slično [14].

U svojoj teoriji psihosocijalnog razvoja Erik Erikson ovaj period pozicionira u petu fazu - fazu identiteta koja traje od 12. do 20. godine [14]. Glavna uloga ove faze jeste formiranje identiteta, a prema njegovoj teoriji, samo oni koji u ovu fazu stupaju sa samopoštovanjem imaju mogućnost pravilnog formiranja identiteta. Ovo je period kada adolescenti preuzimaju na sebe razne uloge, stiču kritičko mišljene o sebi i drugima. Pored toga, navodi da "narušeno samopoštovanje vodi u samozavaravanje. Vrlina koja se razvija na ovom stepenu jeste vjernost i odanost. Vjernost se odnosi na praćenje načina života, za koji se adolescent opredjelio pri razrješavanju krize" [8].Pored Eriksona, pitanjem razvoja identiteta bavio se i Marcia. On definiše četiri kategorije formiranog identiteta:

1. *Postignut identitet* (konačno formiran identitet i ličnim izborom);
2. *Odloženo formiranje identiteta* (još nije prošao period krize i osoba traga za konačnim izborom);
3. *Prihvaćen identitet* (izbor je izvršen bez kriznog perioda ali pod uticajem drugih);
4. *Difuzija identiteta* (osoba se nije opredjelila, niti dalje pokušava da dođe do izbora). Pojedine kategorije identiteta određuje prisutnost ili odsutnost dva bitna elementa: same krize (tj. perioda odmjeravanja, ispitivanja, preispitivanja alternativa i odlučivanja) i opredjeljenje za određene ciljeve i vrijednosti. [8, str. 321-322].

Važnu ulogu u periodu adolescencije ima vršnjačka grupa, odnosi sa vršnjacima postaju bliži i značajniji. Dolazi do sklapanja novih prijateljstava koji se zasnivaju na povjerenju i podršci. Neka istraživanja su pokazala da su kod djevojaka prijateljski odnosi intimniji i uzajamniji nego kod mladića, a glavni kriterijum i pokazatelj jeste brojnost prijateljstava u okviru kojih se traži neki oblik podrške. Vrsta ovog odnosa postaje važniji od odnosa roditelj-dijete. U ovom periodu najčešće dolazi do sukoba mišljenja u odnosu sa roditeljima, dok se među vršnjacima traže istomišljenici i podrška. Razgovori sa roditeljima više nisu povjerljive i intimne prirode, dolazi do povlačenja i izolovanosti, a fokus je na prijateljskim odnosima. Ovaj period budi sve veću potrebu za osamostaljenjem, ali još uvijek zahtjeva prisustvo roditelja i potebu za roditeljskom podrškom. Stupanjem u razne vršnjačke grupe, dolazi do formiranja novih i mijenjanja postojećih stavova.

U savremnom dobu socijalnu komunikaciju licem u lice adolescenti u većoj mjeri zamjenjuju sa online komunikacijom putem društvenih mreža. Jedan od najvećih problema kada su u pitanju adolescenti, jeste intenzitet korištenja društvenih mreža. Istraživanje koje su sproveli Barry i saradnici, kreiralo je jasnu perspektivu - 93-97% mladih u dobi 13-17 godina koristi barem jednu društvenu mrežu [4]. Ovo istraživanje pokazalo je i obim upotrebe društvenih mreža - u prosjeku adolescenti koriste čak tri različite društvene mreže, dok neki koriste osam različitih platformi dnevno. Neka ranija istraživanja ukazuju i na korelaciju pola i vremena provedenog u korištenju savremenih tehnoloških uređaja - naime djevojke provode više vremena na mobilnim uređajima, društvenim mrežama i u pisanju tekstualnih poruka, dok dječaci provode više vremena igrajući igrice [34].

Aktivne i pasivne korisnike razlikujemo prema načinu na koji koriste društvene mreže. Biti aktivan korisnik znači redovno učestvovanje u kreiranju i obnavljanju sadržaja. Aktivni korisnici pored toga što objavljuju sadržaj, oni takođe učestvuju u diskusijama, grupama i lajvovima, reaguju na komentare drugih na njihovim objavama. S druge strane, pasivni korisnici su oni koji prate objavljivanje sadržaja, ali rijetko kada direktno učestvuju u kreiranju istog. Njihovo prisustvo na mrežama je više u ulozi posmatrača, ne doprinosi direktnom kreiranju sadržaja i participaciji u pogledu razmjene mišljenja.

Ako izvršimo komparaciju između adolescenata nekada i sada, možemo primjetiti uticaj društvenog i kulturnog konteksta na oblikovanje ove razvojne faze. Ranije je uticaj na odrastanje adolescenata u velikoj mjeri imala porodica i bliže okruženje. Odnosi sa vršnjacima su se formirali putem ličnih kontakata, igara, sportskih aktivnosti, dok su informacije, za razliku od danas, stizale mnogo sporije i putem tradicionalnih medija ili obrazovnih institucija. Odrastanje je podrazumjevalo veći kontakt s prirodom, manje distrakcije i direktniji odnos sa odraslima, ali i snažniji pritisak društvenih normi i očekivanja.

U odnosu na prethodne generacije, adolescenti danas ranije dolaze do informacija koje su nekada bile nedostupne za njihov uzrast i smatrale su se zabranjenim temama za njihov uzrast. Ova činjenica kreirala je drugačiju perspektivu u pogledu psiho-socijalnog razvoja - sa jedne strane došlo je do većih informativnih kapaciteta adolescenata, a sa druge strane dovelo je do konfuzije. Izvor vrijednosti i znanja je djelomično relociran. Nekadašnji glavni autoriteti su bili roditelji i nastavnici koji su bili glavni izvori znanja, danas je to sasvim drugačije - datu ulogu su u značajnoj mjeri preuzele online zajednice, influenseri, blogeri. Ovakav način odrastanja stvara konfuziju u formiranju identiteta. Društvene mreže pokazuju vlastiti potencijal u formiranju stavova, mišljena o sebi i drugima, a praćenje trendova i želja za stalnim prisustvom na mrežama u velikoj mjeri utiče na mentalno zdravlje adolescenata.

Danas, u digitalnom dobu, adolescencija se odvija u potpuno izmijenjenim okolnostima. Internet, društvene mreže i pametni telefoni postali su sastavni dio identiteta mladih. Virtuelni prostor nudi mogućnost brzog povezivanja, izražavanja i istraživanja interesa, ali donosi i nove izazove. Adolescenti su izloženi stalnom poređenju sa drugima, pritiscima da prikažu idealizovanu verziju sebe, riziku od elektronskog nasilja i zavisnosti o digitalnim sadržajima[1]. Granica između privatnog i javnog života postala je nedefinisana, a potreba za validacijom kroz „lajkove" i komentare oblikuje samopouzdanje mladih. Istovremeno, digitalna tehnologija omogućava pristup znanju, kreativnim resursima i globalnoj komunikaciji, što može pozitivno uticati na razvoj ako se koristi odgovorno.

Adolescencija, dakle, ostaje univerzalna razvojna etapa, ali način njenog proživljavanja u velikoj mjeri zavisi od vremena i konteksta. Odrastanje uz savremene tehnologije nam daje veći pristup informacijama, mogućnost za usavršavanje i bolji intelektualni razvoj, dok sa druge strane, društvene mreže daju u većini slučajeva obrnuti efekat - dolazi do problema sa mentalnim zdravljem adolescenata. Istraživanja pokazuju sve veću prisutnost anksioznih i depresivnih poremećaja kod adolescenata koji većinu svog slobodnog veremena provode na društvenim mrežama[11].

DRUŠTVENE MREŽE I PSIHOLOŠKO ZDRAVLJE

Iako savremene tehnologije pružaju razne mogućnosti za učenje, napredovanje i komunikaciju, sa uticaj društvenih mreža značajno utiče na njihovo mentalno zdravlje pri čemu anksioznost predstavlja jedan od najučestalijih problema kod mladih korisnika. Anksioznost možemo definisati kao stanje pretjerane zabrinutosti, straha ili napetosti koja može biti izazvana stvarnim ili zamišljenim prijetnjama [2].

Adolescencija, kao razvojna faza, potencijalno stvara pozitivne uslove za različite oblike psiholoških poremećaja. Javljanje anksioznih poremećaja takođe se pojavljuje u tom periodu životnog razvoja, uključujući socijalnu anksioznost, panični poremećaj te fobiju [7]. Anksiozni poremećaji su najčešći psihijatrijski poremećaji među adolescentima, s procijenjenom prevalencijom od 31%, a češće se javljaju kod djevojaka nego li kod mladića [21]. Kod adolescenata se vrlo učestalo simptomi depresije i anksioznosti pojavljuju istovremeno, odnosno prisutan je komorbiditet poremećaja [34]. Javljanje anksioznosti i depresije u adolescenciji povećava rizik od širokog raspona negativnih posljedica tokom života, uključujući ponavljanje epizoda poremećaja u odrasloj dobi [9]. Brojna istraživanja su pokušala razriješiti to značajno pitanje odnosa između simptoma depresije i anksioznosti tokom adolescencije. Pokazalo se da adolescenti s anksioznim poremećajima imaju povećan rizik za pojavu depresije, odnosno anksiozni simptomi su statistički značajan prediktor depresivnih simptoma u adolescenciji [19] [4] .

Socijalna anksioznost kod adolescenata manifestuje se kroz intenzivan strah od negativne procjene drugih, teškoće u ostvarivanju i održavanju socijalnih kontakata, te povlačenje iz društvenih situacija. U digitalnom kontekstu, ovaj oblik anksioznosti poprima specifične oblike. Mladi se često upoređuju sa idealizovanim prikazima vršnjaka na mrežama, što dovodi do osjećaja nedovoljnosti, niskog samopouzdanja i pojačanog straha od izloženosti. Strah od propuštanja dodatno pojačava pritisak jer adolescenti osjećaju da moraju stalno biti prisutni na mrežama kako bi ostali dio socijalnog toka, iako im to često donosi stres i emocionalnu iscrpljenost.

Anksioznost i depresija u većini istraživanja bili su dva najčešće mjerena ishoda korišćenja društvenih mreža kod adolescenata. Većina članaka uključenih u jednoj meta analizi pozitivno je povezivala depresiju (82,6%) i anksioznost (78,3%) sa korišćenjem društvenih mreža. U 13% članaka uključenih u isti pregled primećena je „doza-odgovor" veza između vremena provedenog na društvenim mrežama i simptoma depresije i anksioznosti [11]. U nekoliko drugih pregleda dobijeni su slični rezultati, čime se dodatno potkrepljuju ovi ishodi [19] [5].

Iako ne postoji čvrsta korelacija između socijalne anksioznosti i društvenih mreža, digitalni kontekst joj daje specifičan oblik. Ključno je naglasiti da adolescenti tek razvijaju sposobnosti kritičkog mišljenja i emocionalne regulacije, pa su posebno ranjivi na ovaj pritisak. Stoga je važno da odrasli - roditelji, nastavnici i stručnjaci - prepoznaju rane znakove socijalne anksioznosti, kao što su povlačenje, izbjegavanje kontakata, prekomjerno vrijeme provedeno online ili opsesivno praćenje reakcija drugih.

Prevencija i podrška mogu uključivati jačanje socijalnih vještina, rad na samopouzdanju, razgovore o realističnom korištenju mreža i podsticanje offline aktivnosti. Na taj način se adolescentima omogućava da razviju stabilniji osjećaj vlastite vrijednosti, nezavisan od virtuelne potvrde, čime se značajno smanjuje rizik od hronične socijalne anksioznosti.

FoMO – digitalni generator anksioznosti

Strah od propuštanja (*Fear of Missing Out*) posmatra se kao izrazito relevantan konstrukt u savremenom istraživanju odnosa između digitalnih tehnologija i mentalnog zdravlja mladih. On označava trajnu kognitivno-emocionalnu dispoziciju u kojoj pojedinac osjeća zabrinutost ili nelagodu zbog percepcije da propušta društveno relevantna iskustva koja drugi doživljavaju [30] [13]. U suštini, FoMO predstavlja kombinaciju socijalne anksioznosti, potrebe za pripadanjem i sklonosti ka neprestanoj socijalnoj komparaciji [13].

Fenomen *Fear of Missing Out* (FoMO) definiše se kao trajna zabrinutost da drugi ljudi proživljavaju pozitivna iskustva u kojima pojedinac ne učestvuje, što podstiče stalnu potrebu da pojedinac ostane povezan sa socijalnim okruženjem putem digitalnih medija [30]. Na teorijskom nivou, FoMO se često povezuje sa teorijom samoodređenja, koja sugeriše da se pomenuti fenomen može pojaviti usljed nedovoljno zadovoljenih osnovnih psiholoških potreba za povezanošću, kompetencijom i autonomijom. Dodatno, teorija socijalne komparacije objašnjava FoMO kao posljedicu stalnog poređenja sa pozitivnim prikazima života drugih, dok modeli problematične upotrebe tehnologije, FoMO opisuju kao motivacijski konstrukt koji vodi ka kompulzivnom korištenju mreža [13].

Kod adolescenata je ovaj fenomen posebno izražen jer se radi o periodu života u kojem je osjećaj pripadanja i socijalna povezanost jedan od glavnih razvojnih zadataka. Mladi koriste društvene mreže kako bi gradili identitet, održavali prijateljstva i pratili trendove, ali istovremeno time ulaze u začarani krug stalnog poređenja sa drugima. Ako njihovi vršnjaci objavljuju slike s druženja na kojima oni nisu bili ili postavljaju sadržaje koji djeluju zabavnije od njihove svakodnevnice, javlja se osjećaj isključenosti i nezadovoljstva vlastitim životom.

FoMO je povezan sa čitavim nizom negativnih posljedica. Najčešće se spominju anksioznost i depresivnost, koji se pojačavaju usljed stalnog osjećaja da se „zaostaje“ za drugima [13]. Takođe, istraživanja pokazuju da FoMO remeti obrasce spavanja: mladi često ostaju budni do kasno u noć prateći sadržaje na mrežama [28]. Nedostatak sna, dodatno pogoršava emocionalnu regulaciju i stabilnost. Još jedan važan mehanizam je kompulzivno korištenje interneta i telefona: osoba s izraženim FoMO-om vrlo teško kontroliše vrijeme provedeno online, što može narušiti školske obaveze, porodične odnose i opštu dobrobit.

Konkretnije, studije među adolescentima pokazuju da je FoMO medijator između intenziteta korištenja društvenih mreža i negativnih psihosocijalni posljedica. Oberst i saradnici pokazali su da FoMO posreduje u vezi između psihopatoloških simptoma i negativnih posljedica te da intenzivno i problematično korištenje vodi većoj psiho-socijalnoj nelagodi i lošijem funkcionisanju kod tinejdžera [28]. Slične nalaze donose studije koje povezuju FoMO s povećanim rizikom od ovisničkog ponašanja prema pametnim telefonima, socijalnim mrežama i s većim stepenom anksioznosti i depresije [30].

Navedena istraživanja sve više potvrđuju posredničku ulogu FoMO-a u vezi između intenziteta korištenja mreža i anksiozno-depresivnih ishoda. On predstavlja kompleksan fenomen koji uključuje individualne, razvojne i društveno-strukturne dimenzije. U krajnjoj instanci, potrebna su dodatna istraživanja koja razdvajaju uzročnost od korelacije u adolescentnim populacijama.

SAVREMENO ELEKTRONSKO NASILJE (CYBERBULLYNG) – DRUŠTVENE MREŽE, ALGORITMI I PSIHOLOŠKE IMPLIKACIJE

Specifičnosti društvenih mreža doprinose tome da se nasilje u digitalnom prostoru razlikuje od klasičnih oblika vršnjačkog nasilja. Platforme omogućavaju anonimnost i pseudonimnost, čime se snižava psihološka barijera za agresivno ponašanje i povećava moralna distanca [5].

Tehnološki razvoj je kreirao preduslove za nastanak novih oblika posmatranja na sam fenomen elektronskog nasilja. Ranije, neki značajni autori su elektronsko nasilje definisali kao intencionalnu i agresivnu radnju putem koje, pojedinac ili grupa, koristi elektronske oblike kontakata, a koja ostaje konstantna tokom vremena sa žrtvom, koja nema velikih mogućnosti da se odbrani [5]. U ovom kontekstu, elektronsko nasilje podrazumjevalo je postojanje kontinuiteta samog odnosa između nasilnika i žrtve, čime je postojala jasna namjera, postojali jasno definisani odnosi i definisani subjekti elektornskog nasilja (nasilnik/žrtva). Postojanje jasnih kontura elektronskog nasilja, u smislu odnosa nasilnika i žrtve, omogućavalo je jasnu identifikaciju i posmatranje nasilja.

U savemenim uslovima intenzivnog razvoja društvenih mreža i razvoja algoritamske logike, neki obrasci elektronskog nasilja čini se da se mijenjaju ili su potpuno izmijenjeni [17]. U savremenom digitalnom okruženju, društvene mreže funkcionišu putem algoritamskih sistema, dizajniranih da povećaju angažovanje korisnika i obezbjede veću zaradu platformama. Međutim, iste logičke procedure mogu nenamjerno pogodovati širenju nasilnog, uvredljivog ili trolovskog sadržaja, čak i u situacijama gde ne postoji direktna veza između počinioca i žrtve.

Studija Lackeya i Taylora opisuje takozvane *algoritamske narodne teorije* (algorithmic folk theories) koje žrtve, počinioci i posmatrači internetskog nasilja koriste da razumiju kako algoritmi možda ne prepoznaju kontekst i tako nenamjerno amplifikuju nasilje [29]. Na primjer, smatra se da algoritmi reaguju prvenstveno na sadržaj koji već ima mnogo prijava ili angažmana, što ih čini neosjetljivim na diskretno, ali štetno ponašanje te potencijalno izoluje žrtvu. Ove teorije pomažu da se objasni kako algoritamski mehanizmi mogu da generalizuju, povezuju korisnike sličnog nasilnog ponašanja, i omoguće eskalaciju bez direktne namjere počinioca [29].

U kreiranju sadržaja na društvenim mrežama i njegovog algoritamskog distribuisanja, kao i viralnog širenja, identifikacija nasilnika i žrtve može biti otežana, a specifičnosti tog odnosa teško prepoznatljivi [12]. Ovdje mislimo na tzv. „sivu zonu“ elektronskog nasilja, gdje pojedinci mogu biti izloženi ovom obliku nasilja a da je sam primordijalni izvor nepoznat. Takođe, treba spomenuti i algoritamske posrednike (nasilnike) u lancu nasilja, koji nemaju vremensku konstantnost sa žrtvom, ali svojim učestvovanjem kreiraju algoritam koji može dodatno uticati na samu žrtvu. Primjer toga jesu kreatori sadržaja na društvenoj mreži Tik Tok, koja ima vrlo razvijen algoritam koji posredno mogu pogađati samu žrtvu. Studije su pokazale da algoritmi mreža poput TikToka rapidno pojačavaju ekstremne ili mizogine sadržaje. Istraživači sa UCL i Univerziteta u Kentu otkrili su da se nivo mizoginog sadržaja na TikTok-ovoj „For You“ stranici povećao četiri puta u roku od pet dana monitoringa, od 13 % do 56 % [35]. Ovo predstavlja klasičan primjer kako algoritamsko filtriranje i pojačavanje može stvoriti toksičnu normu, čak kada pojedini akteri nisu imali namjeru da šire nasilje. Na taj način, stvara se opasnost od kreiranja kompletnog ekosistema nasilja koji prevazilazi klasične okvire.

Empirijska istraživanja dosljedno pokazuju povezanost elektronskog nasilja sa negativnim psihološkim ishodima. Metaanalize longitudinalnih studija ukazuju da je viktimizacija u online prostoru značajan prediktor porasta simptoma depresije i anksioznosti tokom vremena, iako su efekti u proseku mali do srednji [23] [26]. Na primjer, studija Wrighta i Wachs, praćena kroz tri godine, pokazala je da adolescenti koji su češće bili mete elektronskog nasilja imaju značajan porast simptoma anksioznosti i depresije u poređenju sa onima koji nisu bili izloženi takvom iskustvu [39]. Iako je moguće da adolescenti sa već postojećim psihološkim smetnjama češće postaju žrtve, longitudinalni podaci ipak potvrđuju da viktimizacija prethodi pogoršanju mentalnog zdravlja, što upućuje na postojanje uzročne veze [26]. Ono što je takođe važno napomenuti, elektronsko nasilje ne pogađa samo žrtve, već i posmatrače. Pasivni posmatrači često internalizuju osećaj krivice i nesigurnosti, što ukazuje da je domet psiholoških posljedica širi nego što se obično pretpostavlja.

Pored anksioznosti i depresivnosti, sve je više dokaza da elektronsko nasilje može dovesti i do simptoma sličnih posttraumatskom stresnom poremećaju (PTSP). Najnovija istraživanja sugerišu da žrtve koje trpe intenzivne i dugotrajne oblike digitalnog uznemiravanja mogu razviti flashbackove, hipervigilnost i izbegavajuće ponašanje, slično iskustvima kod žrtava traume izvan digitalnog konteksta [24]. Ovo saznanje otvara prostor za redefinisanje, ne samo kao problema discipline u školskom okruženju, već i kao ozbiljnog rizika po dugoročno mentalno zdravlje adolescenata.

Važan aspekt u razumijevanju uticaja društvenih mreža jesu socio-psihološki indikatori. Adolescenti sa slabijom porodičnom podrškom i nižim nivoima emotivnih kompetencija, pokazuju u pravilu veći stepen ranjivosti, dok obrnuto, visok nivo emocionalne inteligencije i zadovoljavajuća komunikacija u porodici, stvaraju psihološku rezistenciju kod mladih [40]. Takođe, na nivou škole programi edukacije i prevencije digitalnog nasilja, stvaraju pozitivan ambijent u kojem mladi imaju više hrabrosti da prijavljuju nasilnike i razvijaju strategije suočavanja. U pogledu intervencija, metaanaliza Gaffney i saradnika pokazuje da su programi prevencije i intervencije efikasniji kada uključuju pristup više nivoa: kombinaciju edukacije učenika, treninga nastavnika i saradnje roditelja [18]. Međutim, njihova efikasnost je ograničena ukoliko društvene mreže same ne razviju adekvatne mehanizme za prijavljivanje i sankcionisanje nasilnih sadržaja. Zbog toga se sve češće ističe potreba za aktivnijom regulacijom platformi i većom transparentnošću algoritama.

Ono što je naročito važno jeste da se i dalje radi o efektima koji su u prosjeku mali do srednji, ali konzistentni. To znači da društvene mreže nisu “toksične” po definiciji, već da njihova upotreba otvara mogućnosti za različite ishode, u zavisnosti od obrazaca ponašanja korisnika i konteksta u kojem se one koriste [29].

Sve navedeno ukazuje na ozbiljan problem elektronskog nasilja u savremenom životu mladih i adolescenata. Iako efekti elektronskog nasilja variraju i nisu uniformni, dosljedni nalazi metaanaliza i longitudinalnih studija potvrđuju da su adolescenti koji trpe online viktimizaciju u većem riziku od razvoja anksioznosti i srodnih psiholoških teškoća [5]. Polimorfan i difuzan karakter savremenih društvenih mreža stvara takve obrasce nasilja koji zahtjevaju sistemski i interdisciplinarni pristup te kreiraju potrebu za adekvatnim politikama i strategijama koji bi stvorili pozitivan digitalni ambijent za mlade.

WHOLE SCHOOL PRISTUP KAO ODGOVOR NA RIZIKE

Elektronsko nasilje (cyberbullying) sve češće se javlja kao oblik interpersonalne agresije koji nadilazi granice školskog dvorišta i zahvata digitalni prostor. Mnoga društva u svijetu već su prepoznali rizike i utvrdili sistemske korake koji bi u budućnosti trebali dovesti do pozitivnih promjena.

U ovom kontekstu, kao i u drugim aspektima pedagoško-psihološke podrške, bazični koncept podrške jeste cijelokupni školski pristup, poznat kao whole-school pristup. Kao takav, predstavlja kolaborativnu strategiju u kojoj cijela školska zajednica, uključujući učenike, školsko osoblje, roditelje i širu zajednicu, rade zajedno na postavljanju zajedničkih ciljeva, kao što su poboljšanje zdravlja, blagostanja i akademskih rezultata.

Ovaj pristup nije nastao iz jedne teorije, već je dio međunarodnih zdravstvenih i obrazovnih politika. Najčešće se povezuje sa strategijama Svjetske zdravstvene organizacije iz 1980-ih i 1990ih u okviru programa *Health promoting school* [38]. Ideja programa je bila da škole budu promoteri zdravlja, dobrobiti i prevencije rizika. Kasnije, ovaj pristup je proširen kroz programe o inkluzivnom obrazovanju i dječijim pravima [36].

Primjena cijelokupnog školskog pristupa u prevenciji elektronskog nasilja zasniva se na nekoliko komplementarnih dimenzija [36] [38]. Prije svega, riječ je o uspostavljanju jasnih školskih politika i normi ponašanja koje obuhvataju i digitalno okruženje. Kada škole razvijaju eksplicitne strategije protiv vršnjačkog nasilja, uključujući i elektronsko nasilje, i kada te strategije dosljedno provode, dolazi do smanjenja učestalosti nasilnih incidenata i povećanja povjerenja učenika u institucionalne mehanizme zaštite [10].

Druga dimenzija odnosi se na edukaciju učenika kroz razvoj digitalne i medijske pismenosti. Ovaj model ne ograničava se na tehnička uputstva o bezbjednosti na internetu, već integriše kritičko promišljanje o algoritamskoj logici, viralnosti i dinamici društvenih mreža.

Treći element bi predstavljali programi socio-emocionalnog učenja (social and emotional learning - SEL) koji jačaju emocionalnu regulaciju, empatiju i nenasilnu komunikaciju. Ovi programi pokazali su se ključnim u prevenciji različitih oblika nasilja jer mijenjaju šire socijalne norme i promovišu kolektivnu odgovornost među učenicima [15]. U okviru whole-school modela, SEL pristupi ne ostaju izolovani u učionicama, već postaju dio cijelokupne školske kulture.

Jedan od najznačajnijih empirijskih primjera uspješne primjene whole-school pristupa je finski KiVa program. Ovaj model kombinuje edukaciju, praćenje i intervenciju na nivou cijele škole, pri čemu se naglasak stavlja na odgovornost vršnjaka i aktivno učešće zajednice. Evaluacije su pokazale da KiVa značajno smanjuje učestalost i tradicionalnog i elektronskog nasilja, potvrđujući da je integrisani pristup efikasniji od fragmentisanih intervencija [32].

Program se bazira na hipotezi da nasilje nije samo individualni čin nasilnika prema žrtvi, već socijalni fenomen u kojem učestvuje cijela vršnjačka grupa. Posebno naglašava ulogu posmatrača, tj. učenika koji nisu direktno uključeni u nasilje, ali ga svojim ponašanjem, bilo podrškom, indiferentnošću ili pasivnošću, mogu održavati ili spriječiti [32]. KiVa kombinuje univerzalne komponente (npr. kurikularne aktivnosti, digitalne igre za učenje empatije, diskusije i radionice o nenasilnoj komunikaciji) sa indikovanim intervencijama (podrška žrtvama, individualni razgovori s nasilnicima, uključivanje posmatrača).

KiVa je postao međunarodni model, implementiran u više od desetak zemalja, uključujući Italiju, Estoniju, Veliku Britaniju i Sjedinjene Američke Države. Rezultati iz Estonije i Italije pokazuju slične obrasce: smanjenje učestalosti nasilja i povećanje empatije među učenicima [10]. Ipak, istraživanja naglašavaju da uspješnost programa zavisi od kulturnog konteksta, kapaciteta nastavnika i dosljedne implementacije.

Pored KiVa modela, u svijetu postoje mnogobrojni programi koji se bave značajem digitalnih aspekata socijalne stvarnosti adolescenata: programi digitalne pismenosti širom Evrope i SAD (npr. *EU Kids Online* projekat), Velike Britanije (*Status of Mind*), kao i primjeri tehnoloških rješenja koji su prepoznali rizike (aplikacija *Headspace* ili *Smiling Mind*), koje su uvedene u školama u Australiji i Velikoj Britaniji, kao podrška adolescentima u razvijanju mindfulness praksi i balansiranju vremena provedenog online.

ZAKLJUČAK

Analiza prezentovanih podataka i teorijskih uvida ukazuje na to da je adolescencija, kao razvojna etapa obilježena intenzivnim formiranjem identiteta, posebno osjetljiva na negativne aspekte digitalnog okruženja.

Društvene mreže u ovom kontekstu se pojavljuju kao dvostrani fenomen - s jedne strane omogućavaju socijalnu povezanost, kreativno izražavanje i pristup informacijama, dok s druge strane, generišu čitav spektar psiholoških rizika, uključujući anksioznost, depresivnost, socijalnu anksioznost, fenomen straha od propuštanja (FoMO) i različite manifestacije elektronskog nasilja. Empirijska istraživanja potvrđuju konzistentnu povezanost između intenzivne upotrebe digitalnih platformi i pogoršanja mentalnog zdravlja adolescenata, pri čemu se, posebno, algoritamske logike društvenih mreža prepoznaju kao poseban faktor u nastanku i održavanju psiho-patogenih obrazaca.

U tom kontekstu, obrazovni sistem i posebno škola kao centralni agens socijalizacije, imaju presudnu ulogu u prevenciji i redukovanju ovih pojava. Cijelokupni školski pristup (Whole-school pristup), integrisan kroz politiku škole, razvoj digitalne pismenosti i implementaciju programa socio-emocionalnog učenja, pokazuje se kao jedan od najefikasnijih okvira djelovanja. Empirijski validirani modeli, poput finskog KiVa programa, jasno demonstriraju da intervencije na više nivoa, koje simultano obuhvataju učenike, roditelje, nastavnike i širu zajednicu, imaju daleko veći učinak od pojedinačnih mjera.

Implikacije za buduća istraživanja stvaraju realne potrebe za: longitudinalnim studijama koje bi razjasnile uzročnoposljedične veze između upotrebe društvenih mreža i mentalnih poremećaja; dubljom analizom algoritamskih mehanizama društvenih mreža i njihovog doprinosa širenju nasilnih ili toksičnih sadržaja; evaluacijom kulturnih varijabli u implementaciji preventivnih programa; i razvojem inovativnih pedagoških i psiholoških intervencija koje će kombinovati digitalnu pismenost, emocionalnu otpornost i algoritamsku osviještenost.

Za buduća istraživanja važno je usmjeriti se na razjašnjavanje uzročno-posljedičnih veza između intenzivne upotrebe mreža i mentalnog zdravlja adolescenata, kao i na razumijevanje specifične uloge algoritama u formiranju digitalnog iskustva. Takođe, možemo reći da je potrebno razvijati i testirati nove preventivne i pedagoške modele koji će kombinovati digitalnu pismenost, emocionalne vještine i kritički odnos prema medijskim sadržajima. Samo kroz takav integrisani i multidisciplinaran pristup, moguće je obezbijediti stabilniji razvoj mladih u uslovima digitalnog doba.

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ADOLESCENCE AND SOCIAL MEDIA: PSYCHOSOCIAL RISKS AND THE ROLE OF THE SCHOOL SYSTEM IN PREVENTION

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ABSTRACT

Contemporary digital environments have significantly transformed the developmental context of adolescence, influencing the processes of socialization, identity formation, emotional regulation, and interpersonal relationships among young people. The subject of this paper concerns the analysis of the impact of social media and the modern digital environment on the psychological health of adolescents, with particular emphasis on anxiety, depression, the phenomenon of Fear of Missing Out (FoMO), and cyberbullying as dominant psychosocial risks of the digital age. Furthermore, the study analyzes the role of the school system in the prevention of cyberbullying. The aim of this paper is to examine, through a review of relevant contemporary literature, the ways in which the digital environment affects the fulfillment of basic psychological needs and the resulting psychological outcomes. Methodologically, the paper is based on a review analysis of scientific sources from the fields of psychology and digital studies. The findings indicate that the use of social media is potentially associated with reduced psychological well-being, thereby confirming the importance of internal motivational mechanisms in understanding adolescents' digital behavior.

Keywords: Adolescence, anxiety, cyberbullying, school, social media.

ENERGY AND NON-ENERGY INPUTS SUBSTITUTION POSSIBILITIES IN NIGERIA'S MANUFACTURING SECTOR: A TRANSLOG COST FUNCTION APPROACH

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ABSTRACT

This study investigates the substitution possibilities between energy and non-energy inputs in Nigeria's manufacturing sector from 1981 to 2023. Utilizing a transcendental logarithmic (translog) cost function estimated via iterated Seemingly Unrelated Regression (iSUR), we compute both Allen and Morishima elasticities of substitution to analyze factor relationships. Results reveal significant substitution possibilities: capital and energy are substitutes with a Morishima elasticity (MES) averaging 3.66, while energy and labor show substitutability with an MES of 2.32. Conversely, capital and labor emerge as complements (MES = -1.94), suggesting that technological upgrading in this context requires simultaneous investments in human capital. These findings have crucial implications for energy and industrial policy, particularly in the context of energy price reforms and carbon taxation. We demonstrate that the Morishima elasticity provides more policy-relevant information than conventional Allen elasticities by capturing changes in input ratios rather than partial adjustments.

Keywords: Input Substitution, Translog Cost Function, Morishima Elasticity, Allen Elasticity, Nigerian Manufacturing, Energy Policy

INTRODUCTION

The manufacturing sector's response to energy price changes represents a critical nexus between energy policy, industrial competitiveness, and environmental sustainability. In Nigeria, where the manufacturing sector accounts for approximately 20% of commercial energy consumption [1] and faces increasing energy costs following recent subsidy reforms, understanding how firms adjust their input mix has become particularly urgent. The theoretical and empirical literature presents mixed evidence on factor substitutability, with findings varying across countries, time periods, and methodological approaches [2], [3].

Neoclassical production theory posits that firms substitute relatively cheaper inputs for more expensive ones along an isoquant, with the ease of substitution captured by elasticity measures. However, the empirical realization of this theoretical possibility depends on technological constraints, adjustment costs, and institutional factors specific to each economic context. For Nigeria, existing studies on input substitution are either outdated or focus on specific energy types rather than the aggregate energy-non-energy relationship [4].

This study addresses three critical gaps in the literature. First, it provides contemporary estimates of substitution elasticities using data through 2023, capturing recent energy market transformations. Second, it employs both Allen and Morishima elasticity measures, demonstrating the superior policy relevance of the latter. Third, it examines the aggregate manufacturing sector, providing a comprehensive picture that can inform economy-wide industrial and energy policies.

THEORETICAL FRAMEWORK AND METHODOLOGY

Theoretical Foundation

The study followed the works of Berndt and Wood (1975, 1979) and Tovar and Iglesias (2013) to develop a framework for modelling energy and non-energy inputs substitution possibilities [5], [6], [7]. The study assumed that manufacturing firms have a twice differentiable, weakly separable, and strictly quasi-concave production function exhibiting the functional relation between output, *Q,* and inputs capital, *K,* labour, *L,* and energy, *E.* The production function takes the following general form:

$$Q = f(KLE) \qquad (2.1)$$

It is further assumed that the production function is characterized by constant returns to scale, separable in factor inputs, and any technical change affecting *K, L,* and *E* is Hicks-neutral. A common problem while estimating production functions is that factor inputs are likely to be endogenous due to simultaneity bias, leading to biased estimates [2], [3]. The dual of the production function is a cost function that reflects the production technology. The application of factor prices in the cost function alleviates the problem of endogeneity. Hence, a cost function is preferable to a production function [2]. The cost function takes the following general form:

$$C = C(Q, P_k, P_l, P_e, T) \qquad (2.2)$$

where C is the total cost, P_k, P_l, P_e are the input prices of *K, L,* and *E,* respectively and T captures Hicks-neutral technical change (changes in output brought about by technological change).

In minimizing total costs subject to constraints and following Tovar and Iglesias (2013), equation (3.15) could be expressed as follows [7]:

$$C = C(Q, P_i, T) = \min_i\{P_i' : f(i), i \gg 0\} \qquad (2.3)$$

where P is a vector of input prices with $(P_k, P_l, P_e)' \gg 0$, i is input demand, and $f(\cdot)$ is the production function.

It is assumed that the cost function is homogeneous of degree one in input prices, quasi-concave, twice differentiable, and weakly separable. Further, the function is assumed to be non-declining in output and input prices [3], [7].

For the cost function C to be assessed, a functional form needs to be specified. Following Berndt and Wood (1975, 1979), Tovar and Iglesias (2013) and Haller and Hyland (2014), this study adopted a transcendental logarithmic (translog) cost function, which was suggested by Christensen et al. (1973)]5], [6], [7], [3], [8]. The cost function is flexible, twice differentiable and does not demand advanced assumptions on the link between the factor inputs [3], [5]. The link is established through analysis. The function is expressed as follows:

$$\ln C = \alpha_0 + \sum_{i=1} n\, \delta_i \ln P_{ift} + \frac{1}{2}\sum_{i=1} n \sum_{j=1} n\, \alpha_{ij}\, lnP_{ift}\, lnP_{jft} + \sum_{i=1} n\, \beta_i \ln P_{ift} \ln Q_{ft} + \tau_q\, lnQ_{ft}$$
$$+ \tau_{qq}(lnQ)^2 + \sum_{i=1} n\, \mu_{fi} \ln P_{ift} + \theta_\gamma \gamma_t \qquad (2.4)$$

$$i, j = k,l,e \quad i \neq j$$

where γ captures time dummies, and θz and $\theta\gamma$ are the coefficients to be estimated. The factor share equations are provided as follows:

$$S_{if} = \delta_i + \sum_{j=1} n\, \alpha_{ij} lnP_{jft} + \beta_i lnQ_{ft} + \mu_{if} \qquad (2.5)$$

To make certain that the cost function is symmetric and homogeneous of degree one in input prices, the following constraints are imposed:

$$\sum_{i=1} n\, \delta_i = 1; \sum_{i-1} n\, \alpha_{ij} = 0; i,j = 1, \dots, n; \sum_{i=1} n\, \beta_i = 0 \quad (for\ homogeneity\ condition) \ (2.6)$$

$$\alpha_{ij} = \alpha_{ji}, i,j = k,i.e; i \neq j \qquad (for\ symmetry)$$

Equations (2.5) and (2.6) were jointly analysed using Zellner's iterated seemingly unrelated regression (iSUR) method. According to Haller and Hyland (2014), this technique takes care of possible correlation between errors in the equations. Given that the factor shares must add up to one, one of the factor shares (in this case, capital) was arbitrarily dropped, and it was calculated as a residual. Employing iSUR ensured that the estimated parameters remained unchanged regarding the dropped factor [3].

The joint estimation of the translog cost function and the factor share equations provided the initial step of a two-step process. In the second step, elasticities were calculated directly from the estimated parameters of the translog cost function and predicted cost shares. The study first estimated own - and cross-price elasticities of demand (PED). Own-price elasticities provide the percentage change in demand for an input following a percentage change in its price. Cross-price elasticities provide the percentage change in demand for an input in reaction to a one percent change in the price of another factor input. The price elasticity of demand was calculated as follows:

$$\epsilon_{xiPi} = \sigma_{ii}\, X\, S_i = \frac{\alpha_{ii} + S_i X S_i}{S_i} \qquad (2.7)$$

$$\epsilon_{xiPj} = \sigma_j\, X\, S_j = \frac{\alpha_{ij} + S_i X\, S_j}{S_i} \qquad (2.8)$$

Where ϵ_{xiPi} is own-price elasticity and ϵ_{xiPj} is cross-price elasticity.

For the cross-price elasticity, if $\epsilon > 0$, the variable inputs were taken to be substitutes. This means that a rise in the relative price of one input increased demand for the other input. If $\varepsilon < 0$, the inputs were considered to be complements. This implies that a rise in the relative price of one factor reduced demand for the other input. Haller and Hyland (2014) note that own-and cross-price elasticities can be helpful to policymakers who might desire to identify the potential effect of, for instance, a carbon tax on demand for energy and other factor inputs [3]. The elasticities measure the actual change in demand for non-energy inputs following an increase in energy price. Nevertheless, some literature has opined that price elasticity of demand is not a satisfactory measure of factor substitutability because it fails to measure the ease of substitution or curvature of the production function [3], [9]. In addition, Zha and Ding (2014) note that the own- and cross-elasticities of substitution are measures of absolute substitution and do not reveal changes in factor input ratios, yet they are of important economic interpretation [9].

Allen elasticity of substitution (AES) and Morishima elasticity of substitution (MES) are theoretically better measures of substitution [3], [9]. According to Frondel (2004), they reveal the scenario in which substitution possibilities are determined entirely by technology [10]. AES was first proposed by Hicks and Allen (1934) and was later improved by Allen (1938) and Uzawa (1962) [11], [12], [13]. It is thus often referred to as Allen–Uzawa elasticity of substitution and is expressed as follows:

$$AES_{xiPj} = \frac{\epsilon_{xiPj}}{S_j} \qquad (2.9)$$

AES estimates the actual percentage change in demand for factor input *i* in reaction to variation in factor *j*'s price and has the same sign as cross-price elasticity. However, Blackorby and Russell (1989) note that this measure suffers from three weaknesses: first, AES does not measure the ease of substitution or curvature of the production function and it adds no information to cross-price elasticities; second, the measure does not provide evidence of relative factor shares, yet this is the rationale for the elasticity of substitution; lastly, it cannot be elucidated as a derivative of a quantity ratio with respect to a price ratio, implying that it is entirely unproductive [14]. In addition, Zha & Ding (2014) note that this measure provides partial elasticities as it considers a case of two inputs only. This means that AES fails to permit optimum alteration of all inputs to a variation in price ratio [9].

MES provides an alternative to AES. It was first developed by Morishima (1967) and Blackorby and Russell (1989) [15], [14]. The measure gives a natural generality of the two-factor elasticity of substitution to a situation of more than two-factor inputs. It alters along an isoquant, thus giving an accurate measure of factor substitution [16] (Zellner, 1962). Further, Blackorby and Russell (1989) note that MES is a measure of ease of substitution, provides information about relative factor shares and is a derivative of the quantity ratio with respect to the price ratio [14]. MES is therefore preferred to AES in this study. It is calculated as follows:

$$MES_{ij} = \frac{\partial \ln (X_i/X_j)}{\partial \ln P_j} = \epsilon_{xiPj} - \epsilon_{xjPi} \quad (2.10)$$

where X_i and X_j are demands for factor inputs *i* and *j* and ϵ_{xiPj} and ϵ_{xjPi} are cross- and own-price elasticities.

Equation (2.9) reveals that MES corrects cross-price elasticity for variations in the requirement for a factor input when its price varies. It describes the change in the ratio of two factors (X_i/X_j) when the price of one-factor input (Pj) varies and exemplifies the technical substitution possibility between the inputs. Based on this measure, factors i and j are substitutes if the *i/j* input ratio increases (MES > 0) following a rise in price Pj. Thus, in the case of a rise in the price of energy input, the demand for both energy and non-energy inputs, such as capital, drops, but the demand for capital falls less. In this case, capital and energy would be categorized as Morishima substitutes. This is indicative of the reality that the production process is now more capital-intensive. If on the other hand, MES < 0, the two-factor inputs i and j are labeled MES complements.

DATA AND VARIABLES

The study utilizes annual time-series data (1981-2023) from the Central Bank of Nigeria, National Bureau of Statistics, and World Bank. Manufacturing output (MO) represents real value added. Factor prices are constructed as follows: the price of capital (P_K) is proxied by the maximum lending rate plus depreciation; price of labour (P_L) uses average manufacturing wages; price of energy (P_E) employs a weighted average of electricity, diesel, and gasoline prices. Total cost (C) represents the sum of capital, labor, and energy expenditures in real terms.

Table 2.1: Definition and Measurement of Variable

Variable Category	Variable Name	Symbol	Measurement
Dependent Variables	Manufacturing Output Total Manufacturing Cost	MO C	Total annual sales/value of output (NGN) Sum of capital, labour, and energy costs (NGN)
Independent Variables	Capital Input Labour Input Energy Input Energy Efficiency	CAP LAB E EE	Total value of machinery and equipment (NGN) Total wages paid to employees (NGN) Total cost of electricity and fuel (NGN) Score derived from Stochastic Frontier Analysis (0 to 1)
Price Variables	Price of Capital Price of Labour Price of Energy	P_K P_L P_E	User cost of capital (proxied by maximum lending rate) Mean wage earnings per employee Weighted average cost per tonne of oil equivalent (TOE)

RESULTS AND ANALYSIS

The substitutability of energy and non-energy inputs (capital [K], labour [L] and energy consumption [E]) was examined from the estimation of the translog cost function involving the total manufacturing cost (C) in relation to labor price (PL), price of capital (PK) proxied by the maximum lending rate, energy price (PE) and manufacturing output (MO). Both the Allen elasticity of substitution (AES) and Morishima Elasticity of Substitution (MES) were employed to examine the level of substitutability among the inputs.

When estimating a translog cost function, imposing linear homogeneity in input prices is crucial to ensure that the function accurately represents the underlying production technology. Linear homogeneity implies that a proportional

increase in all input prices leads to a proportional increase in total cost, holding output constant [8]. This property is essential for the cost function to be consistent with economic theory. Thus, imposing linear homogeneity usually involves scaling the cost and input prices by one of the input prices [5]. This normalization ensures that the cost function is homogeneous of degree one in input prices. By imposing linear homogeneity and scaling the variables, the study can obtain more accurate estimates of input substitutability and elasticities, which are critical for understanding firms' and industries' behavior. Based on the foregoing, the price of labour (PL) was used as the scaling factor for manufacturing cost, price of capital, and energy price for the estimation of the translog cost function using the ordinary least squares estimation (OLS) method. Based on the scaling, C⁄P_L is the total cost relative to labour price; P_K⁄P_L is the price of capital relative to labour price; P_E⁄P_L is the energy price relative to labour price.

Descriptive Statistics and Model Fit

Summary statistics (Table 1) reveal substantial variability in input prices and shares over the study period. The translog model demonstrates excellent fit, with a system R^2 of 0.9918 and significant parameter estimates for most second-order terms.

Table 1. Descriptive Statistics of Key Variables (1981-2023)

Variable	Mean	Std. Dev.	Minimum	Maximum
S_K	0.384	0.062	0.301	0.502
S_L	0.412	0.058	0.335	0.521
S_E	0.204	0.041	0.142	0.289
$P_K\ (real)$	22.65%	6.12%	10.00%	36.09%
$P_L(real,\ '000N)$	16.10	19.24	0.63	70.28
$P_E(real/TOE)$	72.44	108.09	0.15	617.00

Allen Elasticities of Substitution

The estimated AES (Table 2) indicates substitution between all input pairs. However, these partial elasticities, while positive, provide limited insight into the magnitude and direction of factor ratio change.

Table 2. Average Allen Elasticities of Substitution (1981-2023)

Input Pair	AES	Std. Error
Capital-Energy	0.9990	0.0006
Energy-Labor	2.0001	0.0001
Capital-Labor	0.9977	0.0001

Morishima Elasticities of Substitution

The MES results (Table 3) reveal more nuanced and policy-relevant relationships:

Table 3. Morishima Elasticities of Substitution - Summary Statistics

Elasticity	Mean	Std. Dev.	Min	Max	Interpretation
MES_KE	3.659	0.862	1.948	4.496	**Substitutes**
MES_EL	2.318	0.275	1.927	2.714	**Substitutes**
MES_KL	-1.937	0.432	-2.484	-1.165	**Complements**

The positive MES for capital-energy (3.66) indicates that a 1% increase in energy price would increase the capital-energy ratio by approximately 3.66%, suggesting strong substitution potential. Similarly, the energy-labor MES (2.32) indicates substitution possibilities, though less pronounced. The negative MES for capital-labor (-1.94) reveals complementarity, implying that capital deepening is associated with increased skilled labor demand rather than labor displacement (Figure 1).

The temporal patterns reveal important structural changes: the capital-energy substitutability has strengthened over time (MES_KE increased from 1.95 to 4.50), likely reflecting technological advancement and increased automation potential. Conversely, energy-labor substitutability has weakened slightly, possibly due to changing skill requirements in manufacturing.

More specifically, using the averaging approach, Table 4 presents the summary statistics of the Allen elasticity of substitution

(AES) and Morishima Elasticity of Substitution (MES) between capital (K), labor (L), and energy (E). A comparison of the mean values across the pairs reveals that the AES-EL (2.0001) is significantly higher than that of AES-KE (0.9990) and AES-KL (0.9977), indicating that energy and labor are highly substitutable, while capital is a close substitute for both energy and labor [5], [17].

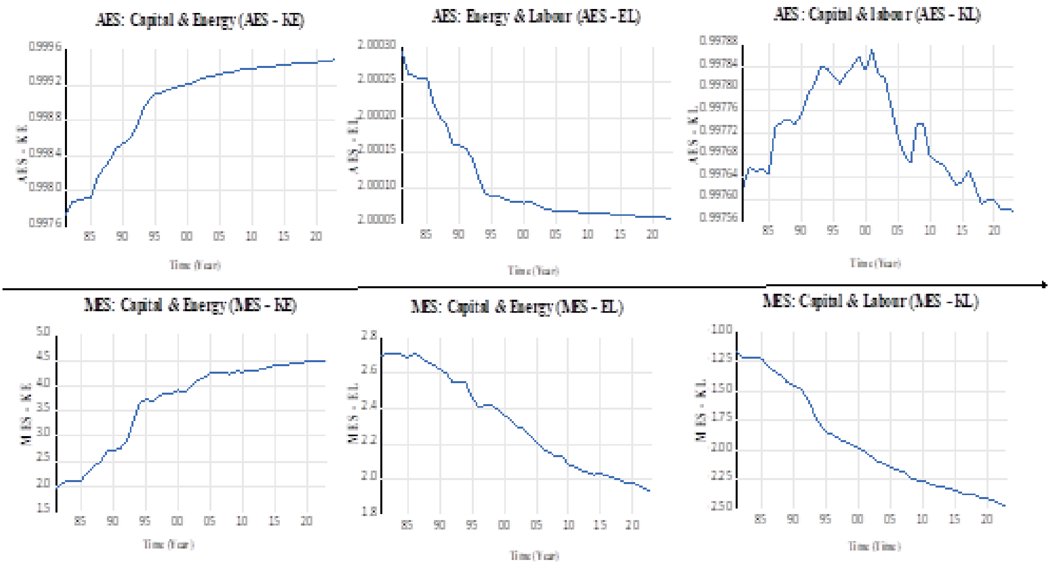

Figure 1 Trends in AES and MES between Capital (K), Labour (L) and Energy (E)

Table 4. Summary Statistics of Variables
Realization-: $T = 43$ (1981 – 2023)

Statistics	Variables					
	AES-KE	**AES-EL**	**AES-KL**	**MES-KE**	**MES-EL**	**MES-KL**
Obs.	43	43	43	43	43	43
Mean	0.9990	2.0001	0.9977	3.6594	2.3177	-1.9368
Maximum	0.9995	2.0003	0.9979	4.4963	2.7139	-1.1647
Minimum	0.9977	2.0001	0.9976	1.9483	1.9266	-2.4835
Std. Dev.	0.0006	7.07E-05	9.10E-05	0.8619	0.2752	0.4319
Skewness	-1.1345	1.3395	0.1500	-0.8285	0.1312	0.5317
Kurtosis	2.8363	3.3630	1.6665	2.1207	1.5204	1.8453

The mean MES values also exhibit significant variation across the pairs. The mean MES-KE value (3.6594) is substantially higher than that of EL (2.3177), indicating that capital and energy are more substitutable than energy and labor [14]. The mean MES value for KL (-1.9368) is negative, indicating that capital and labor are complements, which is consistent with the findings of previous studies [5].

The high mean AES-EL value suggests that manufacturers in Nigeria can easily substitute labor for energy, which may be due to the abundance of labor in the country [18]. The high mean MES-KE value for KE suggests that manufacturers can also substitute capital for energy, which may be driven by the increasing adoption of energy-efficient technologies [19].

A comparison of the standard deviations across the pairs reveals that the AES-values for EL (7.07E-05) and KL (9.10E-05) exhibit relatively low variability, indicating that the substitutability between energy and labor, and capital and labor, is relatively stable over time [5]. In contrast, the standard deviation of AES_KE (0.0006) is slightly higher, indicating that the substitutability between capital and energy is relatively more volatile.

The standard deviations of the MES values are significantly higher than those of the AES values. The standard deviation of MES-KE (0.8619) is the highest, indicating that the substitutability between capital and energy varies substantially over time [14]. The standard deviations of MES-EL (0.2752) and MES-KL (0.4319) are lower, but still indicate significant variability in the substitutability between energy and labor, and capital and labor.

The relatively low variability in the AES values for EL and KL suggests that manufacturers in Nigeria have a stable substitution pattern between energy and labor, and capital and labor [17]. The high variability in the MES values, particularly for KE, suggests that manufacturers are more likely to adjust their input mix in response to changes in capital and energy prices [18].

Based on the foregoing statistical narrative, as a measure that captures the variability in the relationship between capital (K) and labor (L), and energy (E), the MES might be preferred as compared to the AES measure. For instance, the higher variability in MES_KL suggests that the complementarity between capital and labor may be changing over time, which could be important to consider in policy decisions. On the other hand, as a measure that demonstrates a more stable estimate of the relationship between any two inputs, the AES measure might be preferred due to its lower variability. However, this stability might come at the cost of not capturing the distinction of the relationship between the inputs.

DISCUSSION AND POLICY IMLICATIONS

Theoretical Implications

Following the empirical findings, the Allen elasticity of substitution (AES) and Morishima Elasticity of Substitution (MES) estimates suggest that capital and energy are substitutes, with AES values close to 1 and MES values ranging from 1.9483 to 4.4963. This finding is consistent with previous studies, such as Berndt and Wood (1975), which reported that capital and energy are substitutes in production [5]. The high MES values for capital and energy suggest that manufacturers in Nigeria can substitute capital for energy, which may be driven by the increasing adoption of energy-efficient technologies [19].

The AES values for energy and labor are approximately 2, indicating that energy and labor are highly substitutable. This finding is consistent with [17], who reported that energy and labor are substitutes in production. The mean MES value for energy and labor is 2.3177, indicating that energy and labor are substitutes, but the substitutability has decreased over time. The high AES value for energy and labor suggests that manufacturers in Nigeria can easily substitute labor for energy, which may be due to the abundance of labor in the country [18].

In contrast, the AES values for capital and labor are close to 1, indicating that capital and labor are substitutes, but the substitutability is limited. However, the MES values for capital and labor are negative, ranging from -1.1647 to -2.4835, indicating that capital and labor are complements. This finding is consistent with Berndt and Wood (1975), who reported that capital and labor are complements in production [5]. The negative MES values suggest that manufacturers in Nigeria may need to adopt a more integrated approach to input management, considering the interdependencies between capital and labor.

Policy Implications

1. Energy Price Reform and Carbon Taxation: The strong capital-energy substitutability (MES_KE = 3.66) suggests that energy price increases—whether through subsidy

removal or carbon taxation—could accelerate capital-intensive, potentially more energy-efficient, technological upgrading. However, policymakers must consider adjustment costs and financing constraints that may limit this substitution in practice.

2. Industrial Training and Skills Development: The capital-labor complementarity implies that policies promoting capital investment (e.g., through tax incentives or access to finance) must be accompanied by workforce development programs. Without corresponding improvements in human capital, the productivity benefits of new equipment may not be fully realized.
3. Technology Policy and Innovation: The increasing capital-energy substitutability over time suggests growing technological flexibility. Policy should encourage the adoption of energy-efficient technologies through information dissemination, demonstration projects, and support for domestic adaptation of imported technologies.
4. Labor Market Implications: The energy-labor substitutability indicates potential employment effects of energy price changes. Policies to mitigate adverse employment impacts could include retraining programs for workers displaced by energy-saving technological changes.
5. Integrated Policy Design: The interconnected nature of factor relationships calls for coordinated policy approaches. Energy, industrial, education, and labor policies should be designed with awareness of their interactive effects on the manufacturing sector's input structure.

CONCLUSION

The study's findings on energy and non-energy input substitutability in Nigeria's manufacturing sector suggest that capital and energy are substitutes, with high Morishima Elasticity of Substitution (MES) values indicating that manufacturers in Nigeria can substitute capital for energy, potentially driven by the increasing adoption of energy-efficient technologies [19]. This finding is consistent with the Neoclassical Theory, which suggests that firms optimize their production processes by substituting inputs in response to changes in input prices and technological advancements [20].

The study's results also highlight the importance of considering dynamic changes in input relationships when analyzing production processes. The MES values reveal significant variation over time, indicating changes in substitutability in response to price changes and technological advancements. The MES also captures the complementarity between capital and labour, which is not evident in the Allen Elasticity of Substitution (AES) values. The study's results on substitutability support the Translog Cost Function Theory, which provides a flexible framework for estimating the relationships between inputs and outputs in a production process [8]. The MES is a more preferred measure than the AES for analyzing production processes in Nigeria's manufacturing sector, as it captures both the degree and direction of changes in input relationships over time.

Several avenues for future research emerge from this study. First, disaggregated analysis by manufacturing sub-sector would reveal important heterogeneity masked by aggregate data. Second, incorporating embodied technological change through quality-adjusted input measures could enhance elasticity estimates. Third, examining how institutional factors—such as access to finance or workforce skills—constrain or enable substitution would provide valuable insights for policy implementation.

As Nigeria continues its energy sector reforms and pursues industrial revitalization, the substitution elasticities estimated in this study provide crucial parameters for forecasting sectoral responses and designing effective, complementary policies across energy, industry, and labor domains.

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METODIKA MULTIMEDIJALNE NASTAVE

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APSTRAKT

Savremeno obrazovanje zahtijeva primjenu inovativnih didaktičkih pristupa koji odgovaraju potrebama učenika u digitalnom okruženju. Multimedijalna nastava predstavlja važan segment modernizacije nastavnog procesa jer omogućava integraciju različitih medijskih sadržaja u cilju unapređenja učenja. Cilj ovog rada je analiza uloge i značaja multimedijalne nastave u savremenom obrazovanju, sa posebnim osvrtom na njenu primjenu u razrednoj nastavi. Predmet istraživanja odnosi se na multimedijalnu nastavu kao savremeni didaktički pristup, dok su zadaci usmjereni na analizu njenih karakteristika, poređenje sa tradicionalnom nastavom i utvrđivanje njenog uticaja na motivaciju i uspješnost učenika. Metodološki okvir zasniva se na analizi stručne literature, komparativnoj i deskriptivnoj metodi. Rezultati ukazuju da primjena multimedijalnih sadržaja doprinosi boljem razumijevanju nastavnih sadržaja, većoj motivaciji učenika i razvoju digitalnih kompetencija. Zaključuje se da savremena škola treba da integriše tradicionalne i savremene metode rada kako bi odgovorila na potrebe učenika i zahtjeve društva.

Ključne riječi: Multimedijalna nastava, savremeno obrazovanje, razredna nastava, metodika.

UVOD

Opšte je poznato da škola predstavlja jedan od osnovnih stubova obrazovanja i razvoja društva. U savremenom kontekstu njena uloga se ne ograničava samo na prenošenje znanja, već se proširuje na organizaciju, koordinaciju i realizaciju različitih obrazovnih i društvenih aktivnosti. Ovakvo shvatanje škole direktno se povezuje sa savremenim didaktičkim pristupima koji naglašavaju povezanost škole i okruženja. U teoriji „otvorene škole", škola se posmatra kao centar zajednice koji sarađuje sa roditeljima, institucijama i lokalnim subjektima [1]. U praksi, međutim, ova saradnja često nije dovoljno sistematski organizovana, što ukazuje na jaz između teorijskog koncepta i njegove realizacije. Ovaj odnos teorije i prakse biće vidljiv i kroz sve naredne segmente rada, posebno kroz prikaz savremene nastave. Škola predstavlja jedan od osnovnih stubova razvoja savremenog društva. Njena uloga danas prevazilazi tradicionalno prenošenje znanja i obuhvata razvoj kompetencija, vrijednosti i socijalnih vještina učenika. U savremenim didaktičkim pristupima naglašava se povezanost škole sa društvenim okruženjem, što je u skladu sa konceptom „otvorene škole“, prema kojem škola funkcioniše kao dio šire zajednice.

Uprkos teorijskom utemeljenju u praksi se često uočava nedovoljna primjena savremenih nastavnih pristupa, što ukazuje na potrebu za unapređenjem nastavnog procesa. Jedan od načina modernizacije nastave jeste primjena multimedijalnih tehnologija koje omogućavaju dinamičnije i interaktivnije učenje.

Cilj ovog rada je analiza uloge i značaja multimedijalne nastave u savremenom obrazovanju, sa posebnim osvrtom na razrednu nastavu.

Predmet istraživanja jeste multimedijalna nastava kao didaktički pristup.

Zadaci istraživanja su:

- analiza osnovnih karakteristika multimedijalne nastave,
- poređenje tradicionalnih i savremenih nastavnih metoda,
- utvrđivanje uticaja multimedije na motivaciju i uspješnost učenika.

Metodologija rada zasniva se na:

- metodi analize literature,
- komparativnoj metodi,
- deskriptivnoj metodi.

Rad ima teorijsko-praktični karakter jer, pored teorijske analize, uključuje i primjer nastavne prakse. Savremeni obrazovni sistemi sve više naglašavaju razvoj digitalnih kompetencija kao ključnih ishoda učenja. Prema *European Council* digitalna kompetencija predstavlja jednu od osnovnih kompetencija za cjeloživotno učenje, što dodatno potvrđuje potrebu za integracijom multimedijalnih tehnologija u nastavni proces [2].

METODIKA RAZREDNE NASTAVE

Metodika razredne nastave predstavlja naučnu disciplinu koja se bavi proučavanjem i primjenom nastavnih metoda u mlađim razredima osnovne škole. Ona obuhvata didaktičke pristupe u realizaciji nastavnih sadržaja iz različitih predmeta, kao što su maternji jezik, matematika, priroda i društvo, likovna i muzička kultura [3]. Uloga učitelja u ovom procesu je ključna, jer on planira, organizuje i realizuje nastavu u skladu sa ciljevima obrazovanja. Savremena metodika naglašava značaj interakcije nastavnih elemenata: ciljeva, sadržaja, metoda i nastavnih sredstava [4].

Izbor nastavnih metoda zavisi od više faktora, uključujući uzrast učenika, sadržaj nastave, materijalne uslove škole i kompetencije nastavnika [5]. U tom smislu, metodika omogućava sistematično planiranje nastave i unapređenje kvaliteta obrazovanja.

Jedna od ključnih karakteristika metodike razredne nastave jeste integrativni pristup, u kojem se različiti nastavni predmeti ne posmatraju izolovano, već se povezuju kroz tematske cjeline i životne situacije. Takav pristup omogućava učenicima lakše razumijevanje nastavnih sadržaja, jer se znanje povezuje sa konkretnim iskustvima iz svakodnevnog života.

SAVREMENA METODIKA

Savremena metodika posebno naglašava aktivnu ulogu učenika u nastavnom procesu. Učenik više nije pasivni primalac informacija, već aktivni učesnik koji istražuje, postavlja pitanja, rješava probleme i učestvuje u zajedničkom učenju. Ovakav pristup direktno utiče na razvoj kritičkog mišljenja, kreativnosti i sposobnosti samostalnog učenja.

Uloga učitelja u ovom procesu je višestruka. On nije samo prenosilac znanja, već i organizator, motivator i evaluator nastavnog procesa. Učitelj mora posjedovati visok nivo pedagoških, didaktičkih i komunikacijskih kompetencija kako bi uspješno odgovorio na potrebe savremene nastave. Posebno je važno da učitelj bude sposoban da prepozna individualne razlike među učenicima i da prilagodi nastavu tim razlikama.

Metodika razredne nastave takođe podrazumijeva stalnu refleksiju nastavne prakse. Nastavnik kontinuirano analizira efikasnost primijenjenih metoda, prati napredak učenika i prilagođava svoj rad u skladu sa rezultatima evaluacije. Na taj način se obezbjeđuje kvalitet i fleksibilnost nastavnog procesa.

U savremenim obrazovnim uslovima metodika razredne nastave sve više integriše digitalne tehnologije i multimedijalna nastavna sredstva. Njihova primjena omogućava vizuelizaciju apstraktnih pojmova, povećava motivaciju učenika i doprinosi aktivnijem učenju. Ipak, važno je naglasiti da tehnologija ne zamjenjuje nastavnika, već predstavlja sredstvo koje mu pomaže u realizaciji nastavnih ciljeva [6], [7].

Takođe, značajan segment metodike odnosi se na razvoj socijalnih vještina učenika. Kroz grupni rad, saradničko učenje i komunikaciju u razredu, učenici razvijaju sposobnost timskog rada, tolerancije i međusobnog uvažavanja. Ove vještine su jednako važne kao i akademska znanja, jer predstavljaju osnov za kasnije funkcionisanje u društvu.

U cjelini posmatrano, metodika razredne nastave predstavlja dinamičnu i razvojno orijentisanu disciplinu koja se stalno prilagođava savremenim obrazovnim zahtjevima. Njena uspješna primjena zavisi od stručnosti nastavnika, kvaliteta nastavnih sredstava i organizacije školskog sistema.

MULTIMEDIJALNA SAVREMENA NASTAVA

Često se ističe da je Internet nov i jedinstven medij. Pod Internetom možemo podrazumijevati jednu posebnu i veoma važnu mrežu na gobalnom nivou koja pruža niz pogodnosti i prednosti u radu i današnjem školovanju, te svakodnevnom životu. Posebna prednost mu je u vidu spajanja ljudi u virtuelnom smislu gdje lokacija na geografskom području nije bitna, niti mora i treba da bude naznačena. Internet je svakako potpomognut i multimedijima i kao takav omogućava razne poslove između miliona korisnika u vidu ostvarivanja kontakta sa drugim ljudima, zatim uspostavljanje poslovnih odnosa, te mnogih drugih oblika rada i vidova komunikacije.

U obrazovanju multimedija predstavlja dopunu i nadogradnju postojećih klasičnih metoda. Ona omogućava povezivanje audio-vizuelnog sadržaja sa tekstom, interaktivnosti i individualni pristup. Osnovni medijumi prikazivanja su tekst, slika, animacija, zvuk, govor i pokretna slika. Pod multimedijalnom komunikacijom se smatra upotreba više medija ili simultano više načina komuniciranja. Multimedijalni sistemi podržavaju interaktivnu komunikaciju korisnika sa sistemom u realnom vremenu i simultanim korišćenjem različitih pojavnih oblika i informacija [8]. Svakako je potrebno pristupiti i uvođenju savremenog učenja putem metodičkih sistema.

Prema Glasseru (1994), kvalitetno obrazovanje podrazumijeva zadovoljenje osnovnih psiholoških potreba učenika, uključujući potrebu za pripadanjem, slobodom i uspjehom. Multimedijalna nastava doprinosi upravo tome jer čini nastavni proces zanimljivijim i bližim učenicima i njihovim sposobnostima, interesima i željama [6].

Efikasnost multimedijalne nastave potvrđena je i savremenim istraživanjima iz oblasti obrazovne psihologije. Richard E. Mayer u svojoj teoriji multimedijalnog učenja ističe da učenici bolje usvajaju informacije kada se one prezentuju kombinacijom vizuelnih i verbalnih elemenata, nego kada se koriste isključivo tekstualni sadržaji [9].

Takođe, istraživanja pokazuju da upotreba digitalnih alata u nastavi može značajno povećati angažovanost učenika i unaprijediti ishode učenja [10]. Multimedijalni pristup omogućava učenicima aktivno učešće u procesu učenja, čime se doprinosi razvoju viših kognitivnih sposobnosti.

PRIMJER NASTAVNE PRAKSE, KROZ VEZU TEORIJE I PRAKSE

Savremeni obrazovni pristup zahtijeva jasnu povezanost teorijskih znanja i njihove praktične primjene. Multimedijalna nastava omogućava upravo takvu integraciju, jer teorijski sadržaji postaju vidljivi i razumljiviji kroz različite oblike prezentacije. Učenici kroz multimedijalne sadržaje lakše povezuju apstraktne pojmove sa konkretnim primjerima. Na taj način se poboljšava razumijevanje i trajnost znanja. Takođe, ovakav pristup doprinosi razvoju kritičkog mišljenja, jer učenici ne primaju informacije pasivno, već ih analiziraju i upoređuju.

Na osnovu teorijskih pretpostavki multimedijalne nastave, u nastavku se prikazuje primjer nastavnog časa koji integriše savremene nastavne metode u obradi književnog lika. Cilj ovog primjera jeste da se pokaže kako multimedijalni sadržaji mogu unaprijediti razumijevanje književnih tekstova i podstaći aktivno učešće učenika. Primjena video i slikovnih materijala omogućava učenicima da lakše uoče karakterne osobine likova, kao i njihove postupke u konkretnim situacijama. U poređenju sa klasičnim metodama, ovakav pristup povećava motivaciju i olakšava razumijevanje sadržaja.

Predmet: Srpski jezik
Razred: V
Nastavna tema: Književnost
Nastavna jedinica: Opis lika primjenom multimedijalne nastave
Tip časa: Obrada

Zadaci

Obrazovni:

- Učenici prepoznaju osobine književnog lika,
- Uče kako opisati lik usmeno i pismeno,
- Uočavaju razliku između klasične i multimedijalne nastave.

Funkcionalni:

- Razvijaju sposobnost izražavanja,
- Povezuju tekst sa vizuelnim i audio sadržajem,
- Razvijaju digitalne kompetencije.

Vaspitni:

- Razvijaju interes za književnost,
- Podstiče se kreativnost i saradnja

Nastavne metode

- Usmeno izlaganje,
- Demonstracija,
- Tekstualna metoda,
- Multimedijalna metoda.

Nastavni oblici

- Frontalni,
- Individualni.

Nastavna sredstva i pomagala:

- Udžbenik,
- Računar i projektor,
- Prezentacija (slike likova, citati),
- Kratak video/isječak iz filma ili crtani film.

Tok časa

Uvodni dio (5–10 min)

Nastavnik pušta kratak video (npr. scena iz filma ili crtani lik) i postavlja pitanja učenicima:

- Kakav je ovaj lik?
- Kako biste ga opisali?

Najava teme: opis lika uz pomoć multimedije.

Glavni dio (25–30 min)

- Učenici čitaju kratak tekst iz udžbenika,
- Prikaz prezentacije sa slikama i osobinama likova,
- Upoređivanje lika iz teksta i lika iz videa,
- Učenici u paru opisuju lik (usmeno),
- Zapisivanje ključnih osobina.

Završni dio (5–10 min)

- Nekoliko učenika čita svoj opis,
- Kratka diskusija: da li im je lakše učiti uz video i slike?
- Zaključak o značaju multimedije u nastavi jezika.

Evaluacija

Usmeni opis, provjera kroz ponavljanje, pitanja, diskusija.

Osvrt na rad: Učenici su bili motivisani, zainteresovani za rad, te su pokazivali snalažljivost i efikasnost u radu.

ZAKLJUČCI

Predstavnici nove škole su bili veoma radikalni u kritici stare škole. Svojom kritikom su doprinijeli boljem razvoju didaktičke teorije, a i same nastavne prakse. Međutim rezultati reformi koje su preduzeli nisu donijeli visoke rezultate. Razlog tome je što su u svojim idejama išli u krajnost kao i sljedbenici stare škole. Najveće greške su napravljene u smislu neprimjenjivanja principa logičnosti, sistematičnosti i uzročnoposljedične povezanosti sadržaja. Sljedeća greška je bila što su ulogu nastavnika marginalizovali radi učeničke samoaktivnosti. Još jedna greška je ta što su negirali potrebu za minimalnim zajedničkim i jedinstvenim sadržajima nastavnog programa, već su programe stvarali prema potrebama svakog učenika. Jedina dobra strana nove škole u to vrijeme je doprinos u analizi stanja i sagledavanju slabosti stare škole, kao i potrebi da se izvrši reforma postojećeg načina učenja, uz čiju pomoć smo dosli danas do tzv. savremene škole i njenog sistema obrazovanja [11]. Multimedijalna nastava predstavlja značajan korak u modernizaciji obrazovnog sistema. Njena primjena doprinosi povećanju kvaliteta nastave, većoj motivaciji učenika i razvoju savremenih kompetencija. Međutim, uspješna implementacija zavisi od više faktora, uključujući stručnost nastavnika, tehničku opremljenost škola i spremnost obrazovnog sistema na promjene. Savremena škola treba da integriše tradicionalne i moderne metode kako bi ostvarila optimalne obrazovne rezultate i odgovorila na potrebe učenika savremenog društva. Savremeni obrazovni trendovi jasno ukazuju na potrebu integracije digitalnih tehnologija u nastavni proces. U skladu s preporukama OECD i European Commission, obrazovni sistemi treba da razvijaju digitalne kompetencije učenika i nastavnika kako bi odgovorili na izazove savremenog društva [12]. Multimedijalna nastava, kao jedan od ključnih segmenata digitalnog obrazovanja, ima značajnu ulogu u tom procesu, ali njena efikasnost zavisi od planske i pedagoški utemeljene primjene.

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METHODOLOGY OF MULTIMEDIA TEACHING

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ABSTRACT

Modern education requires the application of innovative didactic approaches that correspond to the needs of students in a digital environment. Multimedia teaching represents an important component of the modernization of the educational process, as it enables the integration of various media content in order to improve learning. The aim of this paper is to analyze the role and significance of multimedia teaching in contemporary education, with a particular focus on its application in primary education. The subject of the research refers to multimedia teaching as a modern didactic approach, while the research tasks are focused on analyzing its characteristics, comparing it with traditional teaching, and determining its impact on students' motivation and achievement. The methodological framework is based on literature analysis, as well as comparative and descriptive methods. The results indicate that the use of multimedia content contributes to better understanding of teaching materials, increased student motivation, and the development of digital competencies. It is concluded that modern schools should integrate traditional and contemporary teaching methods in order to meet the needs of students and the demands of modern society.

Keywords: Multimedia teaching, modern education, primary education, digital competencies, methodology.

DAROVITA DJECA U NASTAVNOM PROCESU

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APSTRAKT

Darovita djeca su posebna djeca i takođe se ukazala potreba za poklanjanjem veće pažnje ovakvoj djeci, djeci sa iznadprosječnim koeficijentom inteligencije. Do sada se stalno najviše radilo sa tzv. prosječnim učenikom, kome je skoro bila prilagošena nastava u potpunosti, a darovita djeca su se zapostavljala u nastavnom procesu. Svakako je vrijeme da se dogode promjene i u ovoj oblasti. Potrebno je izraditi nove programe učenja za darovitu djecu, uključiti ih u razne nove vidove učenja kao što je to inovativna nastava i individualni program rada, te praćenje njihovog razvoja. Nastavni proces za darovitu djecu treba da bude izazov i mjesto gdje oni mogu da dalje razvijaju svoje sposobnosti i unaprijede svoje znanje. Na nivou škola bilo bi potrebno oformiti timove koji bi radili na pružanju pomoći i podrške ovoj djeci, te njihovom daljem promovisanju i napredovanju. Takođe bi mogli da pohađaju razne kampove za darovitu djecu gdje bi se i družili sa vršnjacima sličnih oblasti, ali i različitih kako bi naučili i nešto novo. Znamo da vrlo često još na početku pokazuju posebna interesovanja i sklonosti za određene predmete i područja njihovog učenja i razvoja. Veliki broj djece je talentovan i darovit, ali se to nažalost vrlo kasno otkrije, ili se ne otkrije uopšte. Potrebno je sarađivati i sa roditeljima takve djece, te ih uključiti u posebne timove, ali i promovisati u lokalnoj zajednici, pa i šire. Darovita djeca su izuzetna u mnogim sferama i oblastima, te ih shodno tome moramo pripremati za cjeloživotno učenje.

Ključne riječi: Darovita djeca, nastava, nastavni proces, kompetencije.

UVOD

Savremeni obrazovni sistemi sve više prepoznaju značaj individualnih razlika među učenicima, posebno u kontekstu identifikacije i podrške darovitoj djeci. Darovitost se danas ne posmatra isključivo kao visok nivo inteligencije, već kao kompleksan i višedimenzionalan konstrukt koji obuhvata kognitivne sposobnosti, kreativnost, motivaciju i socio-emocionalne karakteristike. Uprkos tome, praksa u mnogim školama i dalje je dominantno usmjerena na tzv. prosječnog učenika, dok potrebe darovitih često ostaju nedovoljno prepoznate i podržane. Takav pristup može dovesti do nedovoljne stimulacije njihovih potencijala, ali i do gubitka motivacije i interesa za učenje.

Cilj ovog rada jeste analiza osnovnih karakteristika darovite djece, kao i razmatranje mogućnosti unapređenja nastavnog procesa kroz primjenu savremenih didaktičkih pristupa. Rad ima karakter stručnog istraživanja i zasniva se na analizi relevantne pedagoške i psihološke literature iz oblasti obrazovanja darovitih. U domaćoj pedagoškoj literaturi takođe se naglašava potreba za sistematskim pristupom identifikaciji i podršci darovitim učenicima, pri čemu se ističe značaj uloge škole i nastavnika u razvoju njihovih potencijala (Grgin, 2004).

KLJUČNA PITANJA U RADU

Ovaj rad ima karakter stručnog i preglednog rada i zasniva se na analizi relevantne pedagoške i psihološke literature iz oblasti obrazovanja darovitih učenika. Cilj rada nije empirijsko istraživanje, već sistematizacija postojećih teorijskih saznanja i njihovo povezivanje sa savremenom nastavnom praksom. U tom smislu, korišćeni su deskriptivni i analitički pristup, pri čemu su relevantni izvori sintetizovani kako bi se dobio uvid u osnovne karakteristike darovitosti i mogućnosti njenog razvoja u okviru nastavnog procesa.

Ključna pitanja rada su:

- Na koji način se darovitost definiše u savremenoj pedagoškoj i psihološkoj literaturi?
- Koje su najčešće karakteristike darovite djece u kognitivnom, kreativnom i socio-emocionalnom razvoju?
- U kojoj mjeri tradicionalni nastavni pristupi odgovaraju obrazovnim potrebama darovitih učenika?
- Koji didaktički i metodički pristupi se u literaturi izdvajaju kao najefikasniji u radu sa darovitom djecom?
- Kakva je uloga individualizacije nastave u razvoju potencijala darovitih učenika?

POJAM I PREPOZNAVANJE DAROVITOSTI

Darovitost se u savremenoj naučnoj literaturi definiše kao kompleksan fenomen koji uključuje interakciju različitih sposobnosti i ličnih osobina. Za razliku od ranijih pristupa koji su darovitost vezivali isključivo za koeficijent inteligencije, savremeni modeli naglašavaju njenu višedimenzionalnost [1].

Prema Renzullijevom troprstenastom modelu, darovitost se manifestuje kroz kombinaciju natprosječnih sposobnosti, kreativnosti i visokog nivoa motivacije [2]. Slično tome, Gagné (2004) razlikuje prirodne sposobnosti (darovitost) i razvijene kompetencije (talente), naglašavajući značaj sredinskih faktora u razvoju potencijala [3].

Darovita djeca često pokazuju:

- napredan razvoj jezika i mišljenja,
- izraženu radoznalost i potrebu za istraživanjem,
- sposobnost brzog usvajanja i povezivanja informacija,
- visok nivo kreativnosti,
- izražene socijalne i emocionalne karakteristike, poput empatije i osjećaja za pravdu [4].

Roditelji nadarene djece već od najranije dobi primjećuju određena ponašanja koja nakon identifikacije darovitog djeteta od strane stručnjaka postanu sasvim logična. Iako samo opažanje ovih znakova nije dovoljno da bi se utvrdila darovitost kod djeteta, poneka ponašanja mogu biti dobar trag koji će roditelja navesti da porazgovara sa stručnjakom kako bi se utvrdila darovitost. Prepoznavanje darovitog djeteta uključuje posmatranje različitih aspekata njihovog ponašanja, razvoja i sposobnosti. Evo nekoliko znakova koje roditelji darovite djece primjećuju:

- Rane razvojne prekretnice – darovita djeca mogu postići razvojne prekretnice kao što su pričanje ili hodanje ranije od svojih vršnjaka.
- Radoznalost česta osobina nadarene djece jest snažna želja za istraživanjem i učenjem o svijetu te nezasitna znatiželja.
- Brzo učenje i pamćenje – darovita djeca često brzo shvaćaju nove koncepte, pokazuju izvrsno zadržavanje pamćenja i mogu pokazati duboko razumijevanje složenih ideja.
- Napredne vještine rješavanja problema – mogu biti izvrsni u rješavanju problema i pokazivati napredne vještine kritičkog

razmišljanja, lako povezujući ideje i rješavajući zagonetke.

Slična shvatanja prisutna su i u regionalnoj literaturi, gdje se darovitost posmatra kao rezultat međudjelovanja nasljednih predispozicija i uticaja sredine. Naglašava se da bez adekvatne podrške obrazovnog sistema i porodice potencijali darovitih učenika mogu ostati nedovoljno razvijeni [5]. Važno je naglasiti da se darovitost ne manifestuje na isti način kod svakog djeteta, te je neophodan individualizovan pristup u njenom prepoznavanju i razvoju.

DAROVITA DJECA U NASTAVNOM PROCESU I INIDVIDUALIZACIJA NASTAVE

Tradicionalni modeli nastave često nisu u potpunosti prilagođeni potrebama darovitih učenika. Standardizovani pristupi mogu dovesti do nedovoljne stimulacije, što može rezultirati gubitkom interesa i smanjenjem motivacije za učenje. Savremeni pristupi obrazovanju darovitih naglašavaju značaj diferencirane i individualizovane nastave. Takvi pristupi omogućavaju prilagođavanje sadržaja, metoda i tempa rada individualnim sposobnostima učenika [6].

Primjena informaciono-komunikacionih tehnologija može dodatno unaprijediti proces učenja, omogućavajući pristup različitim izvorima znanja, simulacijama i interaktivnim sadržajima. Ovi alati doprinose razvoju samostalnosti u učenju i omogućavaju učenicima da napreduju u skladu sa sopstvenim mogućnostima. Poseban značaj ima i kontinuirano praćenje napretka učenika, kao i pružanje povratnih informacija koje podstiču dalji razvoj.

Jedan od ključnih elemenata kvalitetnog rada sa darovitim učenicima jeste individualizacija nastavnog procesa. Ona podrazumijeva prilagođavanje nastavnih sadržaja, metoda i oblika rada specifičnim potrebama i sposobnostima učenika. U praksi se često koristi individualizovani plan rada, koji omogućava sistematsko praćenje razvoja učenika i planiranje odgovarajućih obrazovnih aktivnosti. Ovakav pristup doprinosi efikasnijem razvoju potencijala i većoj motivaciji za učenje. Pored nastavnika, važnu ulogu imaju i roditelji, kao i stručni saradnici u školi. Saradnja između ovih aktera doprinosi stvaranju podsticajnog okruženja za razvoj darovitosti [7].

Kvalitet nastave u radu sa darovitim učenicima ogleda se u sposobnosti nastavnika da primijeni različite nastavne metode i strategije u skladu sa potrebama učenika. To podrazumijeva fleksibilnost u planiranju i realizaciji nastave, kao i kontinuirano stručno usavršavanje nastavnika.

Efikasna nastava treba da omogući:

- maksimalno iskorištavanje potencijala učenika,
- razvoj kritičkog i kreativnog mišljenja,
- podsticanje samostalnog učenja,
- povezivanje znanja sa realnim situacijama.

Kvalitetan nastavni proces ne podrazumijeva samo usvajanje znanja, već i razvoj ličnosti učenika u cjelini. U didaktičkom kontekstu, ističe se značaj prilagođavanja nastavnog procesa individualnim karakteristikama učenika, pri čemu nastavnik ima ključnu ulogu u izboru metoda i oblika rada. Kako navodi Vilotijević (2000), kvalitet nastave zavisi od sposobnosti nastavnika da optimalno kombinuje nastavne metode i sredstva u skladu sa ciljevima učenja i karakteristikama učenika [7]. U tom smislu, individualizacija nastave predstavlja jedan od osnovnih didaktičkih principa savremenog obrazovanja, koji omogućava efikasnije razvijanje potencijala darovitih učenika [7].

Profil darovitog djeteta

Profil darovitog djeteta se opisuje kroz sljedeće podatke (Tabela 1):

- **Opšti podaci o učeniku:**
- **Psihofizički razvoj:**
- **Učenje:**
- **Nivo znanja učenika:**
- **Socijalne vještine**
- **Komunikacijske vještine:**
- **Dar:**

- **Posebne/dodatne napomene-postignuća:**
- **Samostalnost i briga o sebi:**

Tabela 1. Obrazac individualnog plana rada sa darovitom djecom

Redni broj	Nastavni predmet	Postupak prepoznavanja darovitih učenika	Sistemsko praćenje darovitih učenika	Podrška u daljem napredovanju	Izuzetna postignuća

RAZRADA TEORIJSKIH SAZNANJA

Analiza relevantne literature ukazuje na to da savremeni pristupi darovitosti prevazilaze tradicionalna shvatanja zasnovana isključivo na intelektualnim sposobnostima. Umjesto toga, darovitost se sve češće posmatra kao rezultat međudjelovanja kognitivnih, kreativnih, motivacionih i socio-emocionalnih faktora [2]. Ovakvo razumijevanje ima direktne implikacije na organizaciju nastavnog procesa, jer zahtijeva fleksibilnije i individualizovane pristupe učenju.

U radu je ukazano da tradicionalni modeli nastave često nisu adekvatni za razvoj potencijala darovitih učenika. Ovakav nalaz je u skladu sa stavovima autora koji naglašavaju potrebu diferencijacije nastave i prilagođavanja obrazovnih sadržaja individualnim karakteristikama učenika [6]. Takođe, u domaćoj literaturi se ističe da kvalitet nastave u velikoj mjeri zavisi od kompetencija nastavnika i njegove sposobnosti da primijeni različite didaktičke pristupe [7].

Poseban značaj ima individualizacija nastave, koja se pokazuje kao jedan od ključnih faktora u efikasnom radu sa darovitim učenicima. Međutim, njena primjena u praksi često je ograničena organizacionim i sistemskim faktorima, poput velikog broja učenika u odjeljenju i nedovoljne obučenosti nastavnika. Ovi izazovi potvrđuju potrebu za kontinuiranim profesionalnim razvojem nastavnog kadra, što naglašavaju i autori iz oblasti edukacijske psihologije [8].

Pored toga, značajnu ulogu u razvoju darovitosti imaju i faktori izvan škole, prije svega porodica i šira društvena zajednica. Nedostatak koordinacije između ovih aktera može negativno uticati na razvoj potencijala darovitih učenika, što dodatno ukazuje na potrebu sistemskog pristupa ovom pitanju.

ZAKLJUČAK

Talentovani i daroviti se posebno zalažu za sopstveno, lično iskustvo, trud i rad, gdje vrlo malo trebaju pomoć ostalih. Adekvatno raspoređuju svoje vrijeme kako za učenje, tako i za odmor i slobodne aktivnosti. Iskazuju želju za stalnim napredovanjem i cjeloživotnim učenjem. Naime, dolazimo do saznanja da ih uspjesi podstiču na neke nove izazove i stalno usavršavanje u oblastima za koje pokazuju talenat ili dar.

Darovita djeca predstavljaju značajan resurs svakog društva, ali njihovo prepoznavanje i adekvatna podrška i dalje predstavljaju izazov u obrazovnoj praksi. Analiza literature ukazuje na potrebu napuštanja jednostranih pristupa darovitosti i prihvatanja njenog kompleksnog karaktera.

Unapređenje rada sa darovitim učenicima zahtijeva sistemske promjene koje uključuju primjenu savremenih nastavnih metoda, razvoj individualizovanih programa rada i jačanje kompetencija nastavnika. Poseban značaj ima saradnja između škole, porodice i šire društvene zajednice. Samo kroz takav integrisan pristup moguće je obezbijediti optimalne uslove za razvoj potencijala darovitih učenika i njihovu pripremu za cjeloživotno učenje. Na značaj sistemskog pristupa radu sa darovitim učenicima ukazuju i domaći autori, naglašavajući potrebu za kontinuiranim unapređenjem nastavne prakse i profesionalnim razvojem nastavnika [8].

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GIFTED CHILDREN IN THE TEACHING PROCESS

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ABSTRACT

Gifted children are special children and there is also a need to pay more attention to such children, children with an above-average IQ. Until now, most of the work has been done with the so-called an average student, to whom the teaching was almost entirely adapted, while gifted children were neglected in the teaching process. It is certainly time for changes to take place in this area as well. It is necessary to create new learning programs for gifted children, to include them in various new types of learning such as innovative teaching and individual work programs, and to monitor their development. The teaching process for gifted children should be a challenge and a place where they can further develop their abilities and improve their knowledge. At the school level, it would be necessary to form teams that would work on providing help and support to these children, as well as their further promotion and advancement. They could also attend various camps for gifted children, where they would socialize with peers from similar fields, but also from different ones, in order to learn something new. We know that very often, even at the beginning, they show special interests and preferences for certain subjects and areas of their learning and development. A large number of children are talented and gifted, but unfortunately this is discovered very late, or not discovered at all. In order for everything to go well, it is also necessary to cooperate with the parents of such children, and to include them in special teams, but also to promote them in the local community and beyond. Gifted children are exceptional in many spheres and areas, and accordingly we must prepare them for lifelong learning.

Keywords: Gifted children, teaching, teaching process, competences.

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PROBLEMSKO UČENJE I INTERAKCIJA

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APSTRAKT

Savremeni obrazovni sistemi naglašavaju potrebu za primjenom nastavnih pristupa koji podstiču aktivno učenje i razvoj kompetencija učenika. Problemska nastava predstavlja jedan od ključnih didaktičkih modela koji omogućava učenicima da kroz rješavanje problema razvijaju kritičko mišljenje i samostalnost [1]. U kombinaciji sa interaktivnim učenjem, koje se zasniva na saradnji i komunikaciji među učenicima, ovaj pristup doprinosi kvalitetnijem usvajanju znanja [2].

Problem ovog rada odnosi se na nedovoljno sistematičnu primjenu problemske nastave u savremenoj školskoj praksi. Cilj rada je analizirati mogućnosti primjene problemske nastave kroz interaktivni pristup u razrednoj nastavi. Metodološki okvir zasniva se na analizi stručne literature i deskriptivnoj metodi, uz prikaz metodičkog primjera. Rezultati ukazuju da kombinacija problemske i interaktivne nastave doprinosi razvoju saradnje, motivacije i aktivnog učenja učenika [3] (OECD, 2019).

Ključne riječi: Problemska nastava, interaktivno učenje, razredna nastava.

UVOD

Savremena nastava usmjerena je ka učeniku i njegovoj aktivnoj ulozi u procesu učenja. Tradicionalni modeli, koji su bili zasnovani na reprodukciji znanja, sve više se zamjenjuju modelima koji razvijaju kompetencije, kreativnost i sposobnost rješavanja problema. U tom kontekstu posebno se ističe problemska nastava kao didaktički model koji omogućava učenicima da uče kroz istraživanje i rješavanje problema [1]. **Problem istraživanja** odnosi se na nedovoljno jasno metodološki definisanu i nedovoljno dosljedno primijenjenu problemsku nastavu u praksi. **Cilj rada** je analiza primjene problemske nastave kroz interaktivni pristup u razrednoj nastavi. Savremene obrazovne politike naglašavaju razvoj ključnih kompetencija 21. vijeka, gdje se posebno ističu saradnja, komunikacija i kritičko mišljenje [3].

Ovo dokazuje da će radna atmosfera ovakvim načinom učenja biti daleko povoljnija, zanimljivija, maštovitija u skladu sa savremenim društvom i dešavanjima koji nas danas prate. Učenici će imati veće interesovanje, samopouzdanje, motivaciju. Nastavnik će umjesto učenika koji su samo učili dobiti saradnike i stvaraoce novih aktivnosti i proizvoda. Stvaraće neke nove ideje izvan definisanih ciljeva i ishoda. Dogovaraće se oko novih modela i načina rada, jer će imati dobar podsticaj unutar tog ambijenta i što je najvažnije nastava će prestati biti klasična.

PROBLEMSKO UČENJE

Problemsko učenje predstavlja inovaciju u nastavi, te predstavlja pristup u učenju koji je usmjeren na učenike, pod rukovodstvom nastavnika-mentora koji je u ulozi voditelja, te učenici moraju preuzeti odgovornost za svoje učenje, određujući ono što im je potrebno znati kako bi bolje razumjeli i upravljali problemom na kojem rade. Učenje se odvija u malim grupama (obično 5-8 članova) te je potrebna saradnja s drugim učenicima. Problem je nešto novo što učenici moraju sami otkriti, te problem s kojim se učenici bave mora biti sličan stvarnom problemu iz života. Problemsko učenje doprinosi razvijanju sposobnosti samostalnog, produktivnog i stvaralačkog mišljenja učenika [4], [5].

Za problemsku nastavu još možemo navesti i da ona predstavlja didaktički model u kojem učenici stiču znanja kroz aktivno rješavanje problemskih situacija. Nastavnik ima ulogu mentora i organizatora procesa učenja. Prema Hmelo-Silver (2013), ovaj pristup omogućava dublje razumijevanje nastavnih sadržaja jer učenici aktivno učestvuju u procesu konstrukcije znanja [1].

U literaturi se najčešće izdvajaju sljedeće faze:

- postavljanje problema (stvaranje problemske situacije),
- formulacija hipoteza,
- analiza i raščlanjivanje problema,
- rješavanje problema,
- evaluacija rješenja.

Ovakva struktura omogućava logičan i sistematičan tok nastavnog procesa [6].

VEZA PROBLEMSKE NASTAVE I INTERAKTIVNOG UČENJA

Interaktivno učenje podrazumijeva aktivnu saradnju između učenika kroz rad u parovima, grupama i timovima. Ovaj oblik učenja doprinosi razvoju socijalnih i komunikacijskih kompetencija. Prema Johnson i Johnson (2017), kooperativno učenje poboljšava akademska postignuća i jača međusobnu odgovornost učenika [2]. OECD (2019) naglašava da savremeni obrazovni sistemi treba da razvijaju kompetencije saradnje, jer su one ključne za buduće profesionalne i društvene uloge učenika [3].

Problemska nastava i interaktivno učenje predstavljaju komplementarne didaktičke pristupe koji se međusobno dopunjuju u savremenom obrazovanju. Dok problemska nastava stavlja akcenat na rješavanje problemskih situacija kroz strukturisane faze, interaktivno učenje omogućava realizaciju tih faza kroz saradnju, komunikaciju i zajedničku konstrukciju znanja među učenicima.

U savremenoj didaktici posebno se naglašava da znanje nije statična kategorija koja se prenosi sa nastavnika na učenika, već proces koji se aktivno gradi kroz socijalnu interakciju. U tom smislu, interaktivno učenje predstavlja osnovni mehanizam realizacije problemske nastave u učionici [2].

Problemska situacija, kao početna faza problemske nastave, dobija svoju punu pedagošku vrijednost tek kada učenici kroz interakciju razmjenjuju ideje, formulišu hipoteze i zajednički dolaze do rješenja. Time se ostvaruje prelazak sa individualnog na kolaborativno učenje, što je jedna od ključnih karakteristika savremene škole [3].

Da bi se jasnije prikazala povezanost ova dva pristupa, može se posmatrati primjer nastavnog časa u kojem se primjenjuje problemska situacija kroz interaktivni rad učenika.

Moja okolina-primjer situacije

Nastavnik učenicima postavlja problemsko pitanje: „Zašto se neka naselja razvijaju u gradove, a neka ostaju sela?“

Ovo pitanje predstavlja **problemsku situaciju** jer nema jedno tačno i odmah očigledno rješenje, već zahtijeva analizu i razmišljanje.

Faza interakcije-formiranje hipoteza

Učenici se dijele u grupe i kroz razgovor dolaze do različitih pretpostavki:

- dostupnost vode i rijeka,
- položaj naselja,
- mogućnosti zapošljavanja,
- razvijenost infrastrukture.

Ovdje interakcija ima ključnu ulogu, jer učenici zajednički oblikuju hipoteze, što predstavlja prvu fazu problemske nastave.

Faze istraživanja i rješavanje problema

Svaka grupa dobija zadatak da analizira jedan aspekt problema. Kroz diskusiju, razmjenu ideja i međusobno argumentovanje učenici dolaze do zaključaka.

Ovaj proces predstavlja **interaktivno učenje u funkciji problemske nastave**, jer se znanje ne usvaja individualno, već kroz saradnju i komunikaciju.

Prezentacija i evaluacija

Grupe prezentuju svoje zaključke, a ostatak odjeljenja postavlja pitanja i daje komentare. Na ovaj način se ostvaruje dodatni nivo interakcije, gdje učenici ne samo da uče kroz rješavanje problema, već i kroz evaluaciju tuđih rješenja. Prema Johnson i Johnson (2017), upravo ovaj oblik strukturisane interakcije značajno doprinosi dubljem razumijevanju nastavnih sadržaja i razvoju kritičkog mišljenja [2].

ZNAČAJ PROBLEMSKE NASTAVE I INTERAKTIVNOG UČENJA

Integracija problemske nastave i interaktivnog učenja omogućava:

- aktivno učešće svih učenika u nastavnom procesu
- razvoj komunikacijskih i socijalnih kompetencija
- jačanje sposobnosti argumentacije i zaključivanja
- povezivanje teorijskog znanja sa stvarnim situacijama.

Na ovaj način učenik postaje aktivni učesnik u procesu učenja, dok nastavnik ima ulogu organizatora i usmjerivača procesa [1].

Značaj problemske nastave i interaktivnog učenja u savremenom obrazovanju ogleda se u njihovoj sposobnosti da transformišu tradicionalni model nastave u aktivan, istraživački i učeniku usmjeren proces. Za razliku od klasične nastave u kojoj učenik uglavnom reprodukuje gotove informacije, problemska i interaktivna nastava razvijaju sposobnost učenika da razmišlja, analizira i samostalno dolazi do rješenja. Ovakav pristup ima poseban značaj u kontekstu razvoja kompetencija 21. vijeka, gdje se od učenika očekuje da posjeduju sposobnosti kritičkog mišljenja, saradnje, komunikacije i rješavanja problema. U tom smislu, škola više ne predstavlja samo mjesto prenošenja znanja, već prostor u kojem se znanje aktivno konstruiše kroz interakciju i zajednički rad učenika [3].

Takođe, problemska nastava doprinosi većoj motivaciji učenika, jer ih stavlja u situacije koje su bliske realnom životu. Kada učenici rješavaju probleme koji imaju smisao i kontekst, njihovo interesovanje za nastavni sadržaj značajno raste. Interaktivno učenje dodatno pojačava ovaj efekat jer omogućava učenicima da uče jedni od drugih, razmjenjuju ideje i razvijaju osjećaj pripadnosti grupi [2]. Poseban značaj ove teme ogleda se i u promjeni uloge nastavnika. Nastavnik više nije jedini izvor znanja, već postaje organizator, usmjerivač i podrška učenicima u procesu učenja. Ova promjena zahtijeva i nova znanja i kompetencije nastavnika, posebno u oblasti planiranja interaktivnih i problemskih aktivnosti.

ZAKLJUČAK

Problemska nastava i interaktivno učenje predstavljaju savremene didaktičke pristupe koji značajno doprinose unapređenju kvaliteta obrazovnog procesa. Njihova primjena omogućava učenicima aktivno učešće u nastavi, razvoj kritičkog mišljenja, sposobnosti analize i donošenja zaključaka, kao i unapređenje komunikacijskih i socijalnih vještina.

Analizom teorijskih osnova i primjera iz nastavne prakse može se zaključiti da problemska nastava, kada se pravilno metodološki organizuje, ima visok pedagoški potencijal. Međutim, njen kvalitet zavisi od jasno definisanih faza, dobre pripreme nastavnika i adekvatne primjene interaktivnih oblika rada.

Interaktivno učenje u ovom kontekstu ima ključnu ulogu, jer omogućava realizaciju problemske nastave kroz saradnju učenika, razmjenu ideja i zajedničko rješavanje zadataka. Na taj način učenici ne usvajaju znanje pasivno, već ga aktivno grade kroz socijalnu interakciju, što doprinosi njegovoj trajnosti i primjenjivosti.

Savremena škola, u skladu sa preporukama međunarodnih obrazovnih politika, treba da teži većoj zastupljenosti ovakvih pristupa u nastavnoj praksi, jer oni odgovaraju potrebama savremenog društva i tržišta rada [3].

Ipak, uspješna implementacija problemske i interaktivne nastave zahtijeva kontinuirano stručno usavršavanje nastavnika, adekvatnu nastavnu opremu i promjenu tradicionalne nastavne paradigme. Nastavnik mora biti osposobljen da planira nastavu koja podstiče istraživanje, diskusiju i aktivno učenje.

Zaključno, možemo reći da kombinacija problemske nastave i interaktivnog učenja predstavlja jedan od najefikasnijih pristupa u savremenom obrazovanju. Ona doprinosi ne samo usvajanju znanja, već i razvoju ličnosti učenika, njihovih sposobnosti i kompetencija potrebnih za život i rad u savremenom društvu.

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PROBLEM-BASED LEARNING AND INTERACTION

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ABSTRACT

Contemporary education increasingly emphasizes the need for teaching approaches that promote active student participation and the development of higher-order cognitive skills. Problem-based learning represents one of the key didactic models that enables students to develop critical thinking and independence through problem-solving activities. In combination with interactive learning, which is based on cooperation and communication among students, this approach contributes to more effective knowledge acquisition.

The problem addressed in this paper refers to the insufficiently systematic application of problem-based learning in contemporary educational practice. The aim of the paper is to analyze the possibilities of implementing problem-based learning through an interactive approach in primary education. The research is based on literature analysis and a descriptive method, accompanied by a pedagogically structured example of classroom practice. The results indicate that the integration of problem-based and interactive learning contributes to the development of collaboration skills, motivation, and active learning among students.

It is concluded that modern education systems should further integrate problem-based and interactive teaching approaches in order to meet the demands of contemporary society and the needs of learners.

Keywords: problem-based learning, interactive learning, primary education, teaching methods, student-centered learning.

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ABSTRACT

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Figure 1. *Vriesea carinata Wawra* seedlings used in the experiment

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