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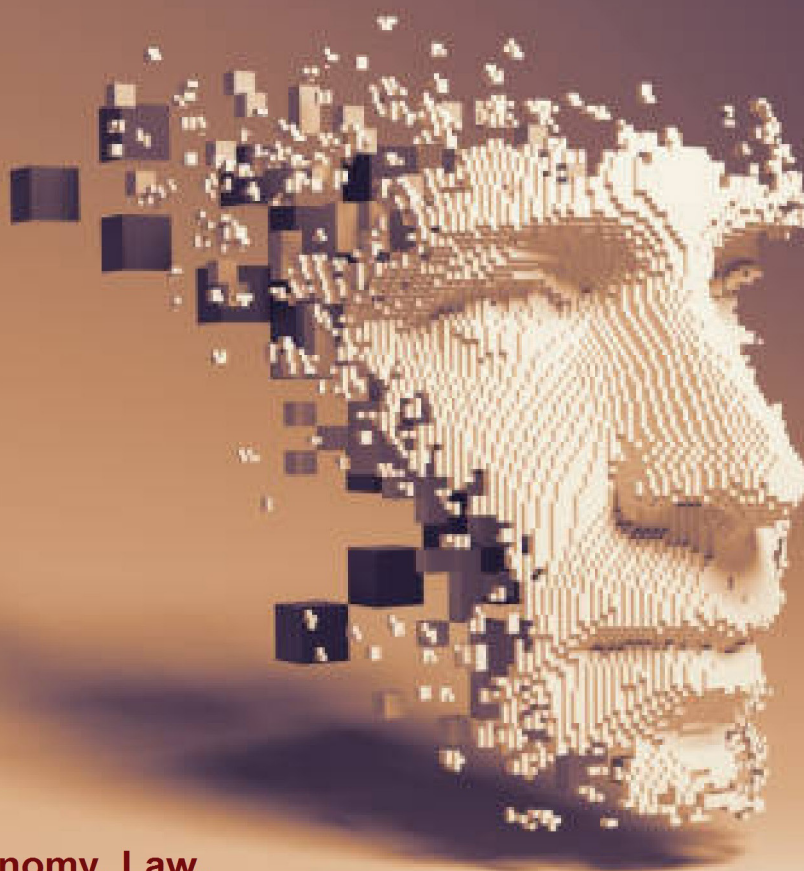
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EXPERIMENTAL STUDY OF THE IMPACT OF INNOVATIVE TEACHING PREPARATION ON THE DEVELOPMENT OF CREATIVITY IN PRIMARY MATHEMATICS TEACHING

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Abstract: Teaching mathematics in the early grades with innovative and problem-based tasks stimulates students' creativity, motivation and interest in learning. The aim of this paper is to examine the impact of innovative teaching methods on the development of creativity in younger school-age students. The research was conducted in the third grade of primary school with 128 students during 30 experimental lessons. The experimental program fully followed the current mathematics curriculum and included 30 experimental lessons. The teaching areas used for the purposes of this research are: Addition and subtraction of numbers up to 100, Multiplication and division of numbers up to 100 and Measurement and measurement. The experimental program included teaching units, aligned with the current curriculum. The teaching units were designed to encourage the development of creativity and application of teaching content through a variety of problem-solving tasks. The tasks on the final tests were structured according to the content of the teaching units from the three teaching areas listed above. Each lesson was implemented by presenting an unusual contextual-research situation that was stimulating in the creative solution of complex mathematical problems (an interesting story with an interesting message), textually relevant scenes from children's films. Students independently solved prepared program-relevant complex mathematical problems. Students were systematically monitored and provided with teacher support when solving problems in conditions of increased curiosity and an emotionally pleasant atmosphere. The structure of the experimental program is based on theoretical foundations and experimental findings. When choosing and constructing a problem-based mathematical task in mathematics, the experimenter respected previous studies on problem-based and research-based teaching, and especially on the requirements that each such task has a hidden unknown that the student should discover through the inventive application of previous thematically relevant mathematical knowledge and through intensive cognitive and creative activity. The results show that the use of problem-based tasks in teaching significantly stimulates creativity, flexibility of thinking and motivation of students for learning mathematics. The results of the experimental program indicate its potential as a practical support for teachers in stimulating creative thinking in younger school-age students.

Keywords: creativity, problem-solving tasks, creative mathematical problem-solving test, experimental teaching

Field: Social Sciences

1. INTRODUCTION

Mathematics, as a scientific discipline and intellectual field, is at the very top of the hierarchical list when it comes to the presence of creativity in its activities or results (Mihajlović, 2023, Vasiljević, 2024). Problem solving from an early age encourages originality, flexibility, fluency and elaboration in students (Filek, 2021). Research shows that open-ended problem tasks, which allow for multiple solutions and reasoned discussion, significantly contribute to the development of mathematical creativity (Becker, 1997, Svitek, 2022). According to Kwon, Park (2020), mathematical creativity is reflected in the creation of new knowledge and flexible problem solving. Dejić, Čebić, and Mihajlović (2009) point out that younger children show a greater degree of creativity than older ones, which confirms the importance of early stimulation of creativity in mathematics teaching. The definition of an open-ended problem, however, varies from researcher to researcher. Takahashi (Takahashi, 2001 according to Ja and Fon 2005, p.1). Closed-ended tasks in primary education allow reproduction of algorithms and checking students' basic knowledge, while open-ended tasks enable discussion, strategy selection, and argumentation of solutions (Nikolić, 2025). Others believe that open-ended tasks enable the development of investigative and creative thinking (Svitek, 2022).

Mathematical creativity is usually described as insight or "choice" (Poincare, 1948, according to Sriraman, 2004). Kwon, Park, and Park (2006) proposed two main criteria in defining mathematical creativity: the creation of new knowledge and the flexible ability to solve problems.

Modern research confirms the importance of these components and further emphasizes the role of the teaching approach in the development of creativity. Thus, Leikin and Sriraman (2022) point out

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that different problem-solving strategies directly develop mathematical creativity. Research conducted by Elgrable and Leikin (2021) shows that creativity in mathematics is closely related to the level of expertise in problem solving. Furthermore, a systematic review by Sipahi and Bahar (2025) confirms that open-ended tasks and research activities have a significant impact on the development of mathematical creativity in students. Similarly, Lu, Kaiser, and Zhu (2025) emphasize the role of mathematical modeling and encouraging creative thinking. Also, Mann and Chamberlin (2025) indicate that the application of modern teaching strategies significantly improves students' creativity in elementary mathematics education.

Recent studies provide additional support and deeper insights into the development of mathematical creativity. Leikin and Elgrably (2022) distinguish between strategy creativity and outcome creativity, highlighting the importance of multiple solution paths in open-ended tasks. Ye, Ng, and Leung (2024) emphasize the role of innovative teaching approaches, such as programming-based mathematical activities, in fostering creative engagement. Furthermore, Li and Kim (2024) point to the cognitive and neurological foundations of mathematical creativity, linking it to complex and flexible problem-solving processes. Ron-Ezra and Levenson (2025) confirm that open arithmetic tasks encourage diverse strategies and enhance creativity even among students with learning difficulties. Additionally, Genç et al. (2025) highlight the strong connection between mathematical communication, thinking, and creativity as mutually reinforcing components.

mathematical creativity is a complex and multidimensional construct that includes originality, flexibility, fluency, and the ability to generate and justify multiple solutions. Contemporary research consistently shows that open-ended tasks, problem-based learning, mathematical modeling, and innovative teaching approaches play a crucial role in fostering creativity from an early age. Therefore, integrating such approaches into mathematics education represents a key step towards developing students' higher-order thinking skills and creative potential.

2. METHODOLOGICAL FRAMEWORK OF THE RESEARCH

The subject and problem of the research is an experimental study of written teaching materials in elementary mathematics teaching with a focus on the influence of problem tasks on the development of creativity in younger school-age students. The problem is to determine the effect of these materials on creative thinking and school success.

The aim of the experimental research is to determine the impact of innovative teaching methods on the development, motivation and interest in mathematics, through a test of creative mathematical problem solving.

Research tasks arise from the set research goal :

1. To determine the impact of an experimental program (written preparations) on the development of creativity in younger school-age students in elementary mathematics instruction.
2. To determine the difference in creativity development between the experimental and control groups.

The main hypothesis of the research is : Experimental application of problem-based teaching methods has a positive effect on the development of creativity in younger school-age students.

Auxiliary hypotheses were put forward :

H1.1. The difference in the results of the creative test between the experimental and control groups is statistically significant after the application of innovative preparations.

X1.1. Students in the experimental group will achieve better results in general achievement than the previous grade.

Sample and research variables

The research was conducted in the 2024/2025 school year in a total of 6 classes of the third grade of primary school (128). The experimental group consisted of 64 students, and the control group consisted of 64. The remaining three classes (64 students). The experiment lasted from the beginning of November to mid-December 2024, a total of 30 experimental classes.

Methods and instruments used in this research: creative mathematical problem-solving test, arithmetic mean, Mann – Whitney U test and Chi-square test.

3. RESEARCH RESULTS

Table 1. Results of the E-group and K-group on the creative mathematical problem-solving test

	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
1. Initial test (test creative solutions mathematical problem)	2021,000	4101,000	-0.130	0.897
2.Final test (test) creative solutions mathematical problem)	1652,000	3732,000	-1.908	0.046
general success previous class	1673,000	3753,000	-2,102	0.036

Source: author's own research

Hypothesis H1.1. On the initial test of creative mathematical problem solving, no significant difference was found between the groups ($r = 0.897$). The difference in the results of the creative test between the experimental and control groups is statistically significant after the application of innovative preparations with problem tasks and is confirmed. Mann-Whitney U test for the 2nd Final Test (creative mathematical problem solving test) ($U = 1652.000$, $Z = -1.908$, $p < 0.05$; $p=0.046$). Since $p < 0.05$, we can conclude that there is a statistically significant difference between the test of creative mathematical problem solving) in relation to the groups (1-Control group/2-Experimental group). Mean Rank 2. The creative math problem solving test for the 1-Control group (58, 31) is statistically significantly different from the Mean Rank for the 2-Experimental group (70, 36). The experimental group has a statistically significantly higher rank. Based on the above, we can conclude that the hypothesis H1.1 is confirmed (not rejected) the difference in the results of the creative test between the experimental and control groups is statistically significant after the application of innovative preparations with problem tasks.

Hypothesis H1.2. Students in the experimental group will achieve better results in general achievement in the previous grade is confirmed.

Table 2. Comparison of control and experimental groups based on overall success

Test	Mann Whitney U	Wilcoxon W	Z value	p- value (Asymp.Sig. 2-tailed)
1.Initial test (creative problem-solving test)	2021,000	4101,000	-0.130	0.897
2. Final test (creative problem-solving test)	1652,000	3732,000	-1.908	0.046
Overall performance in the previous grade	1673,000	3753,000	-2,102	0.036

Source: author's own research

The results of the Mann-Whitney U test indicate that there is a statistically significant difference in the overall success of students between the experimental and control groups ($U = 1673.000$, $Z = -2.102$, $p < 0.05$; $p=0.036$). The obtained mean rank results show that students in the experimental group achieve better overall success (Mean Rank = 70.36) compared to students in the control group. (Mean Rank =58.64). The application of the experimental program had a positive impact on the overall academic achievement of students, which indicates an integral indicator of academic functioning. If we compare individual grades in a particular subject, overall success is a sensitive category to changes in teaching approaches that stimulate learning, motivation and interest of students. The results of the experimental group as a consequence of the application of innovative teaching methods, enabled students are more active in class and develop the components of creative thinking and a positive attitude towards learning .

4. DISCUSSION

The results confirm that the use of innovative problem-based teaching methods significantly stimulates the creativity of younger students. The experimental group showed greater progress on the creative problem-solving test and better overall success, which supports previous research (Mihajlović, 2012). These results indicate the long-term positive effects of the use of open and closed problem-based teaching methods in mathematics teaching, as they stimulate originality, flexibility and elaboration in students' thinking. The methodological approach also shows that creativity can be systematically

developed through structured teaching methods. These findings indicate that the application of innovative teaching methods that involve a variety of problem-based tasks not only affects the acquisition of teaching material, but also the development of cognitive processes such as originality, flexibility and elaboration. It is particularly important that such approaches encourage students to approach the problem from multiple angles, which contributes to a deeper understanding of mathematical content. Also, the observed progress can be attributed to the increased level of student motivation, because problem-based tasks introduce an element of challenge and research into the teaching process. In this way, students do not remain passive recipients of knowledge, but become active learners in its construction. All of the above indicates that problem-based tasks represent a significant didactic tool that can contribute not only to better student achievement, but also to the development of their creative potential through innovative teaching methods.

5. CONCLUSION

Experimental application of problem-based preparation led to statistically significant increases in creativity and overall academic achievement. These results indicate the need for teachers in elementary mathematics education to use innovative and problem-based tasks as a regular part of the teaching. Also, the regular use of innovative teaching methods permeated with a variety of problem-solving tasks encourages the development of critical thinking, analytical skills and independence of students. When students encounter tasks that do not have a simple or standardized answer, they learn how to consider different approaches, evaluate possible solutions and draw their own conclusions. In addition, this approach increases motivation for learning because students see the direct application of mathematics in everyday life, which makes teaching more interactive and meaningful. Given these positive effects, the integration of innovative methodologies such as project-based learning and small group work can further improve academic success, but also the development of creativity, which is crucial for preparing students for more complex tasks in the future. Teachers should therefore plan lessons that stimulate exploration, experimentation, and discussion, creating an environment in which learning mathematics is both challenging and fun.

In conclusion, the consistent implementation of problem-based and innovative teaching strategies not only enhances academic achievement and creativity but also fosters essential 21st-century skills such as critical thinking, problem-solving, and independent learning. By creating a classroom environment that encourages exploration, collaboration, and meaningful engagement with mathematical concepts, teachers can prepare students to approach complex challenges with confidence and adaptability. Therefore, incorporating these methodologies is not just a way to improve immediate learning outcomes—it is an investment in developing lifelong learners who are capable of applying knowledge creatively and effectively in diverse real-world contexts.

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PERCEPTION OF THE STATE OF THE ENVIRONMENT IN NIŠ AMONG MEMBERS OF GENERATION Z AND THE ROLE OF DIGITAL CHANNELS IN SHAPING THEIR ENVIRONMENTAL AWARENESS

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Abstract: Informing every person is one of the most important segments that contribute to the development and deepening of awareness of the importance of environmental protection. With adequate information, the process of developing environmental awareness is shaped to the extent that the individual sees himself as an active social factor in an organized social community. Consequently, the role of man in environmental processes is increasing, because the amount of information on environmental issues is growing every day. Every individual, especially young people, by receiving timely and accurate environmental information, develops environmental awareness, which further leads to the desired results in environmental conservation. Sustainable development is the basic development concept of almost all countries today. As such, it requires that future generations have at least the same quantity and quality of resources as current generations. In order for any country to develop sustainably, it is necessary for citizens to have a developed environmental awareness. What also characterizes modern society is the process of digitalization. Members of Generation Z are digitally literate. They receive information primarily digitally, including information about the need to preserve the environment, sustainable development, and environmental disasters, which can have a major impact on the development of their environmental awareness.

The aim of this paper is to analyze the level of awareness of members of Generation Z about the state of the environment in the city of Niš, as well as to identify digital communication channels through which they receive useful messages related to the environment. The importance of identifying a specific channel or channels is reflected in the fact that public policy makers or brands that want to contribute to environmental protection through social marketing send their messages precisely through that/those channels. In order to achieve the aim of the paper, 102 members of Generation Z from the city of Niš were surveyed. The collected data was processed in the SPSS software package and the results obtained showed that in the eyes of members of this generation, the level of environmental quality is not at a satisfactory level, and that information related to the environment comes to them primarily through social networks.

Keywords: environment, information, environmental awareness, digital channels, social networks

Field: Economics

1. INTRODUCTION

The destruction of natural resources has experienced a significant increase, especially after the Industrial Revolution as a result of increased urbanization (Pinho et al., 2009). From an economic perspective, the process of industrialization has led to an improvement in the quality of life, however, with intensive industrial development, a wide range of pollutants and harmful chemicals have emerged, which have led to the degradation of natural resources (Samanta et al., 2002).

The everyday activities of modern man have caused climate change and the consequences of which are increasingly being observed at a global level (Rubio-Salcedo et al., 2017). It is precisely these continuous changes that lead to the deterioration of the physical, chemical and biological properties of the environment. Such a changed environment has a negative impact on people (Marcilio & Gouveia, 2007).

The insufficiently developed level of awareness of citizens about the need for environmental protection is a consequence of:

1. insufficient representation of this type of education in plans and programs, starting from preschool institutions, up to higher education institutions;
2. lack and insufficient availability of teaching materials
3. insufficient availability of informal forms of education in a given area
4. lack of an information system
5. lack of a high general educational level and low living standards of the population (Nacionalni

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program zaštite životne sredine, n.d.).

Considering that everything starts with the individual, informing members of Generation Z, but also members of Generation Alpha from an early age is of great importance. Their educators in primary and secondary schools, as well as later higher education institutions, play a major role in this process. However, in addition to education in schools, an extremely important medium for members of these generations are digital communication channels. What characterizes members of these younger generations is a short attention span and the need to convey information concisely and in the shortest possible time. This is precisely what digital communication channels, especially social networks, enable (Vučenović & Stojanović, 2004; Sun & Xing, 2002]. The works of numerous researchers have shown that information transmitted via social networks, blogs, websites, paid advertisements, messages from influencers and celebrities is of great importance when it comes to the behavior of members of Generation Z towards the environment (Sun & Xing (2022), Luqman et al. (2021) and Confetto MG et al. (2023). Also, many brands today, in order to be philanthropic and to bring the importance of the environment closer to the younger generation, implement commercial campaigns in which they talk about the importance of the environment, as well as social marketing campaigns, which do not have a commercial effect. In the Republic of Serbia, such campaigns are often implemented by Telekom Srbija, and the campaign "No Species Dies Alone" was particularly notable, while at the global level the Patagonia brand stands out in particular and their campaign "Don't Buy This Jacket" (Vučenović & Stojanović, 2004).

Informing about environmental protection is a complex, specific and unique process, which aims to ensure the acquisition of elementary concepts and knowledge, the development of individual and collective environmental awareness and adequate forms of behavior for the successful protection and preservation of the living and working environment (Klemenović, 2004). In addition to the aforementioned authors, who in their research came to the conclusion that digital channels are the basis for educating younger generations about the state of the environment, there are also works that primarily point to the importance of formal education, and that digital channels can only be used as a support for formal education (Hajj-Hassan et al., 2024; Syamsiah et al., 2024).

The analysis of relevant documents has imposed the need for new research to determine the attitudes of young generations, who will be the carriers of the development of the city of Niš in the future (Sekretarijat za zaštitu životne sredine grada Niša, 2017). What is also worth emphasizing is that when it comes to Generation Z, care must be taken as to how messages are transmitted and through which channels. We have already mentioned that the attention span of Generation Z, compared to Millennials, is significantly shorter, and numerous studies have shown that it is particularly important for them that the key part of the message is conveyed in the first three seconds of a video, speech, or even written text. If this is not done in this way, they will not be interested in listening to the information that is conveyed to them to the end. This certainly applies when it comes to education in schools. Educators of the younger generation must immediately, at the beginning of the presentation, awaken the attention of their students with important facts, because otherwise, they will not be interested in listening to what the educator tells them in the rest of the presentation (Stanković et al., 2024; Ilić Krstić & Milutinović, 2026).

The aim of this paper is to analyze the attitudes of members of Generation Z in the city of Niš about the environment, as well as to identify the digital communication medium through which they obtain information about the state of the environment and the need to improve environmental awareness.

2. MATERIALS AND METHODS

Data collection for the research was carried out through a survey. The survey questions in the paper were defined based on the analysis of the works of Sun & Xing (2022), Luqman et al. (2021) and Confetto MG et al. (2023). The survey of respondents was conducted from January to March 2026. A sample of a total of 103 members of Generation Z was included. The main criteria for selecting respondents were that the respondents resided in the territory of the city of Niš, as well as that they were born between 1997 and 2012.

The survey questionnaire used defined 20 questions, divided into four groups. The first group of questions related to the demographic characteristics of the respondents regarding gender, year of birth and current level of education. The second group of questions in the questionnaire related to the respondents' views on the state of the environment and the respondents' awareness of the problems facing humanity when it comes to the environment. The third group of questions aimed to provide data on how information on the state of the environment and the need to improve environmental awareness reaches members of Generation Z. The fourth part of the questions related to the views of members of Generation Z on the importance of digital communication channels for improving environmental protection.

The respondents were informed that the survey was anonymous and that they were taking part in the survey voluntarily. The respondents were not limited by a specific time interval in which to complete the survey. Respondents were asked to try to give as honest answers as possible, and were informed that the survey results would be used exclusively for scientific research purposes. Respondents expressed their views on environmental protection issues using a descriptive method.

The results of the conducted research were obtained by processing and analyzing the data obtained from the survey. The results were presented in tables and graphs using the SPSS program. There were no invalid questionnaires, which means that 100% of the initial sample was processed. The tests used were the contingency table, the chi-square test, the Cramer's V test, as well as correlation and multiple regression analysis.

3. RESULTS AND DISCUSSION

Analysis The sample is relatively balanced according to the gender of the respondents, with a slight advantage of female respondents. When it comes to the age structure of the respondents covered by the survey, there is a dominance of respondents aged 21–23, whose participation is 40.2%, while the lowest participation is of respondents aged 24–26, who participate with 26.5%. The largest part of the respondents are students, i.e. the participation of undergraduate and master's students is 72.5%, while only 27.5% of the survey participants attend high school.

Members of Generation Z, who reside in the city of Niš, are aware of the presence of environmental problems and insufficiently developed environmental awareness, both in the city of Niš, in the Republic of Serbia and globally. This is shown by the results of their answers to the second group of questions asked in the survey. As many as 78.4% of respondents assess the state of the environment as bad or very bad, which can be seen in Table 1, while only 5 respondents assess the state of the environment as good.

Table 1. Crosstabulation - Gender * Environmental perception

Gender	Poor/Very poor	Other	Total
Male	34	12	46
Female	46	10	56
Total	80	22	102

Source: Authors

Table 2 shows the results of the H2 test, which aimed to show us whether there is an influence of gender when it comes to the perception of the state of the environment among members of Generation Z. As the results from the table show, there is no statistical relationship between gender and the perception of the state of environmental quality ($\chi^2(1) = 2.11$, $p = 0.146$).

Table 2. Chi-Square Tests

Test	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.11	1	0.146
Continuity Correction	1.78	1	0.182
Likelihood Ratio	2.13	1	0.144
Fisher's Exact Test	*	*	0.173
N of Valid Cases	102		

Source: Authors

The effect size, measured by Cramer's V ($V = 0.144$), suggests a weak association between the observed variables, as shown in Table 3, which presents the results. All these results indicate that environmental awareness is evenly distributed between the sexes when it comes to Generation Z in the city of Niš.

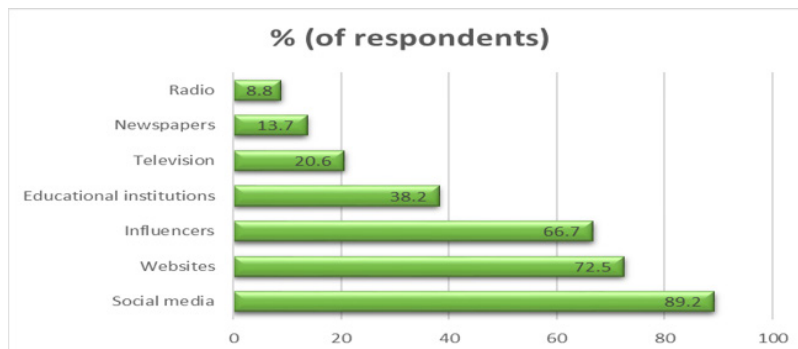
Table 3. Symmetric measures

Measure	Value	Approx. Sig.
Phi	0.144	0.146
Cramer's V	0.144	0.146
N of Valid Cases	102	

Source: Authors

The above tests were also applied to other demographic variables, including environmental perception and environmental awareness. All of them showed that there were no significant statistical differences in the perception of the environment by members of Generation Z of different ages or levels of current education. When it comes to environmental information channels, social networks are dominant among Generation Z, as shown in Chart 1.

Chart 1. Sources of information for Generation Z about the environment in the city of Niš



Source: Authors

As can be seen from the graph, for this question, respondents had the opportunity to choose more than one answer and as many as 89.2% of respondents indicated that social networks are the basis for their information about the environment. There is also a high participation of websites, which also represent a digital communication channel, while the smallest number of respondents of this generation indicated that they receive information about the environment through the radio. Table 4 below shows the distribution of the use of social networks as the main source of information about the environment by age.

Table 4. Crosstabulation - Age * Use of Social Media as information source

Age group	Uses social media	Does not use	Total
18-20	32	2	34
21-23	38	3	41
24-26	21	6	27
Total	91	11	102

Source: Authors

The results from Table 4 clearly show that almost all respondents gather information about environmental problems through social networks, especially the youngest group of respondents, Generation Z. Due to the presence of slight differences, Pearson's Chi-Square Tests of independence were conducted, which indicated a statistically significant difference between the age of the respondents and the use of social networks as the primary source of information ($\chi^2(2) = 6.87, p = 0.032$).

Table 5. Chi-Square Tests (Age * Use of Social Media as information source)

Test	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.87	2	0.032
Likelihood Ratio	7.12	2	0.028
Linear-by-Linear Association	5.94	1	0.015
N of Valid Cases	102		

0 cells (0.0%) have expected count less than 5.

Source: Authors

The effect size of the observed differences was measured by Cramer's V test ($V = 0.259$), and it indicates that there is no extremely high deviation between the observed variables. The obtained results clearly show that younger respondents, between 18-23 years of age, rely more on social networks as the main source of information about the environment compared to older members of Generation Z from the territory of the city of Niš.

Table 6. Symmetric Measures (Age * Use of Social Media as information source)

Measure	Value	Approx. Sig.
Cramer's V	0.259	0.032
N of Valid Cases	102	

Source: Authors

Considering that the surveyed members of Generation Z indicated that social networks were the most important digital marketing communication channels, but also indicated that there is a high level of trust in information obtained through digital channels, Table 7 establishes the correlation between these variables as dependent and environmental awareness as an independent variable.

Table 7. Correlations analysis

Variables	1	2	3	4	Sig. (2-tailed)	1	2	3	4
1. Frequency of social media use	1				1.	—			
2. Following influencers	.58**	1			2.	.000	—		
3. Trust in digital channels	.61**	.55**	1		3.	.000	.000	—	
4. Environmental awareness	.69**	.54**	.71**	1	4.	.000	.000	.000	—

N = 102. $p < 0.01$

Source: Authors

The presented Pearson correlation results show that there is a statistically significant positive relationship between all variables observed ($p < 0.01$). The analysis yielded an extremely strong positive correlation between trust in digital channels and environmental awareness ($r = 0.71$), suggesting that higher levels of trust are associated with greater awareness. Also, frequency of social media use ($r = 0.69$) and influencer following ($r = 0.54$) show moderate to strong positive correlations with environmental awareness.

Table 8. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.740	.550	.530	.480

Source: Authors

In addition to correlation, multiple regression analysis was applied in the paper. The results of this analysis show that the model is statistically significant, as can be seen from Table 9 ($F(3, 98) = 39.82$, $p < 0.001$), which confirms that the selected predictors together contribute to explaining the environmental awareness of members of Generation Z in the city of Niš. The model explains 55% of the variance in environmental awareness ($R^2 = 0.55$), which indicates a high level of explanatory power.

Table 9. ANOVA

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	27.51	3	9.17	39.82	.000
Residual	22.57	98	0.23		
Total	50.08	101			

Source: Authors

Among the predictors that have an impact on the environmental awareness of Generation Z in the city of Niš, the use of social media has the strongest effect as can be seen from Table 10 ($\beta = 0.48$, $p < 0.001$), followed by influencers ($\beta = 0.31$, $p < 0.001$) and websites ($\beta = 0.19$, $p = 0.016$).

Table 10. Coefficients

Model	Unstandardized B	Std. Error	Standardized Beta	T	Sig.
(Constant)	0.84	0.21	—	4.00	.000
Social media use	0.48	0.08	0.48	6.12	.000
Influencers	0.31	0.08	0.31	4.02	.000
Websites	0.19	0.08	0.19	2.45	.016

Source: Authors

The results obtained showed that members of Gen Z who were surveyed are both very aware of environmental problems and interested in solving them, but also that information that has an impact on raising environmental awareness primarily comes to them through digital channels, dominated by social networks.

4. DISCUSSION

A quality environment is a prerequisite for the survival of humanity. Without taking care of the quality of natural resources and taking measures to improve the quality of the environment, society cannot develop sustainably (Samanta et al., 2002; Rubio Salcedo et al., 2017). What is particularly important is that younger generations, on whom the world rests, are aware of this, and who should ensure progress in the future, but while respecting environmental standards and leaving as little ecological footprint as possible.

As part of this work, a survey was conducted among Generation Z, in which respondents from the territory of the city of Niš, who belong to this generation by age, participated. After processing the data, what was determined was that the respondents are very aware of the presence of environmental problems and the need to solve them, which certainly indicated a high level of developed awareness of this young population. However, what is extremely important is that solving environmental problems requires constant education, constant information, not only of the younger population, but of the entire population, in order to direct them towards environmentally correct behavior, which will leave the smallest possible ecological footprint.

Through the research conducted in the paper, it was found that 89.22% of respondents of generation Z, from the territory of the city of Niš, collect information about environmental problems and desirable behavior in order to mitigate or solve them precisely through social networks, in addition, information that they collect by reviewing websites, as well as recommendations they receive from influencers, are also important for them, while formal education (primary and secondary schools and colleges) was only in fourth place as a source of information. These results showed the almost dominant influence of social networks and generally digital communication channels when it comes to members of gen Z. This result was expected, because members of this generation want to receive useful information in a short time and have a lower level of attention to listen for a long time compared to their predecessors, the Millennials (Vučenović & Stojanović, 2024; Sun & Xing, 2022).

The tests conducted, which were further implemented in the work, further supported the fact that the role of social networks is greater compared to other digital and non-digital communication channels when it comes to informing and directing Gen Z in Niš towards environmentally friendly behavior. The results obtained are in line with the results of researchers Sun & Xing (2022), Luqman et al. (2021), Confetto MG et al. (2023) and Vučenović & Stojanović (2024).

Hajj-Hassan et al. (2024) and Syamsiah et al. (2024) in their work, as already presented in the previous text, came to opposite results, i.e. indicated the dominance of formal education over digital channels, when it comes to the environment. However, what is worth emphasizing is that they also emphasized in their work that digital channels should be used as a support for formal channels and that only their combination can contribute to strengthening environmental awareness. Based on the results of the research in this work, when it comes to members of Gen Z in the city of Niš, it can be emphasized that they should primarily be sent messages via digital channels, especially social networks, and that all other channels, including formal education, should be as active as possible in order to solve or mitigate the accumulated environmental problems. The results obtained are useful for economic policy makers, educational institutions, as well as for brands, because they indicate through which channels they should communicate with Gen Z in Niš and convey environmental messages. For the state and local government units, as well as educational institutions, the results obtained indicate that social networks and other

digital channels must include in their strategy and campaigns aimed at improving the quality of the environment. For brands, the results obtained show that high respect for environmental problems should be communicated through their campaigns on social networks because members of Gen Z will appreciate this, regardless of whether they are commercial campaigns or social marketing campaigns (which do not have a commercial effect). Like most other empirical research, this research also faced certain limitations. First of all, the sample size may represent a disadvantage, which may lead to the generalization of the results. The survey questionnaire, which was applied in this work, always carries the risk of subjectivity, i.e. the expression of socially desirable behavior by the respondents. The recommendation for future researchers on this topic is to investigate the long-term effects of different communication channels (through which messages about the environment and desirable behavior are transmitted to Gen Z) by including a larger number of respondents, which will help create an adequate communication strategy with this younger population and enable their guidance towards environmentally desirable behavior.

5. CONCLUSION

During the period of industrial development of civilization, the environment was an issue that was not given enough attention because economic prosperity was the only concern. This behavior led to the degradation of natural resources, and in recent decades, great attention has been paid, both at the local and national levels, and at the global level, to the problem of protecting and improving the quality of the environment, all with the aim of ensuring the survival of human civilization and ensuring that all countries in the world develop sustainably.

In order to solve the problems of environmental degradation and improve its quality, it is necessary to constantly inform and educate citizens, in addition to other measures implemented by the state. It is especially important to constantly inform and educate the younger population, in order to instill in them the attitude that they should leave as small an ecological footprint as possible. Generation Z (born between 1997 and 2012), from the territory of the city of Niš, whose attitudes were analyzed in this paper, showed that they are very aware of the state of the environment. Members of this generation emphasized that it is important for them to receive information about the state and quality of the environment, as well as about the actions that need to be taken in order to leave the smallest possible ecological footprint, through digital channels, which they are primarily focused on as a generation. Information from social networks is especially important for them, which is clear and concise and on the basis of which they can direct their future activities with the aim of protecting and improving the quality of the environment.

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LEVEL OF DEVELOPMENT OF IMAGINATION IN PRESCHOOL CHILDREN

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Abstract: The study examines the level of imagination in preschool children using both quantitative indicators (mean values and standard deviations) and percentage distribution across levels. This approach enables a more comprehensive and objective presentation of the results by combining descriptive statistics with an analysis of sample distribution.

The findings indicate that a medium level of imagination is the most prevalent, with nearly half of the children (47%) falling into this category (mean = 0.467, SD = 0.499). This suggests a relative homogeneity within the group, while also indicating variability in individual outcomes. A low level of imagination is observed in approximately 20% of the children (mean = 0.200, SD = 0.400), which may point to the need for additional pedagogical support and the stimulation of creative abilities. A high level is identified in 33% of the children (mean = 0.333, SD = 0.471), indicating that a substantial proportion of the sample demonstrates well-developed imaginative skills already in the preschool period.

The gender-based analysis reveals both similarities and clear differences. The proportion of children with a medium level of imagination is identical for girls and boys (46.7%), suggesting a similar baseline distribution of imaginative development across genders. However, differences are observed at the extremes: a low level is more common among boys (26.7% compared to 13.3%), whereas a high level is more prevalent among girls (40% compared to 26.7%). These results may be interpreted as indicative of differences in the pace or patterns of creative development, influenced by both individual characteristics and socio-pedagogical factors.

A comparison of four key indicators of imagination—productivity, originality, flexibility, and imagery—provides a more fine-grained differentiation of creative behaviour. The data show that girls outperform boys in productivity (4.8 vs. 4.2), flexibility (4.5 vs. 3.8), and imagery (4.9 vs. 3.5), which may be associated with richer internal representations and a greater ease in combining ideas. Boys, in turn, demonstrate a slight advantage in originality (3.9 vs. 3.7), which may indicate a tendency toward more atypical or unconventional solutions in certain tasks.

In conclusion, the results highlight the importance of differentiated pedagogical approaches aimed at fostering imagination in the preschool years. Accounting for individual differences and gender-related characteristics enables more targeted planning of educational activities. This is a crucial factor in supporting children's cognitive, emotional, and creative development from the earliest stages of education.

Keywords: *imagination, preschool children, originality, flexibility, thinking.*

Field: Humanities

1. INTRODUCTION

Imagination represents a fundamental psychological process associated with the creation of new images and ideas based on prior experience. During the preschool period, it plays a leading role in the development of thinking, language, and creativity. This developmental stage is considered sensitive for the development of imagination, as children's thinking is not yet constrained by stereotypes and social norms. Imagination is grounded in the child's experiences, with richer experience serving as a prerequisite for a higher level of its development (Стойков, 2025).

In the course of its development, imagination evolves from reproductive to creative and voluntary forms. The child begins to generate new images and original combinations, which reflects increasing cognitive activity and independence (Лазарова, 2022). Contemporary research emphasizes that imagination is not entirely detached from reality but is formed through its transformation and interpretation (Harris, 2022).

In preschool age, imagination is regarded as one of the major developmental acquisitions, playing a central role in the development of thinking, language, and social behavior (Almazova et al., 2023). In this process, the cultural and social context is of essential importance. Children who are encouraged to tell stories, engage in dramatization, and share their creative ideas with peers and adults develop richer imagination and better communicative skills (Russ, 2018).

Play occupies a particularly important place in the development of imagination, as it is considered the primary environment for its formation. Through socio-dramatic (role) play, the child:

- reenacts social roles;
- develops symbolic thinking;
- acquires social experience.

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Play stimulates the creation of imaginary situations and functions as a key mechanism for cognitive development (Георгиева, 2025; Hashim et al., 2024). Additionally, both free and structured play with representational materials (e.g., dolls, construction sets, and art materials) is closely associated with enhanced imagination and cognitive skills (Edwards et al., 2020; McLellan et al., 2021).

Home-based educational activities, such as reading and storytelling, also make a significant contribution to the development of imagination, supporting both cognitive and imaginative growth in children (Soto-Calvo et al., 2021). At the same time, digital technologies are gradually entering preschool education. Research indicates that carefully selected interactive applications and games can stimulate imagination and creative expression. However, excessive use of passive digital media may limit independent thinking (Plowman et al., 2022).

The development of imagination is influenced by a number of factors, including:

- the pedagogical approaches employed;
- the presence of a stimulating educational environment;
- the diversity of materials and activities.

In this context, the teacher plays a key role through the selection of methods and activities tailored to the child's age and individual characteristics (Кирева, 2024).

The main objective of the present study is to determine the levels of imagination development in preschool children, as well as to analyze gender differences in the manifestation of imaginative abilities across key indicators—productivity, originality, flexibility, and imagery.

To achieve this objective, the following research tasks are formulated:

1. To examine the level of imagination (low, medium, high) in children aged 4–5 years.
2. To analyze the distribution of the examined children across imagination levels using mean values and standard deviations.
3. To determine the percentage distribution of imagination levels within the sample.
4. To identify differences in imagination levels between girls and boys.
5. To conduct a comparative analysis of gender differences across the main indicators of imagination—productivity, originality, flexibility, and imagery.
6. To interpret the obtained results in light of the characteristics of psychological development in preschool age.

The subject of the present study is the characteristics and level of imagination development in preschool children, as well as its structural components (productivity, originality, flexibility, and imagery), examined in the context of gender differences.

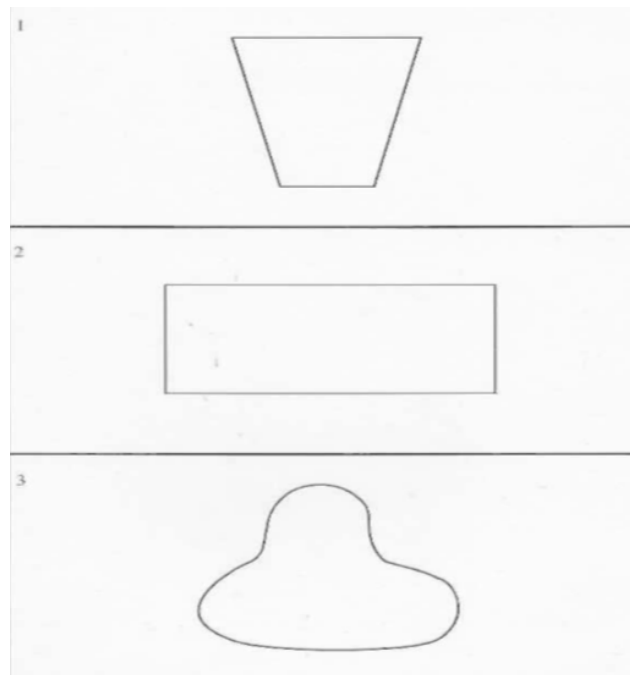
The sample was formed through random selection from the general population and consists of 30 children aged 4–5 years attending kindergarten, including 15 girls and 15 boys. All children demonstrate typical (normal) development.

2. MATERIALS AND METHODS

The study employed the projective technique “What Does This Resemble?” developed by Pavlova and Rudenko, with the aim of assessing the following indicators: figurative thinking, flexibility of imagination, originality, and productivity.

The child participating in the study is successively presented with three cards (Fig. 1) containing images. The instruction provided is: “Look at the picture and say what it resembles.”

Figure 1. Stimulus material of the projective method “What Does This Resemble?”.



Source: Павлова, Руденко, 2008.

The assessment of performance is conducted on the basis of four primary indicators. The first indicator is productivity, measured by the number of responses generated. The second indicator is originality, reflecting the degree of unusualness and non-standard nature of the proposed associations. The third indicator is flexibility, expressed through the diversity of categories employed. The fourth indicator is imagery, characterized by the level of detail and descriptiveness in the responses.

The evaluation is carried out using a three-point scale structured across three levels. The low level is characterized by the child's lack of understanding of the task or by the generation of only one association per drawing, and is scored with 0 points. The medium level includes cases in which the child produces between six and eight associations in total, providing at least two associations per drawing; this level is scored with 1 point. The high level is characterized by the generation of no fewer than nine associations, respectively at least three per drawing, and is scored with 2 points.

3. RESULTS

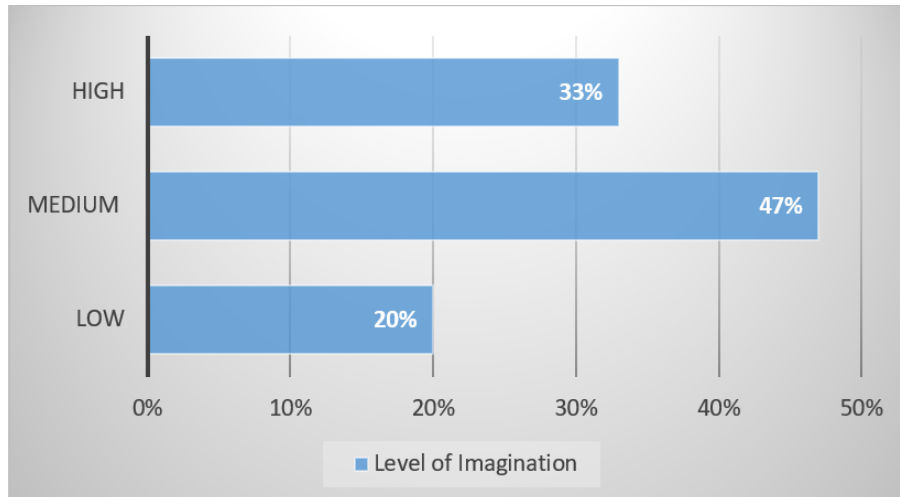
Table 1 presents the mean values and standard deviations of imagination across levels, while Figure 2 illustrates the percentage distribution.

Table 1. Mean values and standard deviations of imagination across levels.

Level of Imagination	Mean Value	Standard Deviation
Low (0 points)	0.200	0.400
Medium (1 point)	0.467	0.499
High (2 points)	0.333	0.471

Source: Author's own survey data (2026)

Figure 2. Percentage distribution of the level of imagination among the children in the sample.



Source: Author's own survey data (2026)

The analysis of the level of imagination in preschool-aged children reveals variability in the degree of expression of imagination among the examined participants.

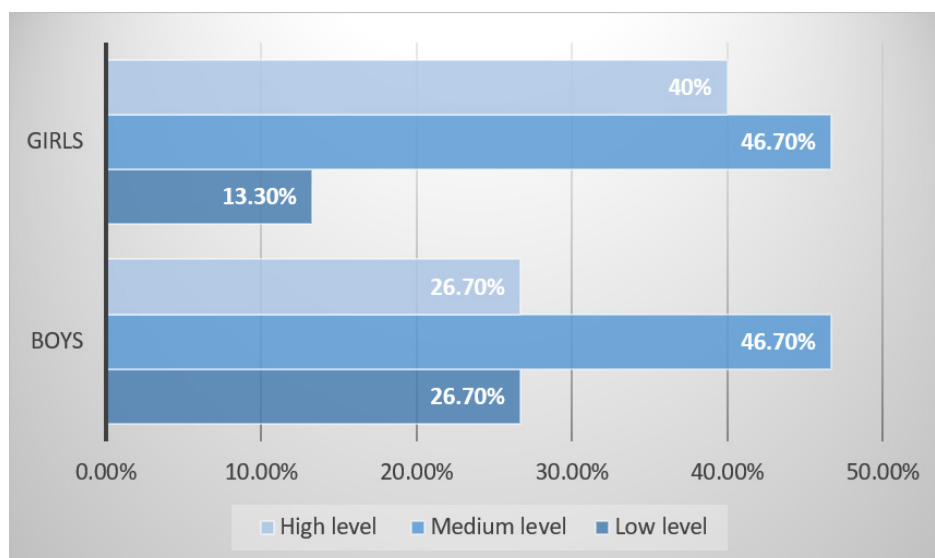
The low level of imagination, scored as 0 points, is observed in approximately 20% of the children. The mean value for this group is 0.2, and the standard deviation is 0.4, indicating that most children in this category have scores close to zero, although there is a small degree of variation.

The medium level of imagination, corresponding to 1 point, includes nearly half of the examined children—47%. The mean value for this group is 0.467, and the standard deviation is 0.499, reflecting a greater dispersion of scores around the mean and suggesting that children with a moderate level of imagination exhibit a wider range of creativity and fantasy expression.

The high level of imagination, corresponding to 2 points, is observed in 33% of the children. The mean value is 0.333, and the standard deviation is 0.471, which also indicates variability in the expression of high imagination; however, overall this group demonstrates more pronounced creative activity compared to children with low or medium levels.

Figure 3 presents the percentage distributions of imagination levels among girls and boys.

Figure 3. Percentage distribution of levels of imagination among girls and boys.



Source: Author's own survey data (2026)

The data presented in Figure 3 allow for a comparative analysis of imagination levels between boys and girls, revealing both similarities and significant differences between the two groups.

First, the distribution of the average level of imagination is completely identical for both sexes

(46.7%). This represents the largest proportion in both groups, indicating that moderate imagination is the dominant characteristic for nearly half of the children studied, regardless of gender. This finding may be interpreted as an indicator of relative homogeneity in the development of basic imaginative abilities within the studied population.

The most pronounced differences are observed in the extreme categories – low and high levels of imagination. In the low level category, a considerably higher proportion is observed among boys (26.7%) compared to girls (13.3%). This suggests that boys are approximately twice as likely to fall into this category. Such a tendency may support the hypothesis that girls less frequently exhibit deficits in imaginative processes or that they more often reach at least an average level of development in this domain.

The opposite pattern is observed in the high level of imagination, where girls (40.0%) significantly outnumber boys (26.7%). This distribution suggests that girls in the sample demonstrate a more pronounced tendency toward the development of high imaginative abilities. Possible explanations may be sought in both socio-cultural factors (e.g., differences in the stimulation of imagination through games and activities) and individual psychological characteristics.

Table 2 presents gender differences in the indicators of imagination.

Table 2. Gender differences in imagination indicators.

Indicator	Mean Values (Boys)	Mean Values (Girls)
Productivity	4.2	4.8
Originality	3.9	3.7
Flexibility	3.8	4.5
Imagery	3.5	4.9

Source: Author's own survey data (2026)

The presented data reflect comparative mean values across four key indicators of imagination: productivity, originality, flexibility, and imagery, differentiated by gender.

First, the productivity indicator demonstrates higher values among girls (4.8) compared to boys (4.2). This suggests that girls generate a greater number of ideas or associations in creative tasks, which may be interpreted as higher divergent activity.

In terms of originality, boys show a slight advantage (3.9 versus 3.7). Although the difference is minimal, it may indicate a tendency toward more unconventional or less frequently occurring ideas among boys, despite their lower overall productivity.

The flexibility indicator reveals a substantial difference in favor of girls (4.5 versus 3.8). This reflects a better ability to shift between different categories or perspectives when solving tasks, which is a key component of creative thinking.

The most significant difference is observed in imagery, where girls achieve considerably higher values (4.9) compared to boys (3.5). This result may be interpreted as a more developed capacity for generating vivid and detailed mental images, which is an essential aspect of imagination.

4. DISCUSSIONS

The presented empirical results allow for a more in-depth academic analysis of the development of imagination in preschool age, taking into account both quantitative distributions and qualitative differences between the studied groups.

First, the distribution of imagination levels (47% medium, 33% high, 20% low) indicates a clearly pronounced tendency toward concentration in the middle range. This is consistent with established positions in Child Development and Educational Psychology, according to which cognitive and creative abilities in early childhood develop gradually and unevenly. The medium level may be regarded as a normative developmental stage in which children already possess basic symbolic thinking skills but have not yet reached a high degree of creative autonomy. The relatively low proportion of children with high levels of imagination suggests that advanced manifestations of creativity require specific stimulating conditions—educational, social, and cultural.

On the other hand, the relatively smaller proportion of children with low levels of imagination may be interpreted as an indication that, under normal conditions, most children develop at least basic forms of

imaginative activity. Nevertheless, this group deserves special attention, as limitations in imagination may be associated with deficits in language development, social interaction, or the quality of the stimulating environment.

A particularly important aspect of the analysis is the observed gender differentiation. The data show that boys are more strongly represented in the low levels of imagination, whereas girls dominate in the high levels, while the medium level remains relatively stable for both groups. These differences may be interpreted through the lens of socialization and culturally conditioned behavioral patterns. It is possible that social expectations and stereotypes encourage more pronounced verbal and imaginative expressiveness in girls, while boys are more often directed toward other types of activities that do not stimulate imagination to the same extent.

In addition, the results for the individual components of imagination—productivity, flexibility, imagery, and originality—provide a more fine-grained differentiation. The superiority of girls in productivity (generating more ideas), flexibility (ability to shift between different categories), and imagery (creating vivid and detailed mental representations) suggests a more developed divergent thinking capacity. In contrast, the slight advantage of boys in originality may be interpreted as a tendency toward more unconventional or less frequently occurring solutions, which also represents an important aspect of creative thinking.

This multidimensional picture confirms the understanding of imagination as a complex construct that cannot be reduced to a single indicator. In this context, it is appropriate to relate these findings to the concept of divergent thinking within Cognitive Psychology, where creativity is emphasized as comprising multiple, partially independent dimensions.

5. CONCLUSIONS

The results of the study highlight the need for targeted pedagogical strategies aimed at stimulating all aspects of imagination while also taking into account individual and gender differences. This creates prerequisites for more effective development of creative potential in early childhood and is of significant importance for the future cognitive and personal development of the child.

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NOMEN EX INVENTORE: LATIN NOMENCLATRURAL STRATEGIES IN NICOLAUS STENO'S OBSERVATIONES ANATOMICAE (1662)

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Abstract: This article analyzes the Latin nomenclatural strategies employed in Nicolaus Steno's *Observationes anatomicae* (1662) as a terminological text at a pivotal juncture in the history of anatomical naming. Through close textual analysis of the original Latin edition (Wellcome Library copy, 1662), the study examines the nomenclatural strategies in the main treatise, the epistemological framework articulated in the preface, and the polemic context of the work's composition. The analysis reveals a central paradox: in the preface, Steno is the first to explicitly articulate the epistemology of personal discovery that renders eponymous naming logically necessary, yet in the main treatise he consistently avoids eponymous nomenclature, describing the parotid duct through functional and topographic periphrases without fixing a proper name. The term ductus Stenonianus is shown to be a post factum act of the scientific community, resulting from a resolved priority dispute with Gerard Blasius, verified through the original text of the 1662 edition. A further significant finding concerns the systematic use of glandula as a central classificatory category (89 occurrences), which makes *Observationes anatomicae* a prototype of a new physiology of secretion rather than a mere report on a single discovery. The article situates Steno's contribution within the broader trajectory from Bauhin's descriptive systematization (1605) to the institutional codification of the Basel Nomenclature (1895) and the elimination of all eponyms in the *Terminologia Anatomica* (1998), arguing that Steno is not the initiator of the eponymic turn in anatomical nomenclature but its first philosophical articulator.

Keywords: anatomical nomenclature; eponyms; *Observationes anatomicae*; Nicolaus Steno; history of medicine

Field: Humanities

1. INTRODUCTION

The history of anatomical nomenclature in the early modern period is characterized by the juxtaposition of two competing principles of naming: the descriptive and the eponymous. The descriptive principle names structures according to their form, location, or function; the eponymous principle uses the name of the discoverer, regardless of morphological characteristics. The transition from the first to the second principle is one of the defining shifts in the history of medical Latin terminology, and its institutional resolution was formulated as late as 1895 with the *Basel Nomina Anatomica* (BNA) and finalized in 1998 with the "*Terminologia Anatomica*" (Chiapas-Gasca et al., 2012; O'Rahilly, 1989). In this context, Gaspard Bauhin's "*Theatrum anatomicum*" (1605) represents the culmination of the descriptive principle—a systematized matrix in which each structure is assigned a Latin term based on its visible characteristics. A textual analysis of *Theatrum anatomicum* reveals an internal contradiction in Bauhin's model: while the main treatise relies on descriptive paraphrases, the binary nomenclature forms for the cranial bones appear only in the figure index, not in the main text (Mirchev, in press)—a symptom of a boundary that the descriptive principle cannot overcome on its own (Ghosh, 2016). Nicolaus Steno's *Observationes anatomicae* (1662) occupies a particular and paradoxical place in this history. Steno is not the founder of the eponymous tradition — it precedes him by at least a century, as the cases of Falloppio and Eustachius demonstrate (Sakai, 2007). His contribution is of a different order: in the preface of *Observationes anatomicae*, he is the first to explicitly articulate the epistemology of personal discovery that renders eponymous naming logically necessary. The present article examines this paradox through close textual analysis of the original Latin edition.

2. MATERIALS AND METHODS

This study is based primarily on the original edition of Nikolaus Stenonis's "*Observationes anatomicae*", published in 1662 in Leiden and available at <https://archive.org/details/b31934080>. A linguistic and comparative method was employed—the Latin text was analyzed in its original form, with particular attention paid to nomenclature patterns, grammatical constructions, and the distribution of key terms across the three parts of the work.

Through appropriate keyword searches, the frequency and context of key terms were tracked: glandula (89 occurrences), ductus / ductum / ductu (various grammatical forms), parotis / parotides (19

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occurrences), and *inveni / observo*. The analysis covers all three parts of the 1662 edition: the main treatise *De Glandulis Oris* (pp. 1–56), the polemic *Responsio ad Vindicias Hepatis Redivivi* (pp. 57–84), and *De Glandulis Oculorum* (pp. 85–108). Secondary literature on the history of anatomical nomenclature and Steno's biography provided the interpretive framework (Kardel & Maquet, 2013; Strkalj, 2013; van Gijn & Gijssels, 2011).

3. RESULTS

3.1 The Preface as Epistemological Framework

The preface of *Observationes anatomicae* is not an ornament to the main treatise but its philosophical foundation. Steno articulates a principled position on the nature of anatomical knowledge, centered on the irreducible incompleteness of observation: “*partium autem, è quibus naturalia corpora componuntur junctâ multitudini subtilitas tanta est, ut vel maximè attentum fallat & eludat*” [“so great is the subtlety of the parts of which natural bodies are composed in their connected multiplicity that it escapes and deceives even the most attentive”] (Steno, 1662, sig. *4r). From this epistemological premise follows the key methodological conclusion: “*nunquam circumspectè adeò omnia observant, quin iisdem artis peritior accedens alius alia inveniatur delenda, supplenda alia, alia mutanda*” [“they never observe all things so carefully that a more skilled other, approaching the same, does not find things to be deleted, added, or changed”] (Steno, 1662, sig. *4r). Significantly, in the same preface Steno alludes directly to the Vesalian project — “*animalium fabricæ ideam omnibus numeris redderent absolutam*” [“to present the idea of the structure of living beings perfect in all its elements”] (Steno, 1662, sig. *4r) — only to declare its principled incompleteness. Vesalius had achieved systematic completeness; Steno demonstrates that it is illusory. The key word in the argument is *alius* — “another”: not an abstract researcher, but a concrete, different observer whose personal gaze adds something irreplaceable. It is precisely this personalization of knowledge that constitutes the philosophical precondition of eponymous naming. The logical implication is clear: if anatomical knowledge is cumulative and personal, naming after the discoverer is not an arbitrary convention but an epistemological necessity.

3.2 Nomenclatural Strategies in the Main Treatise

The central finding of the textual analysis concerns the nomenclature of the parotid duct itself. Steno employs *ductus* in various grammatical forms (*ductui*, *ductum*, *ductu*) throughout the text, but consistently uses it as a general lexeme “canal,” qualified by functional or topographic determiners. The parotid duct is described as *ductum salivarem externam* [“the outer salivary canal”] (Steno, 1662, p. 17), as *ductu singulari ab usu salivari dicto* [“a single canal named after its salivary function”] (Steno, 1662, p. 14), and as *ductus salivaris interioris* [“the inner salivary canal”] (Steno, 1662, p. 5). Neither the form *ductus parotideus* nor any eponymous nomination appears in the primary source. The term *Stensen's duct* belongs entirely to subsequent terminological reception.

A further significant finding concerns the term *glandula*, which appears 89 times across the corpus. Steno not only describes individual glands but defines the category systematically: “*Glandulae quippe omnes propriè dictae*” [“all glands, properly so called”] (Steno, 1662, p. 7), distinguishing types (*conglomeratae* and *conglobatae*) according to a functional principle borrowed from Sylvius. This conceptual reorganization of bodily fluids — each fluid a glandular secretion, each gland with its own canal — constitutes the theoretical core of the work and makes *Observationes anatomicae* a prototype of a new physiology of secretion rather than a mere report on a single discovery. The first-person verbs — *inveni* [“I found”], *observo* [“I observe”], *seco* [“I cut”], *examino* [“I examine”] — appear consistently in direct connection with specific dissection acts on specific animal specimens (Steno, 1662, pp. 6, 11, 15). These are not rhetorical devices but structural markers of the observational genre (*observatio*) to which the work belongs: the personal act of observation is the epistemological warrant for the discovery.

4. DISCUSSION

The polemic context of the work reinforces the nomenclatural findings. The priority dispute with Gerard Blasius over the parotid duct directly motivates the composition of *Observationes anatomicae*. In §.7 of the main treatise, Steno describes Blasius's methodological failure directly: “*viderémque eum ductui tam manifesto nec verum ortum, nec egressum verum assignare potuisse*” [“I saw that he was unable to assign either the true origin or the true exit of so manifest a canal”] (Steno, 1662, p. 6). This is simultaneously an anatomical description and a legal argument: where Blasius saw an unclear structure, Steno describes a precise topographic path. Anatomical precision functions as evidence of priority. The

eponym ductus Stenonianus emerges not from this text but from its reception: Johannes van Horne publicly demonstrated the canal and attributed it to Steno, while Blasius's competing claim was settled in Steno's favor by the scientific community (van Gijn & Gijssels, 2011).

The so-called NOMEN principle (Non-Original Malappropriate Eponymous Nomenclature) formulates the ironic observation that "almost no phenomenon is named after its true first discoverer" (McNulty et al., 2021). The Steno case illustrates this precisely: he formulates in the preface the epistemology that makes eponymous naming logically necessary, but does not practice it in the treatise. The community names the discoverer after the end of the dispute, not the discoverer himself. This mechanism — discovery, contestation, verification, post factum naming — is not unique to Steno: it characterizes the broader eponymous turn in seventeenth-century anatomy, exemplified by Wharton's submandibular duct (1656) and Glisson's hepatic capsule (1654).

A comparison with Steno's immediate contemporaries reveals that the mechanism is not an exception but a rule. Thomas Wharton described the submandibular duct in *Adenographia* (1656) — six years before *Observationes anatomicae* — and, like Steno, used a descriptive term: ductus salivalis. The eponym ductus Whartonianus established itself in clinical usage later, through the same post factum mechanism. Francis Glisson described the fibrous capsule of the liver in *Anatomia hepatis* (1654) without naming it after himself. The paradoxical result is that ductus Stenonianus and ductus Whartonianus coexist in the clinical lexicon without any indication of which belongs to the parotid gland and which to the submandibular (Kachlik et al., 2008) — a practical demonstration of the nomenclatural inefficiency of the eponym as an informational tool.

The cumulative weight of this tradition eventually generated the terminological chaos that required institutional resolution: by the nineteenth century, some 50,000 names circulated for approximately 5,000 anatomical structures (O'Rahilly, 1989), a situation that compelled the Anatomical Society to establish a Nomenclature Commission in 1889 and adopt the BNA in 1895 (Pretterklieber, 2024). The polemic section of *Observationes anatomicae*, the *Responsio ad Vindicias Hepatis Redivivi* (pp. 57–84), confirms that Steno employs the same precise terminology in the polemical as in the scientific text: "lacteis succi per lymphatica ad glandulas oris motum" ["the movement of chyle through the lymphatic vessels to the glands of the mouth"] (Steno, 1662, p. 58). The term is an argument, not an ornament. It is noteworthy that the *Responsio* is not connected to the priority dispute over the parotid duct but is a defense of Steno's Leiden mentor Johannes van Horne against the attacks of Anton Deusing on the function of the liver and lymphatic vessels — two distinct scientific disputes united in a single work. Scientific texts in seventeenth-century anatomy were simultaneously research reports and instruments for the defense of institutional positions.

5. CONCLUSION

The textual analysis of Nicolaus Steno's *Observationes anatomicae* (1662) yields three principal conclusions. First, the preface articulates for the first time in explicit philosophical terms the epistemology of personal discovery that renders eponymous naming logically necessary: if anatomical knowledge is cumulative and irreducibly personal, naming after the discoverer follows as a logical consequence rather than a mere convention. Second, the main treatise consistently avoids eponymous nomenclature: the parotid duct is described through functional and topographic periphrases without a fixed proper name. The eponym ductus Stenonianus is a post factum act of the scientific community, produced by a resolved priority dispute. Third, Steno's conceptual reorganization of bodily fluids around the category *glandula* makes *Observationes anatomicae* a prototype of a new physiology of secretion, whose terminological implications extend far beyond the parotid duct.

Within the broader series of studies on Latin anatomical terminology in early printed editions — covering Vesalius (1543), Falloppio (1561), and Bauhin (1605) — *Observationes anatomicae* closes the sequence in a distinctive way: not as a new systematic nomenclatural text, but as the text whose preface first articulates the philosophy that makes the subsequent nomenclatural history inevitable. Steno is not the initiator of the eponymic turn; he is its first philosophical articulator. The arc from his preface (1662) to the Basel Nomenclature (1895) and the *Terminologia Anatomica* (1998) spans three and a half centuries of institutional working-out of a problem that Steno named but did not resolve.

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EU AND NATO RESPONSES TO HYBRID THREATS: OPERATIONAL GAPS AND STRATEGIC MISALIGNMENT

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Abstract: This paper conducts a conceptual policy analysis of hybrid threats and the responses developed by the European Union (EU) and the North Atlantic Treaty Organization (NATO) since 2016. Hybrid threats are understood as coordinated and synchronized actions that deliberately target systemic vulnerabilities of democratic states and institutions, operating across multiple domains while exploiting the thresholds of detection and attribution (Hybrid CoE, 2024). In this context, Foreign Information Manipulation and Interference (FIMI) is examined as a central instrument of contemporary hybrid activity, defined as a coordinated pattern of behavior aimed at undermining political processes and democratic values (EEAS, 2025).

The paper addresses two research questions: how the EU and NATO operationalize counter-hybrid efforts, and what structural gaps persist in their approaches. The analysis focuses on key institutional mechanisms, including the EU's Hybrid Fusion Cell, FIMI analytical framework, and Hybrid Toolbox, as well as NATO's counter-hybrid support teams and the ABCDE methodology.

The findings indicate that both organizations have made significant progress in developing situational awareness and resilience-building capacities. However, their responses remain unevenly operationalized. While NATO demonstrates a higher degree of operational integration, particularly in intelligence and rapid response, the EU's approach is primarily regulatory and coordination-driven.

The analysis identifies two persistent challenges. First, the problem of attribution continues to limit the effectiveness of both political and strategic responses, as hybrid operations are designed to obscure responsibility. Second, insufficient coordination between the EU and NATO reduces the overall coherence of the Euro-Atlantic response framework.

The paper argues that the commonly described complementarity between the EU and NATO remains only partially realized in practice. It concludes by proposing the development of a joint EU–NATO attribution protocol and shared analytical standards, particularly in the use of exposure matrices, as necessary steps toward more effective and synchronized responses to hybrid threats.

Keywords: hybrid threats, disinformation, EU, NATO, cyber security

Field: Social Sciences and Humanities

1. INTRODUCTION

Hybrid threats should not be understood as a new category of security challenges, but rather as a transformation in how power is exercised in contemporary international relations. What distinguishes them is not simply the combination of military and non-military instruments, but the deliberate targeting of systemic vulnerabilities within democratic societies. These vulnerabilities include political polarization, dependence on digital infrastructure, and openness of information environments, which together create conditions in which external actors can influence decision-making without direct confrontation. Hybrid threats can also be understood as a continuation of complex warfare dynamics involving both conventional and non-conventional actors (Mansoor & Murray, 2012; Bajarunas, 2020)

In this sense, hybrid threats operate less as instruments of war and more as tools of strategic influence. Their objective is not immediate territorial control, but long-term shaping of political outcomes. This is particularly visible in the increasing use of disinformation campaigns, cyber operations, and economic pressure as mechanisms for altering public perception and constraining policy choices. Such activities blur the boundary between war and peace and challenge traditional understandings of security (Caramancion et al., 2022).

The growing prominence of hybrid threats is closely linked to changes in the international system, particularly the intensification of competition between major powers. In the Euro-Atlantic context, these dynamics have exposed structural limitations of existing security frameworks. Institutions such as the European Union and NATO were designed to address clearly defined threats—economic instability in the case of the EU and military aggression in the case of NATO. Hybrid threats, however, deliberately exploit the space between these domains, where responsibilities overlap but coordination remains incomplete

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(Kalniete & Pildegovics, 2021).

Since 2016, both organizations have developed responses to this challenge, but their approaches differ significantly. The European Union has focused on regulatory instruments, resilience-building, and the protection of democratic processes, particularly in the digital domain. Its response reflects its broader role as a normative and regulatory actor. NATO, by contrast, has approached hybrid threats primarily through the lens of security and defense, emphasizing intelligence integration, deterrence, and operational readiness (Balcaen et al., 2021).

Despite these efforts, the effectiveness of both approaches remains limited. One of the central problems is attribution. Hybrid operations are intentionally designed to obscure responsibility, often involving proxies, layered communication channels, and deniable infrastructures. This creates a structural dilemma: while political and legal responses require clear attribution, hybrid strategies are specifically constructed to prevent it (Caramancion et al., 2022).

At the same time, differences in institutional design further complicate the response. The EU operates through complex governance structures that require consensus among member states, which can slow decision-making. NATO, although also based on consensus, possesses more developed operational capabilities, allowing for faster responses in certain contexts. However, this advantage is offset by political constraints that limit the scope of collective action (Bajarūnas, 2020).

Technological developments add another layer of complexity. The expansion of digital platforms and data-driven communication has enabled hybrid campaigns to become more adaptive and scalable. As a result, hybrid threats are not static phenomena but evolving practices that continuously adjust to countermeasures (Caramancion et al., 2022).

Against this background, the central argument of this paper is that the current division of labor between the EU and NATO—often described as complementary—is insufficiently integrated to address hybrid threats effectively. The key issue is not the absence of tools, but the lack of strategic alignment and operational coordination between the two organizations.

Accordingly, this paper addresses two questions: how the EU and NATO operationalize their responses to hybrid threats, and what structural gaps limit their effectiveness. By focusing on practical implementation rather than formal strategies, the analysis aims to provide a more critical assessment of the Euro-Atlantic approach to hybrid threats.

2. EU AND NATO RESPONSES

The European Union has developed a layered and increasingly institutionalized approach to hybrid threats, centered on regulation, prevention, and societal resilience. Rather than relying on centralized operational capabilities, the EU's response is structured around governance instruments that aim to shape the environment in which hybrid activities occur. Platform governance has become a central mechanism through which the EU indirectly shapes the information environment in which hybrid threats operate (Gorwa, 2020). Key mechanisms include the Hybrid Fusion Cell, which enhances situational awareness through the aggregation of intelligence inputs, and the FIMI framework, which enables systematic identification of disinformation networks through behavioral and technical indicators (European External Action Service [EEAS], 2025). This reflects a broader shift toward analytical models that treat hybrid activity as a networked and adaptive phenomenon rather than a set of isolated incidents.

A concrete example of this approach can be observed in Moldova, where coordinated disinformation campaigns were designed to undermine public support for European integration. These campaigns relied on interconnected media ecosystems and amplification strategies across multiple digital platforms, demonstrating how hybrid threats exploit the openness of democratic information environments. Similar patterns have been identified in broader European contexts, where disinformation campaigns operate through hybrid media systems that combine traditional and digital channels (Bennett & Livingston, 2020).

At the regulatory level, the EU has significantly strengthened its capacity through instruments such as the Digital Services Act (DSA), which imposes obligations on large online platforms to assess and mitigate systemic risks related to disinformation and foreign interference. This regulatory approach reflects a distinctive strategic logic: instead of directly confronting hybrid actors, the EU seeks to constrain the infrastructures that enable their activities. Research shows that platform governance plays a critical role in shaping the dynamics of disinformation and hybrid influence operations (Gorwa, 2020).

However, this model also exposes structural limitations. The EU's reliance on coordination among member states and institutions often results in slower response times, particularly in rapidly evolving hybrid threat environments. The absence of centralized operational authority limits the Union's ability to translate situational awareness into immediate action, especially when responses require political

consensus or cross-sectoral alignment (Bajarūnas, 2020).

In contrast, NATO's approach is embedded in its security and defense mandate, enabling a more direct and operational posture. NATO integrates intelligence, military preparedness, and resilience-building into a unified framework, reflecting a strategic shift toward recognizing hybrid threats as a core security challenge. This shift is particularly visible in NATO's increasing emphasis on early warning, attribution, and coordinated response mechanisms.

Moreover, NATO benefits from more developed intelligence-sharing structures, which allow for faster information exchange and a reduced gap between detection and response. Empirical research on alliance behavior suggests that such integration enhances the ability to respond to complex and ambiguous threats, particularly when they span multiple domains (Kostyuk & Zhukov, 2017).

Nevertheless, NATO's operational advantage is not without constraints. Its effectiveness remains conditioned by political consensus among member states, which can delay or limit collective responses. This creates a structural tension between operational capability and political feasibility, which hybrid threat actors can exploit by operating below the threshold that would trigger a unified response.

3. NATO'S OPERATIONAL APPROACH TO HYBRID THREATS

NATO's approach to hybrid threats is characterized less by the introduction of entirely new instruments and more by the gradual integration of hybrid threat logic into its existing deterrence and defense architecture. Rather than treating hybrid threats as a separate category, NATO has incorporated them into its core strategic thinking, recognizing that contemporary conflict increasingly unfolds across interconnected domains, including cyber, informational, and conventional military environments.

A key feature of NATO's operational approach is the emphasis on intelligence integration and early warning. Hybrid threats are not addressed as isolated incidents, but as part of continuous adversarial activity designed to remain below the threshold of collective defense. This has led to the development of more structured analytical practices within the Alliance, aimed at reducing ambiguity and accelerating decision-making. As recent research shows, NATO's adaptation to hybrid threats has been driven by the need to improve responsiveness and strategic coherence in an environment where threats evolve faster than traditional decision-making cycles (Genini, 2025).

What distinguishes NATO from other actors is not only its analytical capacity, but its ability to directly translate intelligence into operational planning. Intelligence-sharing mechanisms within the Alliance reduce fragmentation and enable a more synchronized understanding of hybrid activity across member states. This is particularly important given that hybrid operations are inherently transnational, often targeting multiple states simultaneously through coordinated cyber, informational, and economic actions.

The case of Ukraine illustrates the multidimensional character of hybrid threats. Russian operations have combined cyberattacks, disinformation campaigns, and conventional military pressure in a mutually reinforcing manner. These actions demonstrate that hybrid warfare is not a substitute for conventional conflict, but rather a complementary layer that shapes the strategic environment before and during military engagement. NATO's response has therefore extended beyond traditional military support to include intelligence-sharing, cyber defense cooperation, and resilience-building measures across critical sectors.

At the same time, NATO has increasingly emphasized resilience as a core component of its hybrid threat strategy. This reflects a recognition that not all hybrid activities can be deterred or prevented; instead, reducing vulnerability and ensuring continuity of governance becomes a central objective. Recent discussions within NATO highlight the importance of societal resilience, critical infrastructure protection, and coordinated responses across civilian and military domains as key elements of this approach.

However, NATO's operational model also faces structural constraints. Its ability to act remains dependent on political consensus among member states, which can delay responses in rapidly evolving situations. Hybrid threat actors exploit this limitation by operating in the "grey zone," deliberately calibrating their actions to remain below the threshold that would trigger a unified response. This creates a persistent gap between detection and action, which remains one of the central challenges for NATO's adaptation to hybrid threats.

Ultimately, NATO's approach demonstrates a high degree of operationalization, particularly in intelligence integration and strategic awareness. Yet its effectiveness depends on its ability to reconcile rapid operational needs with inherently slower political decision-making processes—an imbalance that continues to define the Alliance's response to hybrid conflict.

4. DISCUSSION

The analysis of EU and NATO responses demonstrates that hybrid threats are not simply a new security challenge, but a structural feature of contemporary international relations that exposes systemic vulnerabilities within democratic systems. These vulnerabilities are particularly evident in the informational domain, where the openness of democratic societies creates opportunities for external manipulation. As recent studies suggest, disinformation campaigns are most effective not because of their content alone, but because they exploit pre-existing societal divisions and institutional weaknesses (Bennett & Livingston, 2018).

The case of Ukraine highlights the extent to which hybrid threats operate across multiple domains simultaneously. Cyber operations, disinformation campaigns, and conventional military actions are not separate tools but mutually reinforcing elements of a broader strategic approach. This convergence challenges traditional security models, which tend to treat threats as domain-specific. Instead, hybrid threats require cross-domain responses that integrate military, civilian, and technological capabilities.

In the Western Balkans, hybrid threats manifest differently but with similar strategic objectives. Rather than direct confrontation, influence operations focus on shaping public opinion, weakening institutional trust, and slowing down Euro-Atlantic integration processes. These dynamics illustrate that hybrid threats are context-dependent: while their tools may be similar, their effects vary depending on local political and social conditions.

A key insight emerging from this analysis is that both the EU and NATO are addressing different dimensions of the same problem, but without sufficient integration. The EU's regulatory and resilience-based approach is essential for addressing long-term vulnerabilities, particularly in the digital and informational space. NATO, on the other hand, provides the operational capacity needed to respond to immediate threats. However, the lack of synchronization between these approaches creates a strategic gap that hybrid threat actors can exploit. This misalignment does not merely reduce efficiency—it creates structural opportunities for hybrid threat actors to exploit gaps between institutional mandates.

Another critical issue is the problem of attribution. As hybrid operations are deliberately designed to obscure responsibility, both organizations face significant constraints in responding effectively. Attribution is not merely a technical challenge but also a political one, as responses require consensus among actors with differing threat perceptions and strategic priorities. Research indicates that uncertainty in attribution often leads to delayed or diluted responses, reducing their deterrent effect (Lindsay, 2020).

Technological developments further intensify these challenges. The increasing use of artificial intelligence in information operations allows for the rapid generation and dissemination of tailored content, significantly enhancing the scale and precision of disinformation campaigns. This evolution indicates that hybrid threats are becoming progressively more adaptive and capable of circumventing existing detection frameworks, which necessitates continuous innovation in both analytical tools and policy responses (Olawunmi, 2025).

Importantly, hybrid threats challenge not only security institutions but also the conceptual foundations of security policy. The distinction between internal and external security becomes increasingly blurred, as many hybrid activities target domestic political processes while being orchestrated externally. This raises questions about the adequacy of existing institutional frameworks, which are often based on a clear separation between these domains.

Ultimately, the findings suggest that the effectiveness of EU and NATO responses depends less on the development of new instruments and more on their ability to integrate existing ones. Without deeper coordination, shared analytical frameworks, and improved attribution mechanisms, hybrid threats will continue to exploit institutional fragmentation.

5. CONCLUSION

This paper has examined how the European Union and NATO operationalize their responses to hybrid threats and has demonstrated that, despite significant progress since 2016, important structural limitations remain. Hybrid threats are not simply a category of security challenges but a persistent mode of strategic competition that exploits the institutional and societal characteristics of democratic systems. As such, they cannot be effectively addressed through traditional, domain-specific approaches.

The analysis has shown that the EU and NATO operate according to different but complementary strategic logics. The EU focuses on regulation, resilience, and the governance of digital and informational environments, addressing the structural conditions that enable hybrid threats. NATO, in contrast, provides operational capabilities, particularly in intelligence integration, deterrence, and rapid response. However,

this division of labor remains insufficiently integrated in practice.

Two key limitations stand out. First, the problem of attribution continues to constrain both organizations. Without timely and credible attribution, political and strategic responses remain limited, reducing their deterrent effect. Second, coordination between the EU and NATO remains uneven. Despite formal cooperation frameworks, differences in institutional design and decision-making processes hinder the development of fully synchronized responses.

These findings suggest that the effectiveness of the Euro-Atlantic response to hybrid threats depends less on the creation of new instruments and more on the integration of existing ones. In this context, three policy implications emerge. First, the development of a joint EU–NATO attribution framework would strengthen the credibility and timeliness of responses. Second, the establishment of shared analytical standards—particularly in the identification and assessment of hybrid activities—would reduce fragmentation and improve interoperability. Third, deeper operational coordination, including joint exercises and information-sharing mechanisms, is necessary to bridge the gap between prevention and response.

Ultimately, hybrid threats challenge not only the capabilities of institutions but also their ability to act collectively under conditions of uncertainty and ambiguity. Addressing this challenge requires a shift from parallel approaches toward genuinely integrated strategies, capable of responding to hybrid threats as a systemic and evolving feature of contemporary security. In this sense, hybrid threats should be understood not as an exception, but as the defining condition of contemporary security.

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TRANSFORMATION OF NEUTRALITY IN CONTEMPORARY INTERNATIONAL RELATIONS

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Abstract: The paper analyzes the transformation of neutrality in contemporary international relations with the aim of re-examining its traditional understanding as a fixed legal status and its theoretical reconceptualization as a process-based strategic construct manifested through foreign policy practice. Starting from the assumption that the erosion of the border between war and peace, the growth of hybrid threats and increased competition between great powers have fundamentally changed the security environment, the research seeks to explain how states adapt neutrality as a process of strategic positioning in order to preserve security, sovereignty and strategic space for maneuver. The methodological approach is based on qualitative analysis that combines conceptual analysis of theoretical approaches to neutrality, comparative reasoning and selected case studies of European and global examples. Special attention is paid to a comparative consideration of different models of neutrality, including examples of adaptation within formally defined legal neutrality, functional and active manifestations of process-based neutrality, and examples of its abandonment in conditions of increasing perceived threats. The research results show that contemporary neutrality no longer functions as a passive absence of positioning, but as a continuous process of strategic adaptation, that combines selective inclusion in international institutions, risk management and the preservation of political flexibility. The analysis indicates that the transformation of neutrality is shaped by three interrelated factors: structural changes in the international system after the Cold War, geopolitical shocks and the growing influence of internal political and social dynamics on foreign policy decisions. It is concluded that neutrality does not disappear as a relevant concept, but rather undergoes a process of strategic reconceptualization in the direction of functional and active manifestations of process-based neutrality. Based on the findings, the paper recommends that neutrality be viewed in scientific and political analyses as an instrument of uncertainty management and strategic flexibility of small and medium-sized states in a multipolar system. Additionally, the results point to the need to develop analytical frameworks that bridge legal, security, and strategic approaches, in order to better understand the behavior of states that seek to avoid exclusive security choices. The paper contributes to broader debates in the field of international relations and security studies by conceptualizing neutrality as a process of strategic adaptation in conditions of systemic uncertainty.

Keywords: *neutrality, transformation of neutrality, strategic adaptation, small and medium-sized states, multipolar order*

Field: Social sciences

1. INTRODUCTION: THE CONCEPT AND HISTORICAL FRAMEWORK OF NEUTRALITY

In contemporary international relations, neutrality increasingly faces structural pressures created by systemic uncertainty, intensified great power competition, and the gradual blurring of the distinction between war and peace. Although neutrality has long been viewed as a fixed legal status within international law, new geopolitical developments reveal its limitations as a static concept.

This article argues that neutrality should no longer be understood as a fixed legal category, but rather as a process-based strategic construct manifested through foreign policy practice in conditions of systemic uncertainty in conditions of systemic uncertainty. Rather than categorizing states as neutral or non-neutral, the analysis focuses on the ways in which neutrality is continuously negotiated, recalibrated, and used as an instrument of risk management and strategic positioning.

In the classical sense, neutrality implies a legally and politically grounded status of a state that refrains from participating in armed conflicts, does not provide military support to belligerents, and prevents the use of its territory for war purposes (Bothe, 2015). This concept is codified in international law, primarily through the Hague Conventions of 1907, which define the rights and obligations of neutral states in land and naval warfare (Hague Convention (XIII) Concerning the Rights and Duties of Neutral Powers in Naval War, 1907).

During the Cold War, neutrality functioned in a relatively stable bipolar system. A clear division into two opposing blocs allowed neutral states to position themselves “between” them, with the tacit tolerance of the great powers, as long as such a position did not threaten the basic balance of power (Karsh, 1988). In this context, neutrality functioned as an institutionalized, long-term and relatively stable legal status, based on the assumption that restraint and distance are sufficient conditions for security. The

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fundamental question is no longer, whether neutrality is disappearing, but rather how it is changing and adapting to contemporary conditions. This paper is dedicated to this very issue.

The central thesis of the paper is that neutrality in contemporary international relations is not disappearing as a relevant analytical category, but is undergoing a profound transformation from a legally codified and relatively static status to a dynamic, contextually conditioned process of strategic adaptation. In the conditions of a multipolar order, hybrid threats and institutional interconnectedness, neutrality is less and less the absence of a position. It is increasingly becoming a form of active risk management and the preservation of the room for maneuver of small and medium-sized states.

From the methodological point of view, the paper is based on a qualitative research approach that combines conceptual analysis, comparative method and case study elements. The starting point is a critical analysis of theoretical and legal interpretations of neutrality in contemporary academic literature, with the aim of identifying key patterns of transformation of this concept after the Cold War. Conceptual analysis is used to clarify the difference between neutrality as a legal status and neutrality as a strategic process. The comparative approach is applied through a comparative analysis of different models of neutrality in Europe, with a special focus on the Scandinavian countries of Sweden and Finland as examples of abandoning neutrality, and Switzerland and Austria as examples of adaptation within a formal neutral framework. The case study allows these examples not to be treated as isolated cases, but as empirical illustrations of broader structural and systemic trends. The methodology is primarily analytical, without normative pretensions, with a focus on understanding how states use neutrality as a risk management instrument in conditions of contemporary international uncertainty.

The paper is theoretically positioned at the intersection of realist approaches, small state theory, and the literature on coordination and hedging strategies, drawing on classical realist discussions of balancing and alliance strategies in international relations (Walt, 1987). Starting from the realist assumption that the international system is shaped by power relations and structural uncertainty, neutrality is analyzed as a process of strategic adaptation aimed at preserving security, sovereignty and strategic room for maneuver and preserving the room for maneuver of small and medium-sized states in conditions of great power competition. In line with the insights of small-state theory and the multi-actor deterrence of small states, neutrality is interpreted as a form of active strategic positioning within a process-based framework, rather than passive abstention from alignment (Pavić & Beriša, 2026). At the same time, the work relies on the approach of strategic pragmatism, which emphasizes the adaptive combination of cooperation, distance, and selective integration in order to achieve national interests (Pavić & Beriša, 2025). In this context, neutrality is conceptualized as a process that partially overlaps with hedging strategies, i.e. risk management in conditions of multipolarity. Methodologically, comparative cases were chosen with the intention of analytical contrast: Sweden and Finland represent examples of abandoning traditional neutrality due to the growth of security threats, while Switzerland and Austria illustrate a model of adaptation within a formally maintained neutral framework, which allows for the analysis of different paths of transformation of neutrality in the contemporary strategic environment. In this sense, the transformation of neutrality does not represent the abandonment of the concept, but its evolution towards hedging strategies and strategic flexibility, which constitute the operational form of contemporary neutrality.

2. THE CHARACTER OF NEUTRALITY: FROM THE COLD WAR TOWARDS A NEW MULTIPOLAR WORLD

After the collapse of the Soviet bloc and the end of the Cold War, many heralded the “end of neutrality” as a relevant policy. However, the concept has not disappeared, but has transformed and adapted to new geopolitical realities. Rather than simply avoiding bloc conflict, neutrality is increasingly expressed through strategic flexibility as a mode of process-based adaptation in relation to new great powers such as the United States, the Russian Federation, and the People’s Republic of China (Habtom-Desta, 2024). Perhaps the most significant characteristic of contemporary neutrality can be considered through the vision of transformation from status to process. The end of the bipolar order also conditioned the transformation of the meaning of neutrality. As contemporary authors state, after the collapse of the Soviet Union and the emergence of the single superpower, neutrality was often viewed as an archaic concept in public and professional discourse. However, as contemporary literature shows, neutrality does not emerge exclusively from a bipolar systemic structure; it can also be reinterpreted in the triad of unipolarity and multipolarity, which indicates that its role is conditioned by broader changes in the international order, and not only by the structure of the bloc conflict (Habtom-Desta, 2024). In the absence of a stable bipolar order, neutrality can no longer rely on external “external structural conditions of stability” but requires continuous adaptation. Contemporary authors therefore increasingly treat neutrality as a

process-based construct, rather than a static state, as a series of decisions made in relation to specific crises, actors and interests.

Another significant characteristic of contemporary neutrality is reflected in the erosion of the classical legal regime. Contemporary literature increasingly indicates that the legal regime of neutrality, based on the Hague Conventions, no longer fully corresponds to the nature of contemporary conflicts. As James Upcher points out, contemporary crises are characterized by forms of indirect engagement, i.e. sanctions, cyber operations and information wars that evade the classical categories of war and peace (Upcher, 2020). In such a context, neutrality loses its character as a clearly defined legal status and increasingly becomes the subject of political and strategic interpretation.

The third characteristic of contemporary neutrality can be seen through functional and active neutrality. The examples of Switzerland and Austria show that it is possible to maintain the formal status of neutrality, while simultaneously adapting its content. As Lesia Dorosh points out, contemporary neutrality does not imply political passivity, but selective engagement in accordance with the assessment of national interests and normative obligations (Dorosh, 2022). In this sense, neutrality is transformed into a functional instrument of foreign policy, rather than a dogmatic position. In theoretical terms, contemporary neutrality is increasingly approaching the concepts of hedging (a strategy of risk management through combined positioning) and strategic flexibility. As Jürgen Haacke argues, states seek to avoid exclusive security choices and instead combine different forms of cooperation and distance (Haacke, 2019).

The analysis of the evolution of contemporary neutrality indicates that traditional theoretical models that treat neutrality as a stable legal status are no longer sufficient to explain the behavior of states in the post-bipolar system. Contemporary practice shows that neutrality is gradually transforming into a strategic process that combines elements of alignment, selective integration, and risk management, approaching the concepts of hedging and strategic flexibility. Theoretically, this implies a shift in analysis from the question of "is a state neutral" to the question of "how does a state operationally use neutrality". This understanding allows for the integration of realist, institutional and constructivist approaches into a single analytical framework, in which neutrality becomes a dynamic instrument of foreign policy action of small and medium-sized states in conditions of systemic uncertainty.

3. TRANSFORMATION OF NEUTRALITY

In this chapter, we will try to explain how neutrality is being transformed in contemporary international relations through the prism of the previously mentioned "characteristic features" of contemporary neutrality. The transformation of neutrality is not only a European phenomenon, which implies that it must be considered and studied on a global scale. In Asian and other regions, traditions of neutrality and non-alignment (including different forms of non-aligned strategies) have their roots and new forms of reactions to Great American, Chinese or regional imperial maneuvers. The authors have tried to explain the transformation of neutrality through factors such as the end of bipolarity, major geopolitical changes, changes in domestic politics in individual states, through modern strategic approaches, and finally through institutional action.

However, before we begin to consider the above-mentioned factors, we will consider one significant trend that relates to the growing influence of domestic political factors on the policy of neutrality. Decisions to abandon or adapt neutrality are no longer the exclusive domain of security elites. Public opinion, media narratives, and democratic legitimation play an increasingly important role, especially in times of crisis (Baum & Potter, 2008). The moral dimension of contemporary conflicts and the high media visibility of suffering contribute to political pressure to reexamine neutral positions. In this way, neutrality becomes not only a strategic process-based construct but also a socially mediated process, conditioned by internal political dynamics and perceptions of legitimacy.

The transformation of neutrality in the work is analytically decomposed into three interrelated dimensions: structural, strategic, and institutional.

3.1. Loss of bipolar "protective clarity"

The first significant trend is the disappearance of the bipolar structure of international relations. In the post-Cold War period, the international system has become multipolar, fragmented, and marked by asymmetric and hybrid conflicts. In such an environment, neutrality no longer implies a clear and unambiguous "standing aside." Neutral states increasingly face political and economic pressures to take a stand in international crises, whether through sanctions packages, joint declarations, or institutional commitments.

As Andreas Nishikawa-Pacher and Pascal Lottaz point out, the concept of neutrality after the Cold War has lost its clear point of reference and has become the subject of continuous political

interpretation (Nishikawa-Pacher & Lottaz, 2025). Contemporary expert discourse from 2025 confirms this transformation, emphasizing that neutrality is no longer a passive legal status, but a dynamic process-based construct of managing foreign policy relations in conditions of increased uncertainty (GCN, 2025).

3.2. Geopolitical shocks as catalysts for change

Another significant trend in the transformation of neutrality concerns the role of major geopolitical crises as catalysts for strategic change. The war in Ukraine represents a key “stress test” for European neutral states, demonstrating the limitations of traditional reliance on individual neutrality in conditions of high threat perception. The decisions of Sweden and Finland to join NATO after a long period of neutrality indicate that neutrality is no longer understood as an absolute security guarantee, but as a strategy whose sustainability depends on the specific security environment (Ojanen, 2023). These decisions stemmed primarily from a rational assessment of security risks, with the logic of collective defense taking precedence over the traditional policy of distance. The case of the Nordic countries has broader analytical significance, as it shows that geopolitical shocks can lead to a reassessment of neutrality as a risk management strategy for small and medium-sized states as a whole.

3.3. Adaptation instead of abandonment: the “soft transformation” of neutrality

Unlike the Scandinavian countries that decided to formally abandon the policy of neutrality and join collective security alliances, some European countries have opted for adaptation rather than a formal abandonment of neutrality. Switzerland and Austria are examples of the so-called “soft transformation” of neutrality: while formally maintaining their neutral status, they are significantly adjusting their foreign and security policies in line with new international frameworks and security challenges. In Switzerland, the modern interpretation of neutrality includes practical adaptations to international challenges and partnership-based ways of acting in security and economic matters, which shows that neutrality is no longer just a static legal status but a dynamic political choice (Chernyavskiy, 2024). Analyses of Austrian politics point out that after the Cold War, by joining the European Union and through alignment with the common foreign and security policy, Austria is working to adapt neutrality to the new conditions of international politics (Popławski, 2020). At the same time, broader studies show how neutral European states use integration and security mechanisms to secure their status and contribute to solving global issues, without formally joining military alliances.

This adaptation is reflected through various mechanisms: active participation in international diplomatic and security initiatives, selective participation in EU sanctions packages and joint statements, as well as the development of capabilities for the defense and protection of national interests without formally joining military alliances. Such adaptation indicates a shift towards the concept of “active” or “functional” neutrality, where neutrality is no longer just a legal or symbolic status, but a dynamic and practical instrument of risk management. Contemporary expert discourse, including the 2025 recommendations, emphasizes that neutrality in this model implies selective engagement based on an assessment of national interests, international obligations and normative principles, as well as on the possibilities of maximizing room for maneuver in a multipolar and fragmented international system. In this sense, neutrality is no longer seen as a passive status, but as a strategic alternative that allows a state to participate in international processes without fully fitting into dominant military or political blocs.

3.4. Transformation of neutrality: legal, strategic and institutional aspects

The transformation of neutrality in the 21st century involves moving from a classical static legal status to a dynamic, context-dependent process of strategic positioning. From a legal perspective, traditional neutrality laws, based on the 1907 Hague Conventions, no longer correspond to the complexity of contemporary conflicts. As a recent analysis of the concept of neutrality highlights, states are increasingly faced with forms of indirect engagement, such as sanctions, cyber and information attacks, that evade classical war-peace categories and create the need for new interpretations of legal obligations (Berchev, 2025). In this sense, the legal framework of neutrality becomes increasingly flexible in its interpretation and application, which adapts to the dynamics of international institutions and political crises.

Strategically, modern neutrality is no longer just about avoiding conflict. It involves actively managing risks and maximizing the room for maneuver in a multipolar order. Concepts such as hedging, multi-vector foreign policy and selective integration show that neutrality can be a means of achieving strategic flexibility without formally joining military alliances (Nishikawa-Pacher & Lottaz, 2025). The examples of Switzerland and Austria illustrate this strategy: although they formally maintain a neutral status, they practically participate in international initiatives, sanctions packages and regional security cooperation, which allows them to adapt to global security challenges without abandoning formal neutrality (Stöcklin, 2024).

The institutional-political aspect of the transformation is reflected in the porosity of neutrality in the context of integration and multilateral partnerships. Membership in the European Union, the Partnership

for Peace, and acceptance of collective security arrangements condition the traditional neutral status, transforming it into a continuously “bias-managed neutrality” (Parish, 2025). This adaptation suggests that modern neutrality involves simultaneously preserving formal status and actively positioning itself in international systems, which is an example of functional and pragmatic transformation in the context of global uncertainty.

On the other hand, neutrality is used as an instrument of risk management, maneuver space and strategic flexibility. Ultimately, through institutions, formal status remains, but is realistically integrated into international organizations, collective defenses and multilateral partnerships. Thus, modern neutrality is no longer a static or dogmatic concept, but a dynamic and contextually conditioned process, which allows small and medium-sized states to simultaneously maintain their sovereignty and respond to complex geopolitical challenges.

3.5. Neutrality as strategic flexibility and policy evolution

Modern neutrality is increasingly approaching concepts such as hedging, multi-vector foreign policy and selective integration. Instead of a clear commitment to or against alliances, states seek to maximize their room for maneuver in conditions of uncertainty. In this sense, neutrality can be understood as a risk management strategy, rather than a permanent absence of a position. As Haacke points out, neutrality in modern conditions is a dynamic process of adaptation, not a fixed norm (Haacke, 2019).

The evolution of domestic politics and the experience of states such as Switzerland and Austria imply adaptation within the framework of neutrality. Namely, both Switzerland and Austria have retained their formal neutral status, but have adapted their foreign policy course to current circumstances. Switzerland supported sanctions against Russia, which was implemented in practice as part of a pacifist position, but which has caused controversy over what “neutrality” really means today in a situation of total war in Europe (Allen, 2022). These states are also developing an active role in multilateral security initiatives and regional cooperation, whereby neutrality takes the form of “active non-participation” in conflicts, but not isolation.

3.6. The institutional “porosity” of neutrality

Traditional neutrality, without military alliances, is increasingly “porous” through economic and political integration, such as the EU or other partnerships. Other neutral actors are opting for humanitarian participation and collective security agreements, as well as informal international partners (Mařátková, 2017). This shows that states no longer see neutrality simply as the absence of alliances, but as the ability to “fit” various security and diplomatic mechanisms into their foreign policy arsenal.

The strong institutionalization of international relations is another factor in the transformation of neutrality. Membership in the European Union, participation in the Partnership for Peace, and acceptance of common sanctions packages create political obligations that fundamentally change the content of neutrality, even when it remains formally in force (Genini, 2025).

As Geoffrey Pridham notes, neutrality within the EU is becoming a “porous” category, conditioned by common policies and institutional mechanisms (Pridham, 2008). This process does not necessarily mean the loss of sovereignty, but it indicates the transformation of neutrality from an absolute to a relative category.

4. CONCLUSION: FROM STATUS TO PROCESS

What distinguishes contemporary neutrality is a clear distinction: neutrality is not an anachronism, but a process-based form of strategic adaptation for small and medium-sized states in conditions of multipolarity and structural uncertainty. The transformation of neutrality is not limited to Europe. In Asia and other regions, traditions of neutrality and non-participation (including variants of nonalignment) are taking on new forms in response to greater American, Chinese or regional imperial maneuvers, demonstrating the global relevance of the phenomenon.

However, it is not disappearing, but is transforming into a flexible, context-dependent strategy. Contemporary neutrality is less and less a permanent status and more and more a dynamic process of managing risks and preserving strategic maneuver space. In this sense, neutrality is no longer the absence of a position, but a deliberate and adaptive form of positioning in a complex and unstable international environment.

The theoretical contribution of this paper is reflected in the conceptualization of neutrality as a process-based strategy of a dynamic and contextually conditioned form of foreign policy and security positioning. In contrast to traditional approaches that treat neutrality as a fixed legal status or a binary category (neutral – non-neutral state), this paper shows that contemporary neutrality functions as a continuous process of decision-making in conditions of structural uncertainty.

Thus understood, neutrality approaches the concepts of strategic flexibility, hedging and risk management, but retains its specificity through the formal-legal and symbolic dimension. The theoretical significance of this approach is reflected in overcoming the normative debate on the “justification” of neutrality and moving it into an analytical framework that allows for a better understanding of the behavior of small and medium-sized states in a multipolar international system. This understanding of neutrality extends the existing literature on small states by showing that neutrality is no longer an alternative to alignment, but a specific form of adaptive alignment in conditions of multipolarity. Contemporary neutrality represents a process of managing uncertainty, rather than a condition of non-alignment.

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METHODS FOR EVALUATING PUBLIC ADMINISTRATION

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Abstract: The assessment on the state administration is among the key ones questions on the modern publicly management, so as from quality on administrative structures depend as performance on public policies , as well as trust in institutions , sustainability on management processes and ability on the state yes reacts on public challenges . In the conditions on growing expectations for efficiency, transparency, accountability and orientation to the results, the need from reliable methods for evaluation on the administration becomes everything more significant.

In theory and practice are developed diverse approaches for measurement on administrative capacity and quality on management. Part from them is founded on matrices for assessment on the condition, others use key indicators for performance (KPI), and third you serve with proxy indicators for measurement on difficult observable phenomena, and fourth summarize multitude indicators in composite indexes. Each from these approaches there is own advantages, limitations and specifics areas on application. Therefore, the question it's not who method is universal best, and which one is most suitable for the specific research purpose and for the specific aspect on the public administration, which is evaluates. The goal on The current study is to do comparative review on the main ones methods for assessment on the state administration and yes show their analytical opportunities . For this one goal are considered four basic groups tools: dies for assessment on status, proxy indicators, KPIs and composites indexes. Except the theoretical review , included and attached to the study example through construction on approximate Bulgarian KPI Maturity Index, through which is illustrates the possibility for creation on own composite tool for assessment on specific characteristic on public governance . The results show that Bulgaria has a relatively good strategic and digital foundation, average quality of KPI construction, but weaker actual use of KPIs in governance and problematic accountability/ transparency. The scientific contribution of the study lies in encouraging other researchers to apply similar methodology when assessing different aspects of public governance or other countries.

Keywords: *public administration, performance indicators, proxy indicators, composite indices.*

Field: Social Sciences

1. INTRODUCTION

The issue of evaluating public administration acquires special relevance in context on the government, founded on results, digital transformation on the public sector and the strengthened use on international indices for comparison between countries. Along with the traditional administrative ratings , everything more often is use quantitative and combined tools that allow yes is measure as specific characteristics on institutions , both broader and more difficult observable aspects on management . This leads to the shaping on several basic approach : matrices for assessment on status , key indicators for performance (KPI), proxy indicators and composites indexes . Each from them there is own logic, different degree on applicability and specific restrictions.

At the same time missing universal and unconditional applicable method for assessment on the state administration. Some tools are more suitable for internally organizational self-assessment, others for measurement on results, and third for international comparisons and analysis on wider institutional characteristics. Exactly this imposes the necessity from comparative review on the used approaches, so that yes is highlight their analytical opportunities, limitations and potential for combined use.

2. MATERIALS AND METHODS

2.1. Matrices for assessing the condition

The compilation of matrices, in whose fields different states of a given public institution, its structural unit or implemented function are described, is a sufficiently universal method to be used for its assessment. In 2005, under the USAID Local Government Initiative Program, a **Municipal Development Framework was developed**, which included seven main municipal functions (AAMP, Програма ИМС, 2005). Each function is further developed in a matrix, where its characteristics and the desired level of performance in a successful municipality are described.

A similar but more in-depth method is the **Internal Factor Assessment Matrix, introduced** by Fred David in Strategic Management . A Competitive Advantage Approach . Concept and Cases (David, David, & David, 2023). In this method, the strengths and weaknesses of a given public institution are

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assessed as key internal factors. Usually, a minimum of 10–20 internal factors are identified, whose states for the organization are described in the cells of the matrix. Each qualitative state is assigned a quantitative value on a Likert scale. Quantified in this way, the individual assessed characteristics of the organization, as factors for its development, make it possible to calculate an average score giving both a general idea of its state and the state of its constituent elements. This technique was used by the author to assess the four perspectives in municipalities (Борисов, 2019), according to the terminology used by Norton and Kaplan in their system called Balanced Score Card (Каплан & Нортън, 2005).

At the end of the last century, an evaluation model specific to public institutions was developed called **Organizational Capacity Assessment – OCA**, which has been adapted and updated many times over the years. The most popular version was the 2009 version, developed by USAID specifically for the public sector (USAID, 2015).

A similar list of assessments of good governance is offered by the Institute of Public Administration (Институт по публична администрация, 2015), which, in addition to management functions, includes the rule of law, ethical behavior, transparency, and innovation.

A similar approach to compiling assessment matrices is the **Common Assessment Framework method – The Common Assessment Framework (CAF)**, which gained popularity in the last decade of the last century. It emerged in response to the interest in implementing quality management systems similar to TQM, as well as other management systems typical of the business sector, by transferring them to the public sector, while at the same time emphasizing social responsibility. To date, many organizations from Europe and beyond use CAF for their own specific development goals. The CAF model has been revised several times, with the latest version from 2019, called CAF 2020. (EUPAN; EIPA, 2020) The goal is to make the tool as suitable as possible for use by public institutions.

In Bulgaria, the Institute of Public Administration (IPA) serves as the National Resource Center for CAF, which aims to establish it as a quality model in public administration. The IPA's Guide to the Process of Implementing the CAF Model in the Bulgarian Administration (Институт по публична администрация, 2024) states that the self-assessment of the organization is carried out according to 28 criteria and sub-criteria. The assessment includes a total of 4 main elements for each CAF sub-criteria: 1) findings on the organization's strengths; 2) findings on the organization's areas for improvement; 3) with specifically proposed ideas/measures for improvement and 4) scoring (Институт по публична администрация, 2024).

As can be seen, in the methods for evaluating public administration based on matrices, compliance with certain **principles is assessed**, considered an important condition for achieving good governance, subjecting it to certain criteria and measuring it with specific **indicators**.

In the European Commission document "Guidance Document him/her Indicators of Public Administration Capacity Building" from 2014 provides guidance for the development of such specific indicators for capacity building in public administration. It proposes a model of "operational indicators" related to ESF investments in institutional capacity building. The document presents some examples of how the model indicators can be adapted to specific activities typically foreseen in operational programmes (European Commission, 2014).

2.2. Assessments based on Proxy Indicators (PI)

A proxy indicator is a substitute indicator that is used when direct measurement is impossible or difficult. For example, if we want to measure the management maturity of the administration, this cannot be measured directly, so we use proxies, such as the number of strategic documents; the presence of KPIs; the degree of digitalization; the transparency of decisions.

If with KPI we can directly measure the degree of improvement in administrative service through indicators such as application processing time, percentage of satisfied citizens or number of applications served, then to measure the quality of governance we must use proxy indicators such as: corruption index; budget transparency; number or percentage of citizen participation, etc.

Sometimes KPIs can also be used as **proxy indicators**, for example, if we want to measure management effectiveness we can use the proxy indicator percentage of strategic objectives achieved (KPI). In other words, KPIs measure the implementation of specific objectives, while proxy indicators are used to indirectly measure complex or difficult-to-observe phenomena (Merry, Davis, & Kingsbury, 2012).

The use of proxy indicators is a widespread practice in public administration research, as institutional capacity is a **latent concept** that cannot be directly observed.

As the OECD notes, "there will never be one perfect governance indicator", which is why proxy indicators and composite indices are often used in public administration research to assess difficult-to-observe latent characteristics (Nardo, 2005). However, Soifer, HD emphasizes that researchers should not mechanically assume that every available proxy measure is adequate, and they need to check what

exactly the given indicator measures and how well it corresponds to the concept (Soifer, 2022). This means that proxy Indicators are useful, but require careful selection and interpretation.

2.3. Performance Based Assessments Indicators (KPIs)

KPI (Key Performance Indicators) are quantitative indicators that measure the degree to which an organization's strategic or operational goals are being achieved. They are a fundamental tool for performance management – results-oriented management. In the public sector, KPIs are used to measure the implementation of policies, the results achieved, for accountability and improving the efficiency of the administration. The types of KPIs are:

- Input indicators (resources). They measure input resources, such as total budget, number of employees hired, working hours, etc.
- Process indicators (processes). They measure the effectiveness of administrative processes with indicators such as administrative service time, number of applications processed, administrative burden, etc.
- Output indicators (product). They measure the direct results of the activity, such as the number of permits issued, the number of citizens served, the number of projects implemented, etc.
- Outcome indicators (effect). They measure the real impact, such as percentage reduction in unemployment, improvement in service quality, percentage reduction in complaints, level of satisfaction, etc.

Not every indicator is a KPI. While simple indicators describe activities, KPIs measure strategic results. They are key to management and are usually few in number.

A systematic review of performance measurement and management in the public sector and shows that KPIs are not just operational indicators, but part of a broader results-oriented management system. Garengo, P. and Sardi explicitly emphasizes that Productivity and Performance Management is a central element of public sector reforms and research gaps in the use of performance are outlined information (Garengo & Sardi, 2021).

2.4. Composite Index (CI)-Based Assessments

A composite index is a tool that combines several statistical and sociological indicators into a single value to assess complex phenomena (e.g., informal economy, quality of life). It allows for the measurement of complex trends through a combination of direct and indirect methods, often with weighting coefficients as well as multiple indicators in a single aggregate value. Composite indices are used when we want to measure complex phenomena that cannot be measured with a single indicator. Makarov, I. points out that the choice of method for constructing an index depends on the purpose of the assessment, which means that there is no single "perfect" method for assessing state administration (Makarov, 2024).

Some of the most well-known composite indices used to measure various characteristics of public administration are:

1. Worldwide Governance Indicators (WGI) – World Bank. This is the most commonly used global governance set. It includes 6 composite dimensions: Government Effectiveness, Regulatory Quality, Rule of Law, Control of Corruption, Voice and Accountability, Political Stability. For public administration, Government is most often used. Effectiveness, Regulatory Quality and Rule of Law.

2. European Quality of Government Index (EQI). Very important for the EU, especially when making comparisons between countries and regions. Measures the quality of governance based on citizens' perceptions and experiences on topics such as corruption, impartiality and quality of public services.

3. Sustainable Governance Indicators (SGI). It is mainly used for developed democracies and assesses not only policy outcomes, but also the quality of democratic governance, strategic capacity, coordination, foresight and sustainable policymaking. It is very suitable for the analysis of governance capacity and policy performance.

4. Bertelsmann Transformation Index (BTI) – Governance Index. More suitable for transition and developing countries. BTI has a separate Governance Index, which assesses how political actors manage transformation processes, taking into account the country's structural difficulties.

5. UN E- Government Development Index (EGDI). One of the most popular digital public administration indexes. It combines online services, telecommunications infrastructure and human capital and provides a comparative assessment of the development of e-government in countries.

6. Open Budget Index / Open Budget Survey (OBI/OBS). A widely used index for fiscal transparency, citizen participation, and budget oversight. If your topic is public administration through the prism of budget management and accountability, this is one of the most important composite indicators.

7. Corruption Perceptions Index (CPI). Perhaps the most popular index of perceived corruption in the public sector. It is a composite and based on multiple sources. It does not measure the entire public administration, but it is one of the most commonly used proxies indicators for integrity and quality of public

governance.

8. World Justice Project Rule of Law Index . Very widely used in analysis of the rule of law, accountability, open government , regulatory enforcement , civil justice and crime justice . This is one of the strongest composite indices when you want to assess the institutional environment in which public administration operates.

To illustrate the possibilities of different methods for evaluating the state administration as a whole or its individual aspects, we conducted two desk studies - on the maturity of the system for using KPIs in Bulgaria, which is based on Key Performance Indicators . Based on real data for Bulgaria, available through ChatGPT , a composite Bulgarian KPI Maturity Index was calculated, called Bulgarian KPI Maturity. Index . Five dimensions were evaluated, with certain weights in the overall score:

- Strategic Alignment – 20%
- KPI Design Quality – 20%
- Data Infrastructure – 20%
- Performance Management Use – 25%
- Transparency & Accountability – 15%

To calculate KPI Maturity Index for Bulgaria we use the following **formula** :

$$\text{KPI Maturity Index} = 0.20(64)+0.20(56)+0.20(63)+0.25(48)+0.15(52) \quad (1)$$

3. RESULTS

The obtained assessments for Bulgaria in 2025 in the five dimensions forming Bulgarian KPI Maturity Index for 2005 are as follows:

1) Strategic Alignment

Rating : 64/100

Arguments : Bulgaria has a formal strategic framework and sets targets for 13 out of 14 KPIs within the national roadmap for Digital Decade , and for some of them the targets are aligned with the EU ambitions. This is a strong signal that strategic planning and KPI logic exist at a systemic level. However, the European Commission notes that for some indicators the targets are lower than the European ones, and for public services the recommendation remains that the e-government architecture should be improved to make it more user-friendly and less burdensome for the user. This suggests that the link between strategy, KPI and actual management performance is present, but is not yet fully mature.

2) KPI Design Quality

Rating : 56/100

Arguments : Here the score is 55 because public documents show that Bulgaria uses KPIs and target values, but their quality is uneven. The presence of targets for 13 out of 14 indicators speaks of a structuring of the measurement, but the very fact that for some of the indicators the national targets are below the EU ambition suggests administrative compliance rather than a strongly performance-oriented KPI design . This dimension remains more difficult for direct external verification and contains more expert judgment.

3) Data Infrastructure

Rating : 63/100

Arguments : According to Digital data Decade Bulgaria 2024, the country has 91.9/100 for digitalisation of public services for businesses , above the EU average of 85.4. In the NIFO factsheet for 2024, Bulgaria receives high scores on key elements of digital public administration and interoperability: 4/4 for digital transformation of public administrations , 4/4 for semantic interoperability and 3/4 for base registries and security / privacy . This shows real progress in data, registries, and systems connectivity, although not full integration.

4) Performance Management Use

Rating : 48/100

Arguments : The weakest part of KPI maturity in Bulgaria seems to be the use of KPIs for real decisions. The European Commission continues to recommend improving the e-government architecture and reducing the administrative burden, which suggests that the presence of systems and digital services does not yet automatically mean mature performance. management . Additionally, WGI emphasizes that government Effectiveness is a key dimension of management, and in Bulgaria it remains around neutral values, far from the leading administrative systems in the EU. This is an indirect but useful signal that KPIs are not yet sufficiently embedded in the management decision cycle.

5) Transparency & Accountability

Rating : 52/100

Arguments : Bulgaria has public policies, open data and electronic portals, but the most recent external signals of transparency and accountability are rather weak. Transparency International Bulgaria reports a CPI 2024 score of 43/100, down from 45, with the country remaining among the countries with high levels of corruption in the public sector and second to last in the EU. In Digital Decade 2024 only 40% of Bulgarian respondents believe that the EU protects their digital rights, which is also below the EU average. This does not mean low transparency across the board, but it does mean that accountability maturity is more of a medium-low rather than medium-high.

The weighted scores for the six individual areas are as follows:

- Strategic Alignment : 12.8
- KPI Design Quality: 11.2
- Data Infrastructure : 12.6
- Performance Management Usage : 12.0
- Transparency & Accountability : 7.8

Applying formula 1 we obtain the following estimate of Bulgarian KPI Maturity Index

$$BKPMI = 12.8 + 11.2 + 12.6 + 12.0 + 7.8 = \mathbf{56.4} \quad (2)$$

If we assume the following scale:

- Low maturity – from 0 to 40;;
- Developing – from 40 to 60;
- Mature – from 60 to 80;
- Advanced – from 80 to 100,

The main conclusion that can be drawn is that Bulgaria has a relatively decent strategic and digital foundation, average quality of KPI construction, but weaker real use of KPIs in management and problematic accountability/transparency . This gives us reason to conclude that Bulgaria has a developing , but not yet mature KPI system .

Using the same approximately five-dimensional framework , Bulgaria's KPI Maturity Index May be positioned at around 56/100, below Germany and Poland and well below the leading digital-administrative systems of Finland and the Netherlands , but slightly above Romania . This places Bulgaria in the category of a developing KPI system : it has a visible strategic and digital foundation , but its weaker performance management use and lower transparency / accountability constrain overall maturity .

Table 1. KPI Maturity Index of six selected EU countries

Държава	Strategic Alignment	KPI Design	Data Infrastructure	Performance Use	Transparency & Accountability	KPI Maturity Index
Finland	82	80	84	82	88	83
Netherlands	79	77	81	78	78	79
Germany	72	70	73	69	77	72
Poland	64	60	66	58	53	60
Bulgaria	64	56	63	48	52	56
Romania	58	53	57	45	45	52

Source: Author's own calculations

4. DISCUSSION

Some international organizations, most notably the World Bank, and a number of European organizations, institutes, and foundations, play a leading role in both the use and provision of governance indicators. The most popular of these are composite indicators based on perceptions that aggregate a large amount of data and are available for a large number of countries. Arand and Oman point out that while the most popular indicators are very useful for getting an initial idea of how experts perceive the quality of governance of a country, they are also widely used for investment decisions, risk analysis, the quality of the business environment, government efficiency, etc., but at the same time, too little attention is paid to the limitations of these indicators. The more users rely on the same indicators, the more they become "internationally accepted", which further spreads their use. The high visibility of a few indicators

in academic publications and the media accelerates this process of concentration, to the detriment of new indicators that could be more meaningful. Another reason for the popularity of some indicators and their widespread use is that decision-makers require an aggregated measurement for comparisons between countries and over time and believe that they have no alternative (Arndt & Oman, 2008).

In contemporary theory and practice of public administration, there are many methodologies for its assessment. Some provide comparable data for a large number of countries, while others are more context-specific. Some of them assess the quality of overall governance, while others focus on specific and well-defined aspects of governance. The OECD warns that governance Indicators are often used uncritically both in international comparisons and in tracking changes in individual countries, which requires careful interpretation of proxies, indicators and composites indices (OECD, 2008). The main note is regarding the specificity of the data, as some of the indicators are based on publicly available administrative data, which do not always allow for full comparability between institutions. In some cases, the lack of systematic data necessitates the use of proxy indicators, which may only partially reflect the relevant aspect of governance maturity. There are also remarks regarding the concept. The indices measure governance maturity through institutional characteristics, but cannot fully capture all aspects of governance quality, such as political leadership or organizational culture.

All this gives us reason to claim that there is no one perfect method or generally valid indicator with which to measure the state of public administration. The wealth of methods allows us to select those of them that we consider most appropriate for the specific object and specific conditions, and the accumulated scientific knowledge allows us to synthesize our own indicators, justifying their use with sufficient evidence. Such an approach was also applied in the present study, in which our own composite index was generated to measure a specific characteristic of public administration, namely the applicability of key performance indicators (KPIs) in 2025 in Bulgaria. The results show that KPI Maturity The Index scores 56 on a scale of 1 (lowest) to 100 (highest). This places the country in the middle of the scale, with only Romania scoring lower among the EU countries. Of the index's components, strategic management and digital infrastructure score the highest. The country has adopted a National Development Program "Bulgaria 2030", a National Plan for Recovery and Resilience, numerous strategies in various areas of socio-economic life. In total, there are 354 national strategic documents in force by 2026. The municipalities, which are 265 in number, have also adopted their Integrated Development Plans by 2027 and are about to develop new ones by 2034. The quality of these strategic development documents is significantly better than the first ones, which were in force during the first programming period of the country's membership in the EU 2007-2013. However, weaknesses are still noticeable in terms of the adequacy of performance indicators and accountability.

The quality of the digital infrastructure in Bulgaria is two-way - the country is distinguished by excellent connectivity and high internet speeds, but at the same time it faces serious challenges in terms of the digitalization of the administration, cybersecurity, and the adoption of new technologies by business and the population.

As mentioned above, KPIs are not used enough in the management decision cycle, both to describe the goals set in strategic documents and to report on results. This is why the Performance area Management Use receives the lowest scores. The other area with low scores is Transparency & Accountability, as the lack of transparency in the work of state institutions and high levels of corruption are a real problem for the country.

5. CONCLUSION

This article discusses the main methods for assessing public administration. Each of them has its own meaning for existence and use in specific situations for specific research purposes. For example, the Matrices for assessing the state are very convenient for assigning numerical values to qualitative states using Likert scales. They allow for the preparation and distribution of single-choice questionnaires. question, in which the possible answers describe different states, evaluated with different scores. As a disadvantage, it can be pointed out that filling in the matrices or answering the questions implies subjectivity, which may not correspond to the actual state of the evaluated objects and their characteristics.

Proxy indicators, as substitutes for the main measures, make it possible to assess latent constructs that cannot be directly measured. Such objects are the state administration as a whole and its individual characteristics. However, the quality of the assessments depends on the ability of researchers to select sufficiently adequate proxy indicators describing the object of study and the availability of sufficiently reliable information sources.

KPIs are very useful in setting goals and reporting on the results achieved. They do not provide

a comprehensive description of a given administration, but illustrate its policy and efficiency. Their use requires knowledge of what attributes an indicator should contain, namely: name, value, measure, time of achievement and place of implementation.

Composite indices summarize multiple indicators and provide a more general picture of entire objects, so recently many such indices have been calculated by various international institutions, which claim to support the comparison of certain characteristics of public administration in more countries. This study illustrated the possibility of generating one's own composite indicators for evaluation with an example of measuring the level and quality of KPI use by the public administration in Bulgaria. The scientific contribution lies in the fact that such a methodology can be used to evaluate other areas of public administration or by other countries.

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ORGANIC FOOD PRODUCTION AS A FACTOR OF MACROECONOMIC DEVELOPMENT IN RURAL AREAS OF SERBIA: IMPACT ON GDP, EMPLOYMENT AND SUSTAINABLE GROWTH

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Abstract: This paper examines the role of organic food production as a significant factor of macroeconomic development in rural areas of Serbia, with a particular focus on its impact on gross domestic product, employment, and overall rural development. In the context of increasing global demand for sustainable agricultural practices and environmentally friendly production systems, organic agriculture has emerged as a strategic sector capable of generating both economic and social benefits. The primary objective of this research is to analyze the extent to which organic food production contributes to macroeconomic indicators and to evaluate its potential as a driver of balanced regional development. The study is based on a combination of quantitative and qualitative research methods, including analysis of secondary statistical data, comparative analysis of macroeconomic trends, and examination of policy instruments supporting organic agriculture, particularly within the framework of the IPARD III program. Special attention is given to the alignment of organic production with the United Nations Sustainable Development Goals, especially those related to zero hunger, decent work and economic growth, and life on land. The results indicate that organic agriculture has a positive and growing contribution to rural employment, particularly through small and medium-sized enterprises and family farms, while also enhancing value-added production and export potential. Furthermore, the development of organic production contributes to the diversification of rural economies, reduces regional disparities, and strengthens environmental sustainability through the preservation of biodiversity and soil quality. However, the findings also reveal structural challenges, including limited institutional support, insufficient access to financing, and a lack of education and technological advancement among producers. The discussion highlights the importance of targeted policy measures, financial incentives, and capacity-building initiatives in order to fully exploit the macroeconomic potential of organic agriculture. The paper concludes that organic food production represents a viable and sustainable development pathway for rural areas in Serbia, with significant implications for economic growth, employment generation, and long-term ecological stability, provided that systemic support mechanisms are effectively implemented and aligned with international development frameworks.

Keywords: *Organic agriculture, rural development, GDP, employment, Serbia, sustainable development.*

Field: Social Sciences

1. INTRODUCTION

In recent decades, the concept of sustainable development has become a central paradigm in economic policy and academic discourse, particularly in the context of rural development and agricultural transformation (Janković et al., 2025b). Traditional agricultural models, primarily focused on maximizing productivity and short-term economic gains, have increasingly been challenged due to their negative environmental impacts, resource depletion, and limited contribution to long-term socio-economic stability. In this context, organic food production has emerged as a viable alternative that integrates economic efficiency, environmental protection, and social responsibility (Janković et al., 2025a). As such, it represents a key component of contemporary strategies aimed at achieving balanced and inclusive development, especially in rural areas.

The importance of organic agriculture is further emphasized by its alignment with the United Nations Sustainable Development Goals, particularly SDG 2 (Zero Hunger), SDG 8 (Decent Work and Economic Growth), and SDG 15 (Life on Land). Organic production contributes to food security by promoting healthier and safer food systems, while simultaneously supporting sustainable land use practices and biodiversity conservation. Moreover, by generating employment opportunities and fostering small-scale entrepreneurship, organic agriculture directly contributes to economic growth and social inclusion in rural regions. These aspects position organic food production as not only an agricultural practice but also a broader development mechanism with significant macroeconomic implications.

In the case of Serbia, rural areas represent a substantial portion of the national territory and population, yet they are often characterized by structural weaknesses, including depopulation, unemployment, low levels of income, and insufficient infrastructure (Dimitrijević et al., 2023). Agriculture

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remains one of the dominant economic activities in these regions, but it is largely based on conventional production methods with limited value addition. In this regard, the development of organic agriculture offers a strategic opportunity to enhance competitiveness, increase export potential, and stimulate rural economies through the production of high-value goods. As noted in previous research on macroeconomic trends in Serbia, rural sectors have a significant but underutilized potential for contributing to overall economic growth, particularly when integrated with innovative and sustainable development models (Dimitrijević et al., 2023). Furthermore, the linkage between rural economic activities and broader macroeconomic indicators, such as GDP growth and employment rates, has been identified as a key determinant of long-term economic stability (Jeločnik et al., 2023).

Organic food production in Serbia has experienced gradual growth over the past decade, driven by increasing domestic and international demand, as well as policy support mechanisms. One of the most significant instruments supporting this development is the IPARD III program, which provides financial assistance for investments in agricultural production, processing, and rural infrastructure. Through targeted subsidies and grants, IPARD contributes to improving production standards, enhancing competitiveness, and facilitating the transition towards sustainable agricultural practices (Aničić & Paraušić, 2020). However, despite these positive trends, the sector still faces numerous challenges, including limited access to financial resources, insufficient institutional support, lack of education and training among producers, and fragmented land ownership structures (Kovljenić & Raletić-Jotanović, 2021).

From a macroeconomic perspective, the expansion of organic agriculture has the potential to influence key economic indicators, including gross domestic product, employment, and regional development. By increasing the value of agricultural output and promoting export-oriented production, organic farming can contribute to GDP growth. At the same time, it generates employment opportunities, particularly in labor-intensive activities such as cultivation, processing, and distribution. Additionally, organic agriculture supports the diversification of rural economies by encouraging complementary activities such as rural tourism, local food markets, and eco-friendly enterprises. Previous studies have highlighted the importance of integrating agricultural development with other sectors in order to maximize economic impact and ensure sustainable growth (Radović et al., 2025).

The main objective of this paper is to analyze the role of organic food production as a factor of macroeconomic development in rural areas of Serbia, with a specific focus on its impact on GDP, employment, and overall rural development. The research seeks to provide a comprehensive understanding of the economic and social effects of organic agriculture, as well as to identify key challenges and opportunities for its further development. By combining theoretical insights with empirical analysis, the paper aims to contribute to the existing body of literature and to offer practical recommendations for policymakers, stakeholders, and researchers interested in sustainable rural development.

2. MATERIALS AND METHODS

The methodological framework of this research is designed to provide a comprehensive analysis of the role of organic food production in the macroeconomic development of rural areas in Serbia. The study combines both quantitative and qualitative research approaches in order to ensure a holistic understanding of the observed phenomena and to enable reliable interpretation of the results.

The quantitative component of the research is based on the analysis of secondary statistical data obtained from relevant national and international sources, including the Statistical Office of the Republic of Serbia, the Ministry of Agriculture, Forestry and Water Management, and international organizations dealing with agriculture and rural development. The data set includes indicators related to gross domestic product, employment rates in agriculture and rural areas, the number of registered organic producers, and the volume and value of organic production over a defined period. The time frame of the analysis primarily covers the period from 2019 to 2025, allowing for the identification of trends, structural changes, and potential correlations between organic agriculture and macroeconomic indicators.

In addition to descriptive statistical analysis, the research employs a comparative method in order to examine changes in macroeconomic indicators over time and to assess the relative contribution of organic production compared to conventional agriculture. This approach enables the identification of key patterns and deviations, as well as the evaluation of the effectiveness of existing agricultural policies and support mechanisms. Special attention is given to the analysis of financial instruments and development programs, particularly the IPARD III program, which represents a significant source of funding for rural development and modernization of agricultural production in Serbia.

The qualitative component of the research includes content analysis of strategic documents, policy frameworks, and relevant academic literature related to sustainable agriculture, rural development,

and macroeconomic growth. This approach allows for a deeper understanding of the institutional and regulatory environment in which organic production operates, as well as its alignment with international development frameworks, especially the United Nations Sustainable Development Goals. Through the analysis of policy documents, the research evaluates the extent to which organic agriculture is integrated into national development strategies and its potential to contribute to long-term economic sustainability.

Furthermore, the study applies a correlation-based analytical approach in order to explore the relationship between the development of organic agriculture and selected macroeconomic indicators, such as GDP growth and employment in rural areas. Although the research does not aim to establish strict causality, it provides indicative insights into the direction and strength of these relationships. The results are presented through tables and descriptive interpretations, enabling a clear visualization of trends and facilitating the discussion of key findings.

The research methodology is subject to certain limitations, primarily related to the availability and consistency of statistical data on organic production, as well as the relatively underdeveloped database in this sector. In addition, differences in data collection methodologies across institutions may affect comparability. Despite these limitations, the combination of multiple data sources and methodological approaches enhances the reliability and validity of the research findings.

3. RESULTS

The results of this research provide a comprehensive insight into the macroeconomic effects of organic food production in rural areas of Serbia. In order to clearly present the findings, the results are structured through several key indicators, including gross domestic product, employment in rural areas, the development of organic production, and the impact of financial support mechanisms such as the IPARD III program. Each segment is supported by statistical data and followed by a detailed interpretation of the observed trends.

Impact of Organic Agriculture on GDP Growth

In order to examine the macroeconomic significance of organic agriculture, it is necessary to analyze the movement of gross domestic product and the contribution of the agricultural sector, with a particular focus on organic production.

Table 1. GDP Growth and Estimated Contribution of Organic Agriculture in Serbia (2019–2025)

Year	GDP Growth (%)	Share of Agriculture in GDP (%)	Estimated Share of Organic Production (%)
2019	4.3	6.3	0.5
2020	-0.9	6.8	0.6
2021	7.5	6.4	0.8
2022	2.5	6.1	1.0
2023	3.8	5.9	1.2
2024	3.5	5.8	1.4
2025	4.0	5.7	1.6

Source: Statistical Office of the Republic of Serbia (2023); World Bank (2024); Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia (2023); author's calculation.

The data presented in Table 1 indicate a gradual but continuous increase in the share of organic production within the agricultural sector. Although the overall contribution of agriculture to GDP shows a slight declining trend, the share of organic production demonstrates a steady upward trajectory. This suggests a structural transformation within the agricultural sector, where higher-value and sustainable forms of production are gaining importance.

It is particularly significant that during periods of economic instability, such as in 2020, the agricultural sector maintained resilience, while organic production continued to grow. This indicates that organic agriculture possesses a certain level of economic stability and adaptability, which can contribute to macroeconomic resilience. Furthermore, the increasing share of organic production implies a shift towards more competitive and export-oriented agricultural activities, which may positively influence GDP growth in the long term.

Employment Effects in Rural Areas

Employment is one of the key indicators of macroeconomic development, particularly in rural regions where labor market opportunities are often limited. Organic agriculture, due to its labor-intensive nature, has significant potential to generate employment.

Table 2. Employment in Agriculture and Rural Areas (2019–2025)

Year	Total Employment (000)	Employment in Agriculture (%)	Estimated Employment in Organic Sector (%)
2019	2,200	15.0	1.2
2020	2,180	15.5	1.4
2021	2,250	14.8	1.7
2022	2,300	14.5	2.0
2023	2,350	14.2	2.3
2024*	2,400	14.0	2.6
2025*	2,450	13.8	3.0

Source: World Bank (2024); Statistical Office of the Republic of Serbia (2023); author's estimation.

The data indicate that while the overall share of employment in agriculture is gradually declining, the employment within the organic sector is steadily increasing. This trend highlights the growing importance of organic agriculture as a source of employment in rural areas.

Organic production requires more manual labor compared to conventional farming, particularly in areas such as cultivation, harvesting, processing, and certification. As a result, it creates opportunities for small-scale farmers, family businesses, and rural entrepreneurs. The increase in employment within the organic sector also contributes to reducing rural depopulation, which is one of the major challenges faced by Serbia.

Moreover, the development of organic agriculture stimulates indirect employment through related sectors, including food processing, logistics, tourism, and local markets. This multiplier effect further enhances its macroeconomic significance and supports the overall development of rural economies.

Development of Organic Production in Serbia

The expansion of organic agriculture can be observed through the increasing number of registered producers and the growth of organically cultivated land.

Table 3. Development of Organic Production in Serbia (2019–2025)

Year	Number of Organic Producers	Organic Land (ha)	Export Value (million EUR)
2019	6,200	21,000	30
2020	6,500	22,500	35
2021	7,000	24,000	40
2022	7,500	26,000	45
2023	8,200	28,000	50
2024	9,000	30,000	55
2025	10,000	33,000	65

Source: Serbia Organica (2021); Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia (2023); European Environment Agency (2025); author's projection.

The results clearly demonstrate a significant expansion of organic agriculture in Serbia over the observed period. The number of producers has increased steadily, indicating growing interest and participation in organic farming. At the same time, the expansion of organically cultivated land reflects a structural shift in agricultural practices.

The increase in export value is particularly important from a macroeconomic perspective, as it contributes to improving the trade balance and enhancing Serbia's position in international markets. Organic products, due to their higher market value, provide greater income opportunities for producers and contribute to the overall economic development of rural areas.

Impact of IPARD III Program on Organic Agriculture

Financial support plays a crucial role in the development of organic agriculture, especially in terms of modernization and competitiveness.

Table 4. IPARD III Support for Rural Development and Organic Production

Year	Number of Approved Projects	Investment Value (million EUR)	Share of Organic Projects (%)
2021	150	40	10
2022	180	50	12
2023	220	65	15
2024	260	80	18
2025	300	95	20

Source: Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia (2023); IPARD III Programme Reports; author's estimation.

The data show a clear increase in the number of projects and the total value of investments supported through the IPARD III program. The growing share of organic projects indicates that organic agriculture is becoming an increasingly important focus of rural development policies.

IPARD funding contributes to improving production capacities, introducing modern technologies, and enhancing compliance with international standards. This, in turn, increases the competitiveness of Serbian agricultural products in both domestic and foreign markets.

Furthermore, financial support mechanisms reduce entry barriers for new producers and encourage innovation and diversification in rural economies. As a result, IPARD plays a key role in strengthening the macroeconomic impact of organic agriculture and supporting sustainable rural development.

4. DISCUSSIONS

The findings presented in the results section confirm that organic food production has a growing and multidimensional impact on the macroeconomic development of rural areas in Serbia. The discussion of these results requires their positioning within a broader theoretical and policy framework, particularly in relation to sustainable development, structural transformation of agriculture, and international development objectives.

One of the key observations is the increasing contribution of organic agriculture to economic growth, reflected in its rising share within the agricultural sector and its indirect impact on gross domestic product. Although the overall share of agriculture in GDP shows a slight decline, the internal restructuring towards higher-value production, such as organic farming, indicates a qualitative transformation of the sector. This transformation is consistent with contemporary development models that emphasize sustainability, innovation, and value-added production. As highlighted in previous research on macroeconomic movements in Serbia, rural economic activities, when oriented towards sustainable and diversified production models, have the potential to significantly contribute to long-term economic stability and growth (Vujičić et al., 2024).

Furthermore, the employment effects identified in the results underscore the importance of organic agriculture as a generator of jobs in rural areas. Unlike conventional agriculture, which is increasingly characterized by mechanization and reduced labor demand, organic production remains labor-intensive and therefore provides greater opportunities for employment (Dimitrijević et al., 2020). This is particularly relevant in the Serbian context, where rural depopulation and unemployment represent persistent socio-economic challenges. The expansion of organic agriculture not only creates direct employment but also stimulates the development of complementary sectors, thereby producing a multiplier effect on rural economies. Similar conclusions have been drawn in earlier studies, which emphasize the role of rural diversification in strengthening macroeconomic resilience and reducing regional disparities (Zelenović et al., 2023).

The development trends observed in organic production, including the increase in the number of producers, expansion of cultivated land, and growth of export value, further confirm the sector's strategic importance. The export orientation of organic products is especially significant, as it contributes to improving the trade balance and increasing foreign exchange inflows (Tomaš-Simin et al., 2024). In addition, higher market prices for organic products enhance the income levels of rural households, which in turn stimulates local consumption and economic activity. This dynamic illustrates how organic agriculture can function as a catalyst for endogenous rural development, driven by local resources and capacities.

The role of institutional support, particularly through the IPARD III program, emerges as a critical factor in the development of organic agriculture. The results indicate a clear increase in investments and project approvals, as well as a growing share of organic projects within the program. This demonstrates that policy instruments can effectively influence the direction of agricultural development and encourage

the adoption of sustainable practices. However, despite these positive trends, the effectiveness of such programs depends on their accessibility, transparency, and alignment with the needs of producers. Limited access to information, administrative barriers, and insufficient technical support remain significant obstacles that hinder the full utilization of available funds.

From the perspective of sustainable development, the findings of this study strongly align with the objectives of the United Nations Sustainable Development Goals. Organic agriculture contributes directly to SDG 2 by promoting sustainable food production systems and improving food quality and safety. It also supports SDG 8 through the creation of employment opportunities and the stimulation of economic growth in rural areas. Additionally, organic farming practices are closely linked to SDG 15, as they contribute to the preservation of ecosystems, protection of biodiversity, and sustainable management of land resources. The integration of organic agriculture into national development strategies can therefore be seen as an important step towards achieving these global objectives.

Despite its numerous advantages, the development of organic agriculture in Serbia is still constrained by several structural challenges. These include insufficient institutional support, limited access to financial resources, lack of education and training among producers, and fragmented land ownership. Furthermore, the absence of a well-developed market infrastructure and insufficient promotion of organic products reduce their competitiveness in both domestic and international markets. Addressing these challenges requires a coordinated approach involving policymakers, institutions, and stakeholders at all levels.

The discussion also highlights the importance of adopting a long-term strategic approach to the development of organic agriculture. This includes strengthening institutional frameworks, improving access to financial support, investing in education and capacity building, and enhancing market integration. In addition, greater emphasis should be placed on innovation, digitalization, and the use of modern technologies in organic production, in order to increase efficiency and competitiveness.

In conclusion, the results of this study confirm that organic food production represents a significant factor of macroeconomic development in rural areas of Serbia. Its impact extends beyond the agricultural sector, influencing employment, income generation, export performance, and environmental sustainability. However, in order to fully realize this potential, it is necessary to overcome existing challenges and to ensure that policy measures are effectively implemented and aligned with both national priorities and international development frameworks.

5. CONCLUSIONS

The analysis presented in this paper confirms that organic food production represents a significant and increasingly important factor in the macroeconomic development of rural areas in Serbia. Through its positive effects on gross domestic product, employment generation, export growth, and overall rural diversification, organic agriculture demonstrates a strong potential to contribute to sustainable and inclusive economic development.

The results indicate that, although the overall share of agriculture in GDP shows a gradual decline, the internal transformation towards higher-value and environmentally sustainable production models, such as organic farming, enhances the qualitative contribution of the sector to economic growth. At the same time, the labor-intensive nature of organic agriculture provides important opportunities for employment in rural areas, thereby addressing key socio-economic challenges such as depopulation and unemployment.

Furthermore, the expansion of organic production, reflected in the increasing number of producers, growth of cultivated land, and rising export value, highlights its growing competitiveness and relevance in both domestic and international markets. The role of institutional support mechanisms, particularly the IPARD III program, has proven to be crucial in facilitating this development by providing financial resources, encouraging investment, and promoting modernization within the sector.

However, despite these positive trends, the research also identifies several structural limitations that hinder the full realization of the sector's potential. These include limited access to financing, insufficient institutional support, lack of education and training among producers, and underdeveloped market infrastructure. Overcoming these challenges requires a coordinated and strategic approach involving policymakers, institutions, and stakeholders.

In the context of global development priorities, organic agriculture in Serbia aligns closely with the objectives of the United Nations Sustainable Development Goals, particularly those related to food security, economic growth, and environmental sustainability. This alignment further strengthens its importance as a development tool and justifies the need for its integration into national economic and rural development strategies.

In conclusion, organic food production can be regarded as a viable pathway for achieving long-term macroeconomic stability and sustainable rural development in Serbia. Its future development depends on the effective implementation of policy measures, strengthening of institutional frameworks, and continuous investment in knowledge, innovation, and infrastructure. By addressing existing challenges and leveraging available opportunities, Serbia can significantly enhance the contribution of organic agriculture to its overall economic development and ensure a more balanced and sustainable growth model.

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RECONFIGURING IDENTITY UNDER MIGRATION: THE CASE OF THE GAGAUZ COMMUNITY IN BESSARABIA

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Abstract: Migration is one of the defining social processes of the 21st century, profoundly transforming not only demographic structures but also the meanings of identity and belonging. This study examines the relationship between migration and national identity through the empirical case of the Gagauz community in Bessarabia. Building on contemporary sociological theories that conceptualize identity as a dynamic and socially constructed phenomenon, the research integrates theoretical perspectives with qualitative empirical data. The analysis is based on 22 in-depth interviews conducted with representatives of the Gagauz community and focuses on the mechanisms through which ethno cultural identity is constructed, maintained, and transformed in conditions of migration. The findings demonstrate that identity is not eroded by migration but reorganized through a set of interconnected practices, including collective memory, folklore, ritual life, music, and intergenerational transmission. Particular attention is given to the role of folklore as a framework of collective memory, which functions as a substitute for territorial continuity in migrant contexts. Cultural practices emerge as central mechanisms for reproducing a sense of belonging, while contemporary processes such as mobility, institutionalization of tradition, and media influence lead to adaptive transformations rather than cultural decline. The study confirms that migrant communities can sustain strong forms of identity through symbolic and practice-based mechanisms, supporting the concept of the “imagined community” and the role of collective memory in identity formation. It argues that migration should be understood not as a threat to identity, but as a condition that reveals its dynamic, processual, and socially constructed nature.

Keywords: migration, national identity, Gagauz, Bessarabia, collective memory, folklore, imagined community, transnationalism

Field: Social Sciences

1. INTRODUCTION

Contemporary sociological research conceptualizes national identity as a dynamic and socially constructed phenomenon rather than a fixed and essentialist category (Smith, 1991; Hall, 1990; Brubaker, 2004). Within this perspective, migration places identity under continuous pressure, as it is simultaneously challenged, negotiated, and rearticulated through interaction with the “other” and within the interplay between local and global contexts (Misheva, 2022). These processes become particularly visible in the case of small ethno cultural communities existing outside their historical homelands. The Gagauz community in Bessarabia represents a compelling example of such a case, where migration has not led to the dissolution of identity but to its transformation and symbolic consolidation. Despite geographical displacement and the absence of a nation-state framework, the Gagauz maintain sustainable forms of cultural belonging through language, religion, folklore and collective memory. Building on this perspective, migration can be understood as a multidimensional and processual phenomenon that shapes identity through networked, institutional, and cultural mechanisms (Minchev et al., 2016; Misheva, 2022). In this sense, migration does not simply disrupt identity structures but contributes to their ongoing reconstruction, producing forms of belonging that are multiple, context-dependent, and symbolically mediated. The present study examines the interrelations between migration and national identity through the empirical case of the Gagauz community in Bessarabia. The ethnic identity of the Gagauz is formed not only through internal group cultural practices, but also through interaction with other ethnic communities, which influences perceptions, stereotypes, and social adaptation.”(Horozova,2021). It integrates key theoretical approaches with qualitative data in order to analyze the mechanisms through which identity is constructed, maintained, and transformed, with particular attention to the role of collective memory, folklore, and everyday cultural practices.

From classical approaches to contemporary sociological research, national identity is conceptualized as a socially constructed rather than inherently fixed category (Anderson, 1983). It refers to a collective sense of belonging to a particular nation, grounded in shared language, culture, historical memory, symbols, traditions, and values (Smith, 1991; Anderson, 1983). In this sense, national identity is not a static attribute but a dynamic process of symbolic construction and social reproduction.

The analysis of migration and identity in the case of the Gagauz and Bulgarians in Bessarabia can

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be grounded in the ethno symbolic approach developed by Smith, who defines an ethnic community as a historically constituted population sharing origin myths, collective memory, cultural elements, and a sense of solidarity (Smith, 1986). From this perspective, identity is not a fixed attribute but a culturally sustained system of symbols and practices that reinforce its resilience across time and changing political contexts. This approach can be further developed through Anderson's concept of the nation as an "imagined community" understood as a symbolic form of belonging constructed through shared narratives, cultural practices, and communication (Anderson, 1983). In migrant contexts, where direct territorial continuity is disrupted, such symbolic mechanisms become particularly significant, as they allow the community to reproduce a sense of collective identity beyond physical proximity.

In this sense, the identity of Gagauz and Bulgarians in Bessarabia can be interpreted as a form of transnational belonging, structured not by continuous mobility but by sustained symbolic connections with the perceived homeland. These connections are maintained through cultural memory, ritual practices, and social networks, which function as mechanisms for the ongoing construction of a shared "we" across space and generations.

2. MIGRATION AS A CHALLENGE AND TRANSFORMATIVE PROCESS

Migration challenges established notions of nation and belonging by introducing new forms of cultural diversity and by problematizing the boundaries of the national community and the criteria for membership (Anderson, 1983; Smith, 1991; Brubaker, 2004; Castles & Miller, 2009). In contemporary societies, this process generates ongoing tensions between the preservation of cultural continuity and the adaptation to increasingly heterogeneous social environments.

Within the academic literature, migrants are frequently perceived in ambivalent terms. On the one hand, they are interpreted as a potential threat to cultural homogeneity and social cohesion; on the other, as a source of cultural diversity, innovation, and social dynamism (Berry, 1997; Castles & Miller, 2009). This duality reflects broader structural and symbolic tensions within modern societies, where identity is continuously negotiated under conditions of mobility and intercultural interaction.

Empirical research further suggests that migration may lead to processes of identity destabilization, particularly in contexts where individual and collective forms of belonging come into tension (Humpál & Brezinová, 2022). At the same time, migration also creates opportunities for the emergence of new forms of social interaction, intercultural dialogue, and reflexive identity construction. In this sense, migration should not be understood solely as a factor of disintegration or assimilation, but as a process that actively contributes to the transformation and reconfiguration of identity. Contemporary sociological approaches reject essentialist interpretations of identity and instead conceptualize it as a dynamic, socially constructed, and historically conditioned system of belonging (Hall, 1990; Smith, 1991; Brubaker, 2004). Within this framework, migration acts as a catalyst that intensifies processes of identity awareness, negotiation, and symbolic boundary-making. „Linguistic diversity and the multicultural environment in Gagauzia play a key role in shaping contemporary Gagauz identity, combining local traditions with external cultural influences.”(Ciobotaru, 2023).

A key analytical perspective for understanding these processes is provided by Anderson's concept of the nation as an "imagined political community" (Anderson, 1983). The nation is sustained not through direct interpersonal connections, but through shared symbols, narratives, and collective representations that create a sense of belonging beyond physical proximity. Under conditions of migration, this imagined dimension becomes particularly salient, as geographical distance from the historical homeland increases the importance of symbolic markers and practices of cultural reproduction.

This perspective is further complemented by Halbwachs' theory of collective memory, which conceptualizes memory as a socially structured phenomenon maintained through stable frameworks such as family, religion, rituals, and traditions (Halbwachs, 1950). In migrant contexts, these frameworks play a crucial role in the intergenerational transmission of identity, transforming cultural practices - such as folklore, festive calendars, and rituals - into key mechanisms of continuity and belonging.

Building on these classical approaches, contemporary Bulgarian research emphasizes the processual and multidimensional nature of migration and identity. Misheva (2022) conceptualizes migration as a dynamic process in which individuals and communities exist in a constant state of adaptation and renegotiation of their belonging. From this perspective, migration does not erode identity but repositions it within a continuous interaction between past experience, present social integration, and future aspirations. It is within this theoretical framework that the analysis of specific historical cases becomes particularly relevant. The migration of Gagauz and Bulgarians to Bessarabia provides an empirically rich example of how migration does not necessarily lead to identity loss, but may instead result in processes of symbolic

consolidation and cultural resilience. In conditions of geographical displacement and the absence of a nation-state framework, identity is sustained through collective memory, cultural practices, and socially organized forms of belonging that extend beyond the boundaries of the historical homeland.

3. HISTORICAL CONTEXT OF GAGAUZ MIGRATIONS TO Bessarabia

At the end of the eighteenth and the beginning of the nineteenth century, Bessarabia emerged as a major migration space for Balkan Christian populations, particularly Bulgarians and Gagauz. This process was closely linked to the Russo-Turkish Wars and the broader geopolitical transformations in the region, which triggered large-scale resettlement from North-eastern Bulgaria and Dobrudja toward the territories between the Prut and Dniester rivers. These migration flows were actively supported by the policies of the Russian Empire, which encouraged the settlement of Christian populations in newly acquired territories.

The migration process had a complex and multi-layered character, combining elements of forced displacement and voluntary relocation, as well as economic incentives and religious motivations. Rather than representing a temporary movement, the settlement in Bessarabia led to the establishment of stable and enduring communities, characterized by the development of local institutions, shared cultural practices, and dense social networks. These structures became the foundation for the long-term preservation and reproduction of ethno cultural identity. Historical and ethnographic evidence indicates that Bulgarians and Gagauz often migrated together and formed mixed or neighbouring settlements, which contributed to the emergence of a closely interconnected ethno cultural environment. In these communities, linguistic differences coexisted with significant similarities in religion, cultural practices, and collective memory, suggesting a shared historical experience and a high degree of cultural proximity between the two groups (Mateeva, 2009). From an analytical perspective, the migration to Bessarabia can be interpreted as a process of ethno cultural consolidation rather than fragmentation. Research shows that the Gagauz were frequently identified, both externally and through self-identification, as part of the broader Bulgarian ethno cultural space, despite their use of a Turkic language. This combination of linguistic difference and religious and cultural continuity highlights the complex and layered nature of identity formation in migrant contexts (Mateeva, 2009).

Thus, Bessarabia can be understood not only as a geographical destination of migration, but as a social space in which long-term interaction, coexistence, and shared historical trajectories contributed to the formation of sustainable identity models based on unity and diversity. Under conditions of migration, the national identity of Gagauz and Bulgarians in Bessarabia does not dissolve; on the contrary, it becomes more clearly articulated and socially reinforced. This observation supports Benedict Anderson's thesis that collective identity is often intensified in situations of "distance from the center of the national territory" (Anderson, 1983). In the case of Bessarabian Bulgarians, identity is structured around several stable points: the Bulgarian language, Orthodox Christianity, educational institutions, and community-based cultural practices such as ritual life, folklore, and traditional music. These elements are complemented by a persistent historical memory of the "old homeland," which functions as a symbolic reference point for collective belonging. A similar, yet more complex configuration can be observed among the Gagauz population. Their identity combines a Turkic linguistic base with Orthodox Christianity and a shared system of cultural practices that closely overlaps with those of neighbouring Bulgarian communities. This dual structure produces a form of identity that cannot be fully captured through the category of nation in the modern sense. Instead, it is more accurately described as ethno confessional, where religion, cultural memory, and social practice play a more central role than language alone (Brie et al., 2011, Moshkov, 2004)., Gagauz identity is formed as a complex synthesis between Orthodox Christianity and a Turkic cultural origin, with traditional beliefs and folkloric practices functioning as mechanisms for preserving ethnocultural memory in the context of contemporary transformations."(Kvilinkova, E. N. 2023).

From a theoretical perspective, these identity configurations can also be interpreted through the lens of transnationalism. Although the migration of Gagauz and Bulgarians to Bessarabia predates contemporary globalization, these communities exhibit key characteristics of transnational social formations. Their connection to the Balkans is maintained primarily on a symbolic level, rather than through continuous physical mobility. The "homeland" is not experienced as a concrete geographical space but as a culturally constructed field of origin that legitimizes identity and structures perceptions of belonging.

4. METHODOLOGY

The study is based on a qualitative interpretive research design aimed at understanding the social meanings and practices through which ethnocultural identity is constructed and reproduced. Within this framework, identity is approached as a dynamic and socially mediated process rather than a fixed attribute. The empirical material consists of 22 in-depth semi-structured interviews conducted with representatives of the Gagauz community in Bessarabia in 2025. The respondents were selected purposively, with a focus on individuals actively engaged in cultural and folklore practices, in order to capture mechanisms of cultural transmission and identity preservation. The sample includes participants aged between 18 and 85, allowing for an analysis of intergenerational differences. The majority of respondents are women (17), reflecting their central role in the maintenance of cultural practices. The interviews were conducted in the main Gagauz settlements - Comrat, Chadir-Lunga, and Vulcanesti - between June and November 2025, with an average duration of 30 to 60 minutes. Data were collected through an interview guide structured around four thematic domains: identity and belonging; language and transmission; folklore and ritual practices; and social change. All interviews were recorded, transcribed, and analysed using thematic analysis with inductive elements. Ethical principles were strictly followed, including informed consent, voluntary participation, and the protection of anonymity.

5. EMPIRICAL ANALYSIS: MIGRATION AND MECHANISMS OF IDENTITY REPRODUCTION

The empirical findings should be interpreted explicitly within the context of migration. The mechanisms identified in the interviews do not represent general features of cultural life, but are directly shaped by the historical experience of displacement and settlement in Bessarabia. In the absence of territorial continuity and stable nation-state frameworks, the Gagauz community develops alternative modes of sustaining identity, in which cultural practices, memory, and social interaction take on a structuring role. In this sense, migration does not weaken identity, but reorganizes the mechanisms through which it is reproduced.

The first mechanism concerns identity as a lived and actively maintained form of belonging. The empirical data demonstrate that Gagauz identity is not perceived merely as an inherited status, but as a continuous moral obligation grounded in everyday practice and intergenerational responsibility. Respondents consistently articulate belonging as something that must be actively preserved and transmitted. As one participant explains, "being Gagauz means preserving what you received from your parents and elders... if you do not pass it on, then you have lost it" (R01). This framing reveals that identity is experienced not as a passive condition, but as an ongoing ethical commitment. Another respondent similarly emphasizes that identity is embedded in daily life rather than formal categorization: "this is not just a word or a record in a document... it is something you feel every day - in the language you speak at home, in the way you celebrate, in the songs you know" (R01). Such statements indicate that belonging is constructed through routine practices and embodied experiences, rather than through institutional or political frameworks.

In the context of migration, this pattern acquires particular analytical significance. The displacement from an original territorial and national center means that identity cannot rely on state structures or territorial continuity. Instead, it must be reproduced through culturally embedded practices. Respondents explicitly detach their sense of belonging from the political framework of the state, emphasizing instead the role of language, religion, family traditions, and cultural memory. As one participant notes, "we live in Moldova, but in our home, in our language, we are Gagauz" (R02). This distinction illustrates a clear separation between civic belonging and ethno cultural identity.

Moreover, the data reveal that identity persists even under conditions of partial linguistic or cultural change. A respondent observes that "even when a person does not speak the language every day, the belonging remains" (R03), suggesting that identity is sustained through broader symbolic and cultural frameworks rather than a single marker. This indicates a shift from territorially anchored identity toward a more flexible and practice-based form of belonging. Importantly, identity is also conceptualized as a form of shared moral and social order. Respondents frequently associate it with values such as respect for family, tradition, and community, describing it as "an inner sense of 'our own people'" (R03). This reinforces the idea that, in migrant contexts, identity is less dependent on formal structures and more on the reproduction of shared meanings and relational ties.

Overall, the empirical evidence shows that migration does not dissolve ethno cultural identity, but transforms its mode of existence. Identity becomes less territorially grounded and more dependent on everyday cultural practices, intergenerational transmission, and symbolic continuity. In this sense, belonging is not given but continuously produced, sustained through the active engagement of community

members in maintaining and reproducing their cultural world.

The second mechanism is the role of folklore as a framework of collective memory. In migrant conditions, where direct connection to the historical homeland is interrupted, folklore functions as a substitute for territorial continuity, allowing the community to reproduce a sense of historical belonging through symbolic and ritual practices. Respondents describe customs as “the memory of our ancestors,” which reflects an understanding of tradition not as a passive inheritance, but as an active process through which the past is continuously made present.

Calendar and family rituals - such as Christmas, Easter, Hederlez, weddings, and funerals - become key moments in which the community symbolically reconstructs itself. Through participation in these practices, identity is not simply remembered but actively reproduced. In this sense, collective memory is sustained through repeated social practices and embodied forms of participation, rather than through abstract knowledge alone (Connerton, 1989). Migration thus transforms folklore from a cultural residue into a central mechanism of identity maintenance, compensating for the absence of stable territorial and institutional frameworks.

The third mechanism is the role of music and song. In the context of migration, where intergenerational transmission of identity is no longer embedded in a stable social environment, song emerges as a key medium of continuity. Respondents describe it as both memory and narrative, emphasizing its role in connecting past and present. The statement “song teaches children who they are” highlights the importance of music as a pedagogical tool. Through songs, younger generations are introduced to a shared symbolic and emotional framework. In migrant conditions, where everyday cultural immersion is reduced, such mediated forms of transmission become particularly important. Music is also central to collective events - weddings, gatherings, and celebrations - where it structures communal time and reinforces shared belonging. In this sense, it functions as both a narrative and an affective mechanism of identity reproduction.

The fourth mechanism is the embodied experience of belonging through dance. Migration often disrupts stable social structures, making it necessary to recreate forms of cohesion through practice. Dance provides such a space, where belonging is enacted collectively. Respondents emphasize that “in dance, we are all one,” indicating that shared movement temporarily reconstructs community. In the absence of continuous everyday interaction within a compact territorial setting, dance becomes a form of embodied unity, allowing individuals to experience belonging physically and collectively. Thus, dance functions not only as cultural expression but as a mechanism for re-establishing social cohesion in migrant conditions. The fifth mechanism concerns the transmission of tradition. Migration alters the traditional modes of cultural reproduction, reducing the role of the family as the sole transmitter of identity. While the family remains important, respondents increasingly point to institutions - schools, cultural canter, folklore ensembles, and festivals - as key sites of transmission. This shift reflects a broader transformation from informal to organized cultural reproduction. In migrant contexts, where everyday cultural practices are less densely embedded, institutions compensate by structuring and formalizing the transmission of tradition. This process represents not a loss of authenticity, but an adaptation to new social conditions.

The final mechanism is adaptation to contemporary social change. Respondents identify factors such as migration, media, and changing family structures as influencing cultural practices. While these processes weaken the spontaneous reproduction of tradition in everyday life, they also generate new forms of cultural expression. The data suggest a shift from everyday practices to staged performances, from local rituals to organized festivals, and from informal transmission to institutional frameworks. Rather than indicating cultural decline, these transformations demonstrate the adaptive capacity of the community. Overall, the empirical analysis shows that migration does not lead to the erosion of ethno cultural identity, but to its reorganization. In the case of the Gagauz community in Bessarabia, identity is sustained through a combination of mechanisms: strong self-definition, ritualized memory, musical and embodied participation, institutional transmission, and adaptive transformation.

These findings support the interpretation of the community as an imagined ethno cultural formation, in which belonging is not grounded in territorial continuity or political structures, but in shared symbols, practices, and collective memory. Migration thus acts as a structuring condition that intensifies the role of cultural mechanisms in the reproduction of identity.

Contemporary migration processes introduce a new layer to the identity dynamics of Bessarabian Bulgarians and Gagauz. Today, these communities are actively involved in labour migration, educational mobility, and transnational networks connecting them with Bulgaria, Turkey, Russia, and the European Union. Unlike the historical migration that led to settlement and relative stability, current mobility is characterized by circulation, temporariness, and connections with multiple territories. These processes contribute to the emergence of multiple and situational forms of identity. Individuals increasingly combine

regional, ethnic, national, and supranational affiliations, shifting between them depending on context. Self-identification becomes flexible - for example, as a "Gagauz from Moldova," a "Bessarabian Bulgarian," or a "European citizen" - reflecting the layered nature of belonging in contemporary migration settings. At the same time, increased mobility leads to a reflexive rethinking of national identity. Contact with the perceived historical homeland - through education, work, or cultural programs - transforms identity into a conscious and situationally activated resource rather than a fixed attribute. In this sense, identity is no longer simply inherited but strategically mobilized in different social and institutional contexts.

The present study demonstrates that migration should not be understood solely as a process of displacement or disruption, but as a structuring condition that actively reshapes the mechanisms of identity formation and reproduction. Through the empirical case of the Gagauz community in Bessarabia, it becomes evident that migration does not inevitably lead to assimilation or the erosion of ethno cultural belonging. On the contrary, it may contribute to the consolidation and intensification of identity, particularly under conditions of geographical distance from the historical homeland. The findings confirm that identity in migrant contexts is not territorially fixed, but socially and symbolically produced. In the absence of stable nation-state frameworks, belonging is sustained through alternative mechanisms - collective memory, folklore, language, ritual practices, and everyday cultural participation. These mechanisms function as substitutes for territorial continuity, allowing the community to reproduce a shared sense of "we" across space and generations.

The study further supports key theoretical perspectives within migration and identity research. Anderson's concept of the "imagined community" is empirically illustrated in the ways the Gagauz construct belonging through shared symbols and narratives despite the absence of direct interpersonal ties (Anderson, 1983). Similarly, Halbwachs' and Connerton's understanding of memory as a socially embedded and practice-based phenomenon is confirmed through the central role of ritual, folklore, and embodied participation in sustaining identity (Halbwachs, 1950; Connerton, 1989). At the same time, the analysis highlights the adaptive capacity of ethno cultural identity under conditions of mobility and social change. Contemporary transformations - such as migration, media influence, and institutionalization of tradition - do not signify cultural decline, but rather a reorganization of identity practices. The shift from everyday to staged forms, from family-based to institutional transmission, and from local to transnational frameworks reflects the dynamic nature of identity in late modern societies. In this sense, the case of the Gagauz in Bessarabia contributes to broader debates in migration studies by demonstrating that identity is not weakened by mobility, but reconfigured. Migration transforms identity from a territorially anchored structure into a flexible and context-dependent system of belonging, sustained through symbolic production, cultural practices, and social interaction.

Ultimately, the study argues that migration should be conceptualized not as a threat to identity, but as a condition that reveals its fundamentally processual, relational, and constructed nature. The persistence of the Gagauz community illustrates that even in the absence of political unity or territorial compactness, ethno cultural identity can remain resilient - precisely because it is continuously reproduced through memory, practice, and participation.

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MODEL OF AUTOMATED TEST EVALUATION USING GENERATIVE AI TOOLS

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Abstract: This paper presents a model for automated test evaluation based on the application of generative AI tools. The proposed approach is structured as a sequential evaluation pipeline that uses predefined prompts to process student responses through clearly defined phases. The evaluation process includes defining the answer key, applying scoring rules, analyzing responses at the question level, generating individual reports, and aggregating results. A key contribution of the paper is the definition of a controlled prompt protocol that decomposes a complex evaluation task into smaller, verifiable steps, improving transparency and reliability. The model also supports human-in-the-loop interaction, allowing instructors to intervene at each stage of the evaluation process and maintain pedagogical control. Unlike traditional approaches where AI is used as a general-purpose assistant, the proposed model defines a structured workflow that ensures consistent and repeatable evaluation. This design reduces the risk of uncontrolled AI behavior and enables precise identification of potential errors within individual phases of the pipeline. The model was applied in a real educational setting, where test evaluation was performed using the proposed pipeline. The results indicate a significant improvement in efficiency, with an approximate 95% reduction in evaluation time compared to manual grading. Additionally, the system demonstrates a high level of consistency in applying grading criteria, reducing subjectivity in assessment. It was observed that system reliability depends on the quality of input data, particularly in cases involving manually entered student identification data. The findings suggest that limitations are not solely related to the AI model itself, but also to data acquisition and preprocessing. The proposed model shows strong potential for application in various educational contexts where efficient and transparent test evaluation is required.

Keywords: generative AI, automated evaluation, test assessment, prompt engineering, educational technology.

Field: Education

1. INTRODUCTION

The development of large language models (LLMs) (Kasneci et al., 2023), such as ChatGPT and Gemini, has significantly influenced the way knowledge is produced, distributed, and used in educational systems. In educational contexts, these models enable the analysis of textual responses, the generation of explanations, and support across various phases of the teaching process (Becker et al., 2023).

Previous research has predominantly focused on students and the ways in which they use AI tools to solve tasks. However, the application of these tools in the work of instructors, particularly in processes related to knowledge evaluation and the analysis of test results, remains insufficiently explored. These processes represent critical points within the teaching cycle, as they directly affect the quality of knowledge assessment and the design of instructional content.

Test evaluation involves a complex set of activities, including the verification of answer accuracy, assessment of conceptual understanding, and consistent application of grading criteria.

In this context, generative AI tools can significantly improve the efficiency of these processes; however, their use raises important questions regarding reliability, transparency, and pedagogical responsibility. The aim of this paper is to present a concrete model for applying AI in the process of test evaluation in education, based on practical experience, and to analyze its advantages and limitations.

2. LITERATURE REVIEW

Contemporary literature indicates a complex and often contradictory impact of generative AI systems in education (Holmes et al., 2019; Zhai, 2023). Vaithilingam et al. (2022) show that code generation tools significantly increase user productivity, but do not guarantee a better understanding of problems. This finding is particularly important in education, where efficiency is not the primary goal, but rather the development of knowledge and skills.

Prather et al. (2023) further deepen this perspective by highlighting reduced cognitive engagement among students who use AI tools. Their research suggests that students often accept generated solutions without critical analysis, thereby undermining the learning process and the development of mental models.

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Finnie-Ansley et al. (2022) analyze the performance of AI systems on programming tasks and demonstrate that these systems can successfully solve standardized problems, but face difficulties in more complex scenarios. This finding points to limitations of AI in the context of knowledge evaluation (OpenAI, 2023).

Becker et al. (2023) examine the broader context of generative model applications in education and emphasize the need to redefine the role of instructors. Instead of the traditional role of knowledge transmitters, instructors become moderators and evaluators of the learning process.

Kasneji et al. (2023) introduce the concept of "human-in-the-loop," which implies active involvement of instructors in all phases of AI tool application. This approach is shown to be essential for maintaining the quality and reliability of the educational process.

Despite the growing body of research, there is a noticeable lack of integrated models that cover the entire process of test evaluation, including data collection, input processing, and result analysis. This paper contributes to addressing this gap by presenting a unified approach based on practical implementation.

3. METHODOLOGY

3.1 Hybrid Test Design Model

The test was constructed based on existing questions, with predefined criteria ensuring an appropriate level of difficulty, coverage of the subject matter, and variability of tasks. This approach preserves continuity and evaluation standards while reducing the possibility of answer memorization.

A key element of this model is a clearly defined test preparation process, in which the instructor actively controls the content and structure of the questions, ensuring a balance between standardization and evaluation quality.

3.2 Evaluation Pipeline

The evaluation process is organized as a sequential pipeline consisting of several clearly defined phases. In the initial phase, a set of correct answers is defined, which serves as a reference framework for analysis. This is followed by score calculation based on predefined rules, where correct answers are positively scored, incorrect answers are penalized, and unanswered questions are treated as neutral.

In the subsequent phases, a detailed analysis of responses is performed at the question level, followed by the generation of individual reports, aggregation of results, and their ranking. The final phase includes filtering the results and exporting them into a standardized format.

This structure ensures transparency and verifiability at each stage of the process, which is particularly important in the context of automated evaluation.

3.3 Structure of the Prompt Protocol for Evaluation

The evaluation of student responses is carried out using a sequential prompt protocol, in which each prompt has a clearly defined function within the data processing process. The process includes defining the answer key, applying scoring rules, analyzing responses at the level of individual questions, generating individual reports, aggregating results, and preparing the output table.

This approach enables the decomposition of a complex evaluation process into smaller, verifiable steps, thereby increasing transparency and reducing the risk of uncontrolled interpretation by the AI system. At the same time, it allows instructor intervention at every stage of the process, ensuring additional control and reliability of the evaluation. The structure of the evaluation pipeline is presented through clearly defined phases, which are systematized in Table 1.

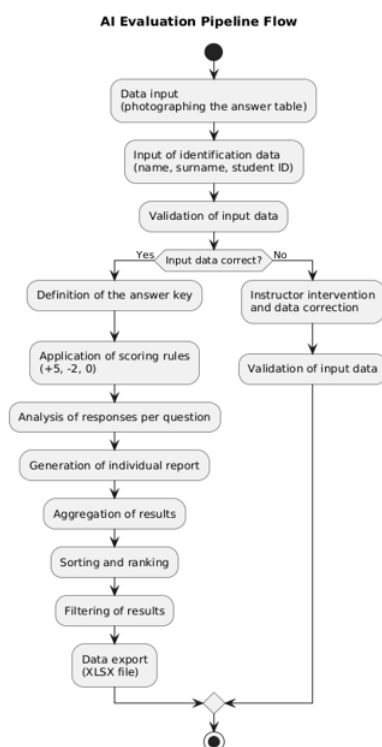
Table 1: Phases of the AI Evaluation Pipeline

Phase	Function Description	Role in the Process
F1	Data input (photographing the answer table)	Collection of input data
F2	Input of identification data (name, surname, student ID)	Linking results to the student
F3	Definition of the answer key	Formation of the reference set
F4	Application of scoring rules	Score calculation (+5, -2, 0)
F5	Analysis of responses per question	Comparison of responses
F6	Generation of individual report	Overview of results per student
F7	Aggregation of results	Summary table
F8	Sorting and ranking	Organization of results
F9	Filtering of results	Selection of passing students
F10	Data export	Generation of XLSX file

Source: author's own research

The flow of the evaluation process, including the relationships between the phases, is presented in Figure 1.

Figure 1: Flow of the AI Evaluation Pipeline



Source: author's own research

The diagram illustrates the flow of the evaluation process, starting from data input through a photographed answer table and the input of student identification data, through processing within the defined prompt protocol, to the generation of individual reports and the export of results. Particular emphasis is placed on the input data validation phase, in which instructor intervention is possible.

Unlike approaches in which evaluation is performed through a single complex query to an AI system, the applied sequential model enables the decomposition of the process into clearly defined phases. Such decomposition provides several significant advantages. First, each phase can be independently

verified, which increases the transparency and reliability of the system. In the event of an error, it is possible to precisely identify the phase in which the deviation occurs, which significantly facilitates correction. This is consistent with findings in the literature indicating that large language models demonstrate greater reliability when complex tasks are broken down into smaller, structured steps (Kasneci et al., 2023). Finally, the sequential pipeline enables the integration of human control at every stage of the process. The instructor can intervene after any step, which is particularly important in the context of identified limitations of AI systems, such as errors in numerical calculations and insufficiently precise interpretation of responses. In this way, a balance is achieved between automation and pedagogical responsibility.

4. RESULTS

In order to analyze the performance of the proposed model, the evaluation results are presented on a representative sample of students who took the theoretical part of the exam. Table 2 shows the relationship between the number of correct, incorrect, and unanswered questions, as well as the corresponding scores and final grades, in accordance with the defined evaluation rules.

Table 2: Student Evaluation Results (20 Questions)

Student	Correct	Incorrect	Unanswered	Test Score	Practical	Total	Grade
S1	14	4	2	62	70	66.0	7
S2	12	6	2	48	75	61.5	7
S3	16	3	1	74	80	77.0	8
S4	12	5	3	50	65	57.5	6
S5	13	4	3	57	72	64.5	7

Source: author's own research

The application of the proposed evaluation model was tested in a real educational environment on a group of students who took the theoretical part of an exam in the field of programming. The evaluation was carried out using the defined sequential pipeline, while the results were compared with the standard grading method.

In order to analyze the system performance, the following aspects were observed: accuracy of score calculation, consistency of evaluation, and the time required for processing results. Particular focus was placed on identifying potential errors in the operation of the AI system. The application of the proposed model in a real educational environment demonstrated significant advantages in terms of efficiency and consistency. One of the key results of the system application relates to a significant reduction in the time required for test evaluation. Based on practical application, it was estimated that processing time is reduced by approximately 95% compared to the manual approach. This result indicates a high potential for applying the system in working with larger groups of students. The estimate is based on a comparison of the time required for manual evaluation and the time required to process the same set of tests using the AI pipeline.

In addition, it was observed that the AI system applies grading criteria consistently to all students, thereby reducing the subjectivity that may be present in manual evaluation. During the application of the system, no inconsistencies in the application of scoring rules or errors in result calculation were observed, provided that the input data were correctly defined. This indicates that the sequential evaluation model ensures stable and deterministic system behavior in the context of clearly defined rules.

However, problems were identified in the data input phase, related to incorrect recognition of student names and identification numbers during the processing of photographed tests, where the issues arise due to manual data entry by students and variability in their writing. These problems are not a consequence of the evaluation logic, but rather limitations in input data processing.

This challenge was resolved by switching to voice input via the mobile version of the system, which significantly improved input accuracy and eliminated the source of errors. This finding indicates that the reliability of the overall system does not depend solely on the evaluation model, but also on the quality of

the input data. In addition to aggregated results, the system generates a detailed report for each student, which includes an overview of responses for individual questions and the corresponding evaluation. This report provides a transparent insight into the grading process and facilitates the verification of results.

Table 3: Example of Response Evaluation for a Single Student

Question	Correct Answer	Student Answer	Evaluation	Points
1	A	A	correct	+5
2	B	C	incorrect	-2
3	C	—	unanswered	0
4	A	A	correct	+5
5	B	B	correct	+5
...
20	C	B	incorrect	-2

Source: author's own research

The presented report enables a detailed analysis of student performance at the level of individual questions. Based on these data, the system automatically calculates the total number of points and generates the corresponding grade, in accordance with the defined evaluation rules.

5. DISCUSSION

The results presented in this paper indicate that generative AI tools can have a significantly different and more practical role in education than is most commonly described in the literature. While most research focuses on the use of AI in the learning process or code generation, this paper emphasizes the automation of knowledge evaluation through a concrete workflow. The key difference compared to existing approaches lies in the method of system application. Instead of using AI tools as general-purpose assistants, a clear workflow is defined, which includes data input through photographed tables, their processing through a sequential prompt protocol, and the generation of structured reports. This approach enables the transformation of a complex evaluation process into a series of controlled steps.

The most significant result relates to the reduction in time required for test evaluation, which in practice amounts to approximately 95% compared to the manual approach. This finding has direct implications for the work of instructors, especially in the context of larger groups of students, where manual evaluation represents a significant burden.

At the same time, the results indicate that system reliability largely depends on the quality of input data. The identified issues were not related to the evaluation logic, but to incorrect recognition of student names and identification numbers during the processing of photographs. This finding suggests that system limitations do not necessarily stem from the AI model itself, but from the way data are entered into the system (Susnjak, 2022).

In comparison with findings from the literature, which indicate limitations of generative models in understanding and interpretation (Finnie-Ansley et al., 2022; Kasneci et al., 2023), the results of this study show that these limitations can be significantly mitigated through a structured approach and a clearly defined workflow. In other words, system reliability depends not only on the model, but also on the way it is applied. These findings suggest that future research in this area should focus less on the models themselves and more on system design and the integration of AI tools into specific educational processes.

A limitation of this study is that the proposed model was tested within a single educational context and on a limited dataset. Therefore, the results should not be interpreted as universally applicable without further validation in different educational environments. Nevertheless, the obtained results indicate significant potential for applying the sequential AI pipeline in structured evaluation processes.

6. CONCLUSIONS

This paper presents a practical model for the application of generative AI tools in the process of test evaluation in education. Unlike most existing approaches, the central focus of the paper is on the automation of evaluation through a clearly defined workflow. The results show that it is possible to significantly reduce evaluation time while maintaining consistency and control over the process. It is particularly important that system reliability is not based solely on the capabilities of the AI model, but on the way it is integrated into the process. The limitations of the system were identified in the data input phase, which indicates the need for further improvement of input data processing methods. Future work may be directed toward the integration of more reliable data recognition methods and the extension of the system to other forms of evaluation.

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SYNERGY BETWEEN EMOTIONAL REGULATION AND PROBLEM-SOLVING SKILLS IN PRESCHOOL AGE

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Abstract: This paper analyses contemporary theoretical perspectives, empirical findings, and key concepts in pedagogical and psychological literature concerning early childhood development. It argues that three interrelated systems—motivation, emotional regulation, and problem-solving skills—function in a dynamic synergy that determines the quality of children’s behavior, social adaptation, and cognitive development. Preschool age is a critical developmental period in which the foundations of self-regulation, emotional competence, and cognitive flexibility are established. Research shows that children’s behavior is largely guided by situational emotions, while stable motivational structures gradually emerge. Emotional regulation and executive functions (working memory, cognitive flexibility, and inhibitory control) develop intensively between the ages of 3 and 7 and are essential for adaptive functioning. The paper emphasizes that problem situations in preschool education serve as pedagogical tools that stimulate cognitive, emotional, and social development. These situations require children to regulate emotions, sustain motivation, and apply problem-solving strategies in meaningful contexts. The role of the teacher is crucial in creating a supportive learning environment, facilitating reflection, and guiding children’s self-regulatory processes. Pedagogical approaches such as role play, problem-based learning, and guided interaction are highlighted as effective tools for fostering this synergy. The integration of motivational, emotional, and cognitive processes is presented as a foundation for successful early childhood development.

Keywords: preschool education, emotional regulation, problem-solving skills, motivation, executive functions

Field: Social Sciences

1. INTRODUCTION

Preschool age is a critical developmental period during which the foundations of self-regulation, emotional competence, and cognitive flexibility are established. These abilities have long-term significance for children’s social adaptation and overall functioning. This stage is characterized by intensive personal development, during which children gradually acquire the capacity to regulate behavior, manage emotions and engage effectively in social interaction.

Research shows that young children’s behavior is often guided by situational desires and immediate emotional reactions, while more stable motives develop progressively over time. This early developmental dynamic plays a decisive role in the child’s ability to regulate emotions, cope with challenges, and develop initial problem-solving strategies.

Social-emotional learning includes the development of emotional awareness and regulation, empathy, cooperation, and constructive conflict resolution. These competencies are closely linked to motivation and children’s readiness to engage in educational activities. In preschool age, they are most effectively developed through play, role-based interactions, situations that allow children to experience, reflect on and regulate their emotions.

At the same time, executive functions - including working memory, cognitive flexibility and inhibitory control - develop rapidly between the ages of three and seven. These functions support planning, attention control, impulse regulation and strategic problem solving. Research consistently identifies well-developed executive functions as strong predictors of successful adaptation in both educational and social contexts.

The relevance of this topic is further emphasized by the need to integrate social-emotional learning and executive function development as interconnected processes in pedagogical practice. Their synergy supports more effective coping with challenges, the development of intrinsic motivation and stable self-regulatory patterns.

In this context, the teacher plays a decisive role by structuring the learning environment, encouraging reflection, supporting emotional stability and fostering cognitive strategies that children will continue to use throughout life.

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2. THEORETICAL FRAMEWORK

This paper is based on theoretical analysis, comparative review and synthesis of contemporary pedagogical and psychological literature related to preschool motivation, emotional regulation, executive functions and problem-solving skills. Classical and recent scientific sources were examined in order to identify major developmental patterns and pedagogical implications.

3. RESULTS

3.1. PROBLEM SITUATIONS IN THE KINDERGARTEN CONTEXT

In pedagogical terms, a problem situation refers to a learning or play-based moment in which a child encounters a challenge for which no ready-made solution is available. Such situations disrupt routine activity, generate cognitive or emotional tension and require the activation of thinking, imagination and self-regulation.

A problem situation should not be understood as a difficulty in a negative sense, but rather as a pedagogically constructed opportunity for development. It encourages children to explore alternative strategies, compare solutions, experiment, ask questions, and reflect on the consequences of their actions. In this sense, it functions as a driver of cognitive development and a natural context for the formation of executive functions.

In preschool settings, problem situations most often emerge during play, social interaction, or exploration and constructive tasks. They may arise from:

- conflicts of interest or opinions among children
- mismatches between expectations and outcomes
- changes in familiar conditions
- lack of sufficient information or resources

Problem situations are inherently social phenomena. Within group interactions, they often lead to negotiation, argumentation, reflective listening, and cooperation. These processes foster empathy, decentration and the ability to consider multiple perspectives.

The teacher's role is to design, recognize and guide problem situations so that they remain accessible yet sufficiently challenging-stimulating cognitive engagement without causing emotional overload. Educators support children through questioning, scaffolding, modeling strategies and establishing an environment in which mistakes are understood as part of learning.

Problem situations thus represent a key mechanism through which the synergy between motivation, emotional regulation and problem-solving skills becomes visible - three systems that underpin cognitive and personal development in preschool age.

3.2. MOTIVATION IN PRESCHOOL AGE AS A FOUNDATION OF SELF-REGULATION AND COGNITIVE ACTIVITY

Motivation in early childhood forms the basis of self-regulation and cognitive engagement. At this stage, it is primarily driven by immediate desires and emotional impulses, gradually becoming more stable, socially mediated, and goal oriented.

Vygotsky emphasized that motivation develops within the social situation of development, while Bozhovich defined it as the "core of personality." During preschool years, children transition from impulsive to more purposeful behavior and their motives become increasingly complex and socially structured.

Peer interaction leads to significant changes in the motivational sphere. While younger children may show limited awareness of others, by the age of four to five, peer approval becomes a powerful motivating factor. Elkonin highlighted the role of recognition in structuring social development.

Children increasingly seek acceptance from peers, influencing their behavior, role selection and participation in group activities. Motives of self-assertion also emerge, as children strive to be respected, heard, and noticed. The desire to assume leading roles in play is a typical manifestation of this tendency.

Preschool children often attribute exaggerated qualities to themselves, such as strength or bravery. This is a normal stage in the development of self-concept (Zaporozhets). However, self-assertion may also manifest in stubbornness or refusal to cooperate.

A positive emotional climate is therefore essential. It supports the development of values and personality structure, enhances confidence, reduces anxiety and facilitates socialization and school readiness.

3.3. MOTIVATION, EMOTIONAL REGULATION AND PLAY

These processes directly activate emotional regulation, as children must manage impulses, frustration and emotional arousal in order to sustain cognitive engagement. At the same time, motivation

is activated, as children need internal reasons to persist, retry or seek assistance.

Social motives function as emotional stabilizers, supporting engagement and regulating behavior in social contexts. Positive relationships with adults and peers create emotional security, reducing impulsivity and supporting rational thinking.

Cognitive motives are expressed through curiosity and questioning ("How?", "Why?"). Exploratory behavior, such as dismantling objects to understand their structure, reflects this motivational drive.

Competitive motives emerge later, typically around ages five to six, when children begin to compare their achievements with those of peers.

Play remains the central activity in preschool education, as it integrates emotional, cognitive, and social development. It provides a natural context in which motivation and self-regulation are closely intertwined.

Role play functions as an internal regulatory mechanism, requiring children to follow rules, inhibit impulses and sustain attention. It enables internalization of social roles and the development of behavioral control.

Thus, play serves as a natural training environment for motivation, emotional regulation and problem-solving skills. Within play, children experience emotions but must regulate them to remain within role boundaries, thereby developing self-control, attention and frustration tolerance.

3.4. EMOTIONAL REGULATION AS A PREDICTOR OF EFFECTIVE PROBLEM SOLVING

Emotions act as regulators of behavior, influencing self-control, attentional stability and readiness to engage in learning. Emotional regulation is therefore central to sustaining attention, controlling impulses and selecting appropriate strategies in problem situations.

Children with stronger emotional regulation demonstrate better concentration, greater persistence and higher cognitive flexibility - key prerequisites for effective problem solving.

Problem-solving skills are a core component of self-regulation in preschool age. They include identifying a problem, formulating a goal, selecting a strategy and evaluating outcomes.

These processes emerge in contexts requiring integration of cognition, emotion, behavior and depend strongly on the quality of the educational environment.

Teachers facilitate this development by creating problem situations, guiding attention and supporting reflection, thereby transforming problem-oriented thinking into a foundation for self-regulation.

4. DISCUSSION

EDUCATIONAL TOOLS SUPPORTING SYNERGY

Teachers play a key role in creating conditions that integrate motivation, emotional regulation and cognitive problem-solving strategies. While children learn through experience, educators structure the environment, stimulate conceptual development and support knowledge transfer across contexts.

Teachers do not provide ready-made solutions, but design environments including stimuli, role-based interactions, problem situations and social contexts that foster emotional regulation and intrinsic motivation.

A positive emotional climate and an accessible learning environment are essential for effective pedagogical practice (Stoyanova, 2023).

Analytical frameworks help teachers identify cognitive patterns, emotional responses and motivational drivers, supporting targeted intervention for self-regulation development.

Practical methods include role play, problem-based tasks, guided questioning, modeling, group work, and multimedia integration.

Concept mapping supports the structuring of children's cognitive representations and may be co-constructed to enhance active learning.

Diagnostic-predictive approaches enable evaluation of pedagogical impact and anticipation of effects on motivation, emotional stability and cognitive development.

Empathy-eliciting strategies involve cognitive conflict and uncertainty to stimulate reflection and engagement.

Multimedia tools further enhance attention, emotional involvement, and reflective processes, especially in older preschool groups.

Reflection - understood as awareness of one's cognitive and emotional states - plays a central role in learning and development.

5. CONCLUSION

The synergy between motivation, emotional regulation and problem-solving skills is fundamental to cognitive, social and personal development in preschool age. Understanding this interrelationship enables educators to design environments that foster intrinsic motivation, self-regulation and active learning.

Psychological and pedagogical theories demonstrate that child development occurs through active participation in meaningful activity. By enriching the structure and content of educational experiences, conditions are created that support holistic development.

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THE ISCR MODEL IN MUSIC THERAPY: AN INTEGRATIVE FRAMEWORK FOR PSYCHOPHYSIOLOGICAL REGULATION IN STRESS AND ANXIETY

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Abstract: This study presents the Integrative Synchronization–Change–Regulation (ISCR) model as an integrative conceptual framework for understanding psychophysiological regulation in the context of music therapy. The model conceptualizes music therapy as a multilevel process that integrates neuroscientific, psychophysiological, and cognitive–affective mechanisms, framing regulation as a dynamic coordination between brain networks, the autonomic nervous system, and interoceptive processes. The theoretical foundation of the model is based on the integration of key approaches, including neurovisceral integration, polyvagal theory, and rhythmic entrainment, which are synthesized into a coherent and sequential regulatory framework. In this context, music therapy is positioned as a structured bottom-up intervention that operates through sensory activation and physiological synchronization, leading to affective and cognitive modulation and ultimately resulting in sustained psychophysiological regulation. The ISCR model is structured into four interrelated stages: Input, Synchronization, Change, and Regulation, which describe the transition from sensory stimulation to stable regulatory outcomes. This process emphasizes the role of synchronization as a central mechanism linking physiological and psychological processes and enabling the coordination of internal rhythms and external stimuli. As a conceptual contribution, the model shifts the focus from symptom reduction toward the expansion of regulatory capacity, defined as the ability to maintain adaptive stability under varying internal and external conditions. In addition, the study outlines a quasi-experimental framework that may serve as a basis for future empirical validation of the model.

Keywords: *music therapy; ISCR model; psychophysiological regulation; regulatory capacity; stress and anxiety*

Field: Social Sciences

1. INTRODUCTION

Stress and anxiety represent some of the most significant risk factors for mental and physical health in contemporary societies. The growing interest in integrative interventions reflects the need for approaches that simultaneously address cognitive, emotional, somatic, and physiological processes. Music therapy has emerged as such an approach, as it engages a wide range of neural and autonomic mechanisms involved in the regulation of stress and emotions (Koelsch, 2014). Recent meta-analytic evidence further supports the efficacy of music-based interventions in reducing physiological and psychological indicators of stress across diverse populations (de Witte et al., 2022).

Neuroscientific research demonstrates that music engages distributed brain networks—including the auditory cortex, limbic system, mesolimbic dopaminergic pathways, and prefrontal regions—that are involved in emotional regulation, motivation, and cognitive control (Levitin, 2006; Salimpoor et al., 2011; Vuust et al., 2022). In parallel, music influences the autonomic nervous system by modulating heart rate, respiration, and physiological arousal (Bernardi et al., 2006).

These mechanisms position music therapy at the center of integrative models of regulation, which conceptualize adaptation to stress as a dynamic coordination between brain, body, and physiology. Stephen Porges’ polyvagal theory and the neurovisceral integration model proposed by Julian F. Thayer and Richard D. Lane highlight the role of autonomic flexibility and functional connectivity between the prefrontal cortex and limbic structures as key factors for effective regulation.

Within this context, the present paper introduces the ISCR model (Input–Synchronization–Change–Regulation) as an integrative framework that unifies neural, physiological, and affective mechanisms into a coherent regulatory process. Empirical observations from an 8-week intervention involving active and receptive music therapy are presented as supportive evidence illustrating the applicability of the model.

2. GAP STATEMENT

Despite substantial advances in music therapy research, significant conceptual and methodological gaps remain in the literature. Existing theoretical approaches tend to examine neural, autonomic, interoceptive, and cognitive–affective mechanisms in isolation, without integrating them into a unified framework that conceptualizes regulation as a coordinated, multilevel process.

Current models—including the polyvagal framework, the neurovisceral integration model, and

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rhythmic entrainment theory—offer valuable insights into specific aspects of regulation. However, they are rarely synthesized into a comprehensive model that explains how these mechanisms interact within a single regulatory system. As a result, an integrative perspective on psychophysiological regulation in music therapy remains underdeveloped.

In addition, the majority of empirical studies focus primarily on symptom reduction, such as decreases in anxiety and perceived stress (de Witte et al., 2022), rather than on the expansion of regulatory capacity as a core therapeutic outcome. At the same time, conceptual contributions that explicitly position music therapy as a structured bottom-up regulatory intervention remain limited.

Furthermore, empirical findings are infrequently used to illustrate and support underlying theoretical mechanisms, and are more often presented as independent clinical outcomes without clear integration into a broader conceptual framework.

The present study addresses these gaps by proposing the ISCR model as an integrative theoretical framework that unifies neural, physiological, and affective mechanisms within a coherent regulatory process, supported by empirical observations.

3. THEORETICAL CONTRIBUTION

The present paper contributes to the literature by introducing the ISCR model as an integrative theoretical framework for understanding psychophysiological regulation in the context of music therapy. The contribution can be summarized along three primary dimensions.

Formulation of the ISCR model as an integrative regulatory framework.

The proposed model conceptualizes regulation as a sequential, multilevel process comprising four interrelated stages—Input, Synchronization, Change, and Regulation. This structure establishes a systematic link between sensory activation and psychophysiological adaptation, offering a novel conceptual perspective on regulatory mechanisms in music therapy.

Integration of multisystem mechanisms.

The ISCR model brings together key processes that are traditionally examined in isolation, including rhythmic entrainment, autonomic regulation, limbic activation, cognitive processing, and interoceptive awareness. By integrating these components within a unified framework, the model provides a comprehensive account of how neural, physiological, affective, and cognitive processes interact in the regulation of stress and anxiety. In this way, music therapy is positioned as a multisystem regulatory intervention operating across multiple levels of functioning.

A conceptually structured framework with potential for empirical validation.

Beyond its descriptive function, the ISCR model offers a structured theoretical architecture that lends itself to empirical investigation. The framework enables the formulation of testable hypotheses concerning the dynamics of regulatory processes and supports the integration of psychological and physiological indicators (e.g., anxiety, perceived stress, heart rate variability). As such, the model provides a foundation for future experimental and clinical research aimed at examining the mechanisms and efficacy of music therapy interventions.

4. THEORETICAL FRAMEWORK

Music Therapy as an Integrative Regulatory Intervention

Music therapy can be conceptualized as an integrative intervention that simultaneously engages cognitive, emotional, somatic, and physiological processes. Its multisensory nature enables the activation of complex regulatory mechanisms, including rhythmic synchronization, affective modulation, and autonomic stabilization (Koelsch, 2014; de Witte et al., 2022).

In contrast to traditional psychotherapeutic approaches that rely primarily on cognitive strategies, music therapy predominantly engages bottom-up regulatory processes originating at sensory and bodily levels. This characteristic makes it particularly relevant for conditions associated with heightened physiological arousal, impaired autonomic regulation, and reduced cognitive control, such as anxiety and chronic stress.

Neural Foundations of Psychophysiological Regulation through Music

Neuroscientific research indicates that music engages distributed brain networks, including the auditory cortex, limbic system, mesolimbic dopaminergic pathways, and prefrontal regions (Levitin, 2006; Salimpoor et al., 2011). Recent integrative reviews further conceptualize music processing as the dynamic interaction of perception, action, emotion, and reward systems within a predictive coding framework (Vuust et al., 2022), with meta-analytic evidence confirming the simultaneous engagement of top-down

and bottom-up neural pathways during music listening (Pando-Naude et al., 2021). These structures are critically involved in emotional regulation, motivation, and cognitive control.

Such widespread neural engagement underlies music's capacity to modulate affective states, reduce physiological arousal, and facilitate adaptive emotional regulation. In parallel, music influences the autonomic nervous system by modulating heart rate, respiration, and overall physiological activation (Bernardi et al., 2006). Within this framework, neural activation provides the basis for processes of synchronization, which represent a central mechanism in the ISCR model.

Autonomic Regulation and the Polyvagal Perspective

The polyvagal theory proposed by Stephen Porges provides a key framework for understanding the relationship between music and autonomic regulation (Porges, 2011). According to this perspective, effective regulation depends on the flexible functioning of the vagal system and the capacity to shift adaptively between different autonomic states. More recent reformulations emphasize perceived safety and co-regulation as foundational conditions enabling the social engagement system and the parasympathetic dominance required for restoration and learning (Porges, 2022).

Music therapy may facilitate this process through rhythmic patterns, vocalization, and breathing synchronization, which support parasympathetic activation and physiological stabilization. These mechanisms correspond to the Synchronization stage of the ISCR model, where coordination across physiological systems is established.

Neurovisceral Integration and Regulatory Capacity

The neurovisceral integration model, developed by Julian F. Thayer and Richard D. Lane, conceptualizes regulation as the result of functional connectivity between the prefrontal cortex, limbic structures, and the autonomic nervous system (Thayer & Lane, 2000). Effective regulation involves not only symptom reduction but also the development of regulatory capacity, reflected in autonomic flexibility and the ability to recover efficiently from stress. Music therapy may support this integration by coordinating affective, cognitive, and physiological processes, corresponding to the Change and Regulation stages of the ISCR model.

Bottom-Up Regulation and the Role of Bodily Processes

As a regulatory intervention, music therapy is characterized by its capacity to engage processes originating at the sensory and bodily level. These bottom-up mechanisms include rhythmic activity, breathing regulation, and interoceptive awareness, which influence both limbic and prefrontal systems (Trost, Labbé, & Grandjean, 2017). Contemporary frameworks further conceptualize interoception as a multi-dimensional construct encompassing accuracy, sensibility, attention, and metacognition, with direct relevance for adaptive emotion regulation and clinical outcomes (Suksasilp & Garfinkel, 2022). This direction of influence enables more direct modulation of physiological arousal and is particularly relevant in anxiety, panic responses, and stress-related conditions. Within the ISCR framework, these processes underpin the Input and Synchronization stages, initiating the regulatory sequence.

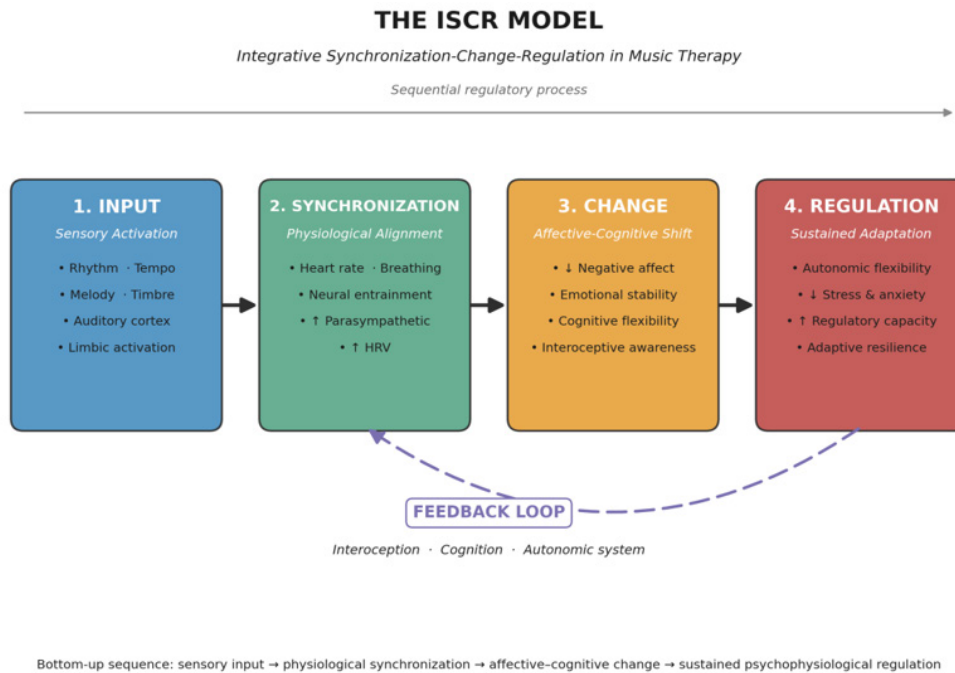
The ISCR Model as an Integrative Framework for Psychophysiological Regulation The ISCR model (Input–Synchronization–Change–Regulation) provides an integrative conceptual framework that unifies neural, physiological, and affective mechanisms within a coherent regulatory process. The model describes how a musical stimulus (Input) initiates neural and physiological synchronization (Synchronization), leading to affective and cognitive modulation (Change), and culminating in sustained psychophysiological regulation (Regulation). Through this structured sequence, the ISCR model integrates existing theoretical approaches into a unified system and offers a novel way of conceptualizing music therapy as an intervention for psychophysiological regulation in stress and anxiety.

5. THE ISCR MODEL: AN INTEGRATIVE FRAMEWORK FOR PSYCHOPHYSIOLOGICAL REGULATION IN MUSIC THERAPY

Figure 1. The ISCR model illustrates a sequential and multilevel process of psychophysiological regulation in music therapy. Sensory input initiates neural and physiological synchronization, enabling affective–cognitive change and culminating in sustained regulation. Feedback mechanisms reinforce adaptive regulatory capacity over time.

The Integrative Synchronization–Change–Regulation (ISCR) model provides a unified conceptual framework for understanding psychophysiological regulation in music therapy. It conceptualizes regulation as a dynamic, multilevel process in which neural, autonomic, affective, and cognitive systems interact in a coordinated cycle, ultimately supporting the expansion of regulatory capacity.

Figure 1. The ISCR Model (Input–Synchronization–Change–Regulation): An integrative framework for psychophysiological regulation in music therapy.



Note. The model illustrates the sequential process of psychophysiological regulation, where sensory input initiates synchronization of neural and physiological systems, leading to affective–cognitive change and sustained regulatory outcomes. Feedback loops reinforce regulatory capacity over time.

Source: Author’s own conceptual model.

The model is structured into four sequential yet interdependent stages—Input, Synchronization, Change, and Regulation—capturing the transition from sensory stimulation to sustained regulatory adaptation.

Input refers to the initial processing of musical stimuli, where acoustic parameters such as rhythm, tempo, melody, and timbre engage auditory and limbic systems, eliciting rapid sensory activation and primary affective responses (Vuust et al., 2022). This stage establishes the neurophysiological conditions necessary for subsequent system-wide coordination.

Synchronization constitutes the central mechanism of the model, involving the alignment of internal physiological rhythms with external musical structures. Through rhythmic entrainment, processes such as heart rate, respiration, motor activity, and neural oscillations become temporally coordinated. This synchronization is associated with autonomic stabilization, including increased parasympathetic activity, reduced sympathetic arousal, and enhanced heart rate variability (Porges, 2022). Concurrently, neural coupling across auditory, motor, and limbic networks supports integrative processing.

Change emerges from synchronized states and reflects the transition toward affective and cognitive modulation. This stage is characterized by attenuation of negative affect, stabilization of emotional tone, and enhanced prefrontal regulation of cognition. Increased interoceptive awareness enables individuals to detect and modulate internal bodily states (Suksasilp & Garfinkel, 2022), facilitating adaptive regulation.

Regulation represents the consolidation of these processes into stable psychophysiological functioning. It is expressed through improved autonomic flexibility, efficient recovery from stress, and reduced vulnerability to dysregulation. Crucially, regulation is conceptualized not merely as symptom reduction, but as the enhancement of regulatory capacity—the ability to maintain internal stability across varying conditions.

A defining feature of the ISCR model is its recursive structure. Feedback loops linking interoceptive awareness, autonomic stabilization, and cognitive processing reinforce ongoing regulation, transforming it into a self-sustaining adaptive process.

By integrating previously fragmented theoretical perspectives into a coherent framework, the ISCR model advances the conceptualization of music therapy as a structured bottom-up regulatory intervention. It offers a scalable architecture for future empirical investigation and provides a foundation

for understanding how music can systematically influence psychophysiological regulation in stress and anxiety.

6. MATERIALS AND METHODS

Study Design

The present study employs a quasi-experimental pre–post design, appropriate for examining temporal dynamics of change in intervention-based contexts where full randomization may not be feasible (Shadish, Cook, & Campbell, 2002). The methodological framework is developed to provide a structured basis for the empirical examination of processes described in the ISCR model and to illustrate its applicability within music therapy. Participants are allocated to two intervention conditions: active music therapy and receptive music therapy. The intervention is conducted over an 8-week period, with two sessions per week.

Participants

The study population consists of adults aged 25–55 years reporting elevated levels of stress and anxiety in everyday functioning.

Inclusion criteria: age between 25 and 55 years; self-reported elevated stress or anxiety; absence of ongoing psychiatric pharmacological treatment; no hearing impairments; provision of informed consent.

Exclusion criteria: presence of severe psychiatric disorders; neurological conditions; substance abuse; concurrent participation in other therapeutic programs.

Measures

Psychological outcomes are operationalized using standardized and widely validated instruments: State–Trait Anxiety Inventory (STAI) (Spielberger, 1983), assessing both state and trait anxiety through two 20-item subscales; Perceived Stress Scale (PSS) (Cohen, Kamarck, & Mermelstein, 1983), measuring subjective stress perception, including perceived uncontrollability and overload.

Intervention

The intervention comprises two complementary modalities reflecting different levels of engagement and regulatory pathways.

Active Music Therapy

The active modality involves direct participation in musical processes, including rhythmic exercises, vocal improvisation, and synchronization of movement and breathing. This format is designed to engage sensorimotor integration, rhythmic entrainment, and interoceptive awareness, corresponding to synchronization and change processes within the ISCR framework.

Receptive Music Therapy

The receptive modality is based on structured music listening (60–80 BPM), combined with guided attention to bodily sensations, breathing regulation, and brief imagery. Musical selection is aligned with principles of parasympathetic activation and physiological stabilization.

Procedure

The study follows a structured sequence: pre-test assessment (STAI and PSS); 8-week music therapy intervention; post-test assessment (STAI and PSS); descriptive analysis of observed trends.

Expected Outcomes

Consistent with the ISCR theoretical framework, the intervention is expected to be associated with reductions in anxiety and perceived stress, improved psychophysiological stability, increased autonomic flexibility, and enhanced interoceptive awareness. Active music therapy is expected to produce more pronounced effects due to higher levels of sensorimotor engagement and direct involvement in rhythmic synchronization processes.

7. CONCLUSION

The present paper introduces the ISCR model (Integrative Synchronization–Change–Regulation) as an integrative conceptual framework for understanding psychophysiological regulation in the context of music therapy. By structuring regulation as a sequential and dynamic process—spanning sensory activation, physiological synchronization, affective–cognitive change, and sustained regulation—the model offers a coherent account of how music therapy may influence multiple levels of human functioning.

A central contribution of the ISCR framework lies in its capacity to integrate previously fragmented theoretical perspectives into a unified regulatory model. By linking neural, autonomic, affective, and cognitive mechanisms within a single process, the model advances the conceptualization of music therapy as a structured bottom-up regulatory intervention, in line with recent empirical evidence on its

psychophysiological efficacy (de Witte et al., 2022).

Importantly, the ISCR model shifts the focus from symptom reduction toward the expansion of regulatory capacity, emphasizing the development of adaptive flexibility and the ability to maintain internal stability under varying conditions. In this sense, music therapy is positioned not only as a modality for alleviating distress, but as a mechanism for enhancing psychophysiological resilience.

The conceptual structure of the model also provides a foundation for future empirical investigation, enabling the formulation of testable hypotheses and the integration of psychological and physiological indicators. As such, the ISCR framework offers both theoretical and methodological value for advancing research and practice in music therapy and stress regulation.

8. LIMITATIONS AND FUTURE DIRECTIONS

Several limitations should be acknowledged. First, the present work is primarily conceptual in nature, and the proposed framework has not yet been subjected to systematic empirical validation. While the model is grounded in established theoretical and empirical literature, its mechanisms and assumptions require direct testing through controlled experimental designs.

Second, the proposed intervention structure is based on a quasi-experimental logic and may be influenced by contextual and individual variability, including differences in baseline physiological regulation, musical experience, and responsiveness to sensory stimuli. These factors highlight the need for more refined methodological approaches in future studies.

Third, the integration of multiple systems—neural, autonomic, affective, and cognitive—poses inherent challenges in terms of measurement and operationalization. Future research should incorporate multimodal assessment strategies, including physiological measures, neurocognitive indicators (Pando-Naude et al., 2021), and validated psychological scales, to capture the complexity of regulatory processes.

Future investigations should focus on empirically testing the sequential dynamics proposed by the ISCR model, particularly the role of synchronization as a mediating mechanism between sensory input and regulatory outcomes. Comparative studies examining active versus receptive music therapy may further clarify the contribution of sensorimotor engagement to regulatory change. Additionally, longitudinal designs are needed to examine the stability and durability of regulatory effects over time, as well as the extent to which music therapy contributes to sustained changes in regulatory capacity.

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THE APPLICATION OF DATA ANALYTICS IN THE OPTIMISATION OF DIGITAL MARKETING CAMPAIGNS

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Abstract: Digital marketing campaigns today are increasingly based on the collection, processing and interpretation of large volumes of data generated through user interactions with websites, social media, email campaigns, mobile applications and e-commerce platforms. The application of data analytics enables organisations to monitor campaign performance more accurately, understand consumer behaviour and make decisions based on measurable indicators, rather than solely on intuition or previous experience. Key performance indicators are particularly important, such as click-through rate, conversion rate, user engagement, website bounce rate, customer acquisition costs and return on investment, as they enable the continuous measurement of the effects of marketing activities and their alignment with business objectives. Data analytics contributes to the optimisation of digital campaigns through user segmentation, content personalisation, customer journey analysis and the prediction of future consumer behaviour. By using big data processing technologies, customer relationship management systems and data on purchasing patterns, companies can develop more detailed customer profiles, identify the most valuable segments and adapt marketing messages to the specific needs and interests of users. This increases the relevance of communication, improves the user experience and creates a greater likelihood of conversion. Advanced forms of analytics, including predictive analytics, machine learning and artificial intelligence, further improve campaign efficiency. These approaches enable the prediction of user engagement, the ranking of potential customers, and the optimisation of advertisements, budgets and communication channels in real time. However, the successful application of analytics depends on data quality, the integration of different sources, privacy protection and the ethical use of user information. It is concluded that data analytics represents a key instrument for optimising digital marketing campaigns, as it enables more precise advertisement targeting, greater personalisation, better cost control and the improvement of overall marketing results.

Keywords: data analytics, digital marketing, campaign optimisation, consumer behaviour, personalisation.

Field: Social Sciences, and Humanities.

1. INTRODUCTION

Contemporary business increasingly depends on digital communication channels, which is why digital marketing is becoming one of the key elements of organisations' market presence. Today, companies use websites, social media, email, search engines, mobile applications and e-commerce platforms to communicate with existing and potential customers. In such an environment, large volumes of data are generated on user behaviour, interests, purchasing habits, responses to advertisements and movement through different stages of the customer journey. For this reason, data analytics plays an increasingly important role in the planning, monitoring and optimisation of digital marketing campaigns (Al Adwan et al., 2023). The application of data analytics enables marketers to make decisions not solely on the basis of intuition, but on the basis of measurable indicators and concrete insights. By measuring website performance, analysing activity on social media, monitoring the results of email campaigns and examining the customer journey, organisations can better understand the needs, preferences and level of engagement of their target audience (Al Adwan et al., 2023). In addition, reporting systems based on key performance indicators help organisations link marketing activities with business objectives, monitor results in real time and adapt campaigns more quickly to changes in the market (Kufile et al., 2022).

Big data, predictive analytics and machine learning are of particular importance, as they enable the identification of patterns in consumer behaviour, the personalisation of messages and the prediction of users' future responses. Such an approach helps companies target advertisements more precisely, identify valuable customer segments, increase the conversion rate and allocate the marketing budget more efficiently (Agboola et al., 2022; Theodorakopoulos & Theodoropoulou, 2024). However, the successful application of analytics depends on data quality, the integration of different sources, the protection of user privacy and the ethical use of information. Therefore, the aim of this paper is to show how data analytics

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contributes to the optimisation of digital marketing campaigns and the improvement of overall marketing results.

The paper consists of five chapters. Following the introductory considerations, the second chapter explains the key performance indicators and the importance of measuring the performance of digital marketing campaigns. The third chapter discusses consumer behaviour analytics and campaign personalisation as a basis for more precise targeting and more relevant communication with users. The fourth chapter analyses the role of predictive analytics, machine learning and automation in the optimisation of marketing decisions. The concluding chapter summarises the main findings of the paper and highlights the importance of data analytics for improving the efficiency, personalisation and overall results of digital campaigns.

2. KEY PERFORMANCE INDICATORS AND CAMPAIGN PERFORMANCE MEASUREMENT

Key performance indicators represent the basis for monitoring, evaluating and optimising digital marketing campaigns. In the contemporary digital environment, marketing decisions cannot be based solely on subjective judgement, but must rely on specific and measurable data showing the extent to which a campaign achieves its set objectives. According to Kufile et al. (2022), reporting systems based on key performance indicators enable organisations to convert large volumes of marketing data into useful insights that support tactical decisions and the long-term adjustment of strategy. Such indicators are particularly important in rapidly developing campaigns, as they enable results to be monitored in real time, problems to be identified promptly and marketing activities to be corrected quickly.

In digital marketing, the most commonly monitored indicators include click-through rate, conversion rate, website bounce rate, cost per click, customer acquisition cost, user engagement, return on investment and return on advertising spend. These indicators make it possible to view campaign performance from several perspectives: through user behaviour, financial viability and the degree to which communication objectives have been achieved. Kufile et al. (2022) emphasise that indicators can be viewed as behavioural, financial and attitudinal, with priority given to those indicators that are directly linked to growth objectives and business results. For this reason, it is not sufficient to monitor a large number of metrics; rather, it is important to select a smaller number of relevant indicators that genuinely demonstrate campaign success.

Campaign performance measurement includes the analysis of different digital channels. Al Adwan et al. (2023) state that the effectiveness of digital marketing campaigns can be monitored through website performance, social media metrics, the success of email campaigns, the analysis of customer data for targeting and personalisation, and customer journey analysis. In this way, the campaign is not viewed in isolation, but as part of a broader process in which the user passes through multiple touchpoints with the brand. The results of the study by Al Adwan et al. (2023) indicate a significant relationship between social media data, customer journey analysis, successful advertising and strategy formation, confirming that performance measurement has a direct role in shaping further marketing decisions. Dashboards and data visualisation tools play a particularly important role in performance measurement. They enable marketers and managers to present complex data in a clear and accessible manner, using charts, timelines, alerts and comparisons of results across different platforms. Swetha et al. (2025) emphasise the importance of dashboards that display key metrics such as click-through rate, engagement, conversions, bounce rate and impressions, with the possibility of comparing performance by platform, demographic group and advertisement type. Such an approach enables weaker campaigns to be identified quickly, while successful activities can be further strengthened.

Performance measurement is important not only after a campaign has ended, but also during its implementation. Real-time analytics enables the continuous monitoring of user behaviour and the adjustment of campaign elements, such as budget, target audience, advertising content and the choice of communication channels. According to Agboola et al. (2022), predictive analytics enables the dynamic adjustment of campaigns based on current insights into consumer behaviour and campaign results. In this way, organisations can reduce costs, allocate resources more effectively and increase the likelihood of conversion. However, successful performance measurement depends on the quality and reliability of data. If data are incomplete, outdated or poorly integrated from different sources, conclusions about campaign success may be inaccurate. It is therefore necessary to ensure standardised data collection, processing and verification, as well as clearly defined indicators linked to campaign objectives. When properly selected and monitored, key performance indicators form the basis for making reliable marketing decisions, optimising investment and increasing the overall efficiency of digital marketing campaigns.

Table 1 presents the most important areas of digital marketing campaign measurement, the key performance indicators, their importance for optimisation and the sources from the literature used. Table

1 indicates that campaign success is assessed through a combination of different indicators, rather than on the basis of a single metric.

Table 1. Key performance indicators in measuring the performance of digital marketing campaigns

Measurement area	Key performance indicators	Importance for campaign optimisation	Sources
Website performance	Number of visits, page views, average session duration, bounce rate	Show how many users visit the website, how long they stay and whether the content meets their expectations.	Al Adwan et al. (2023)
Social media and email	User engagement, reach, open rate, click-through rate, conversion rate	Enable the assessment of communication effectiveness with the audience and the adjustment of content, format and posting time.	Al Adwan et al. (2023)
Financial efficiency of the campaign	Return on investment, return on advertising spend, cost per click, customer acquisition cost	Shows whether the campaign justifies the invested resources and helps with better allocation of the marketing budget.	Kufle et al. (2022)
Conversions and potential customers	Conversion rate, number of potential customers, quality of potential customers, sales results	Show whether the campaign leads to concrete business results, such as a purchase, registration or enquiry.	Agboola et al. (2022)
Customer journey and personalisation	Brand touchpoints, user behaviour, purchasing habits, user preferences	Help in understanding consumer behaviour and enable more precise targeting of messages towards different segments.	Theodorakopoulos & Theodoropoulou (2024); Kuštelega et al. (2024)
Predictive analytics and automation	Probability of conversion, engagement prediction, sales forecasting, real-time advertisement performance	Enable the advance assessment of user responses and the continuous adjustment of the campaign for greater efficiency.	Al Rafi (2023); Swetha et al. (2025)

Source: Authors' research

3. CONSUMER BEHAVIOUR ANALYTICS AND CAMPAIGN PERSONALISATION

Consumer behaviour analytics represents one of the most important elements in the optimisation of digital marketing campaigns, as it enables organisations to understand how users search for content, respond to advertisements, make purchasing decisions and interact with a brand across different digital channels. In the digital environment, consumers leave a large number of traces through visits to websites, clicks, time spent on a page, searches, purchases, comments, reactions on social media and the use of mobile applications. By analysing these data, it is possible to obtain a clearer picture of consumers' interests, needs and habits, which provides a basis for more precise campaign planning. Theodorakopoulos and Theodoropoulou (2024) emphasise that big data enables a deeper understanding of consumer preferences, behaviour and user experience, thereby improving the effectiveness of digital marketing.

A particularly important part of consumer behaviour analytics is customer journey analysis. This involves tracking consumers from their first contact with the brand, through the stages of interest and consideration of the offer, to purchase and post-purchase experience. Al Adwan et al. (2023) state that customer journey mapping enables the identification of touchpoints between users and companies, as well as the detection of weak points, obstacles and user needs at each stage of the purchasing process. Such an approach helps companies better understand what users expect, what content they need and at what moment a particular marketing message should be delivered. In this way, analytics is not used only to observe past results, but also to actively shape future campaigns.

Campaign personalisation is based precisely on the insights obtained from the analysis of consumer behaviour. Instead of showing the same message to all users, companies can create content adapted to specific audience segments or even to individual users. Personalisation may include product recommendations, tailored advertisements, individualised email messages, special offers and content that corresponds to users' previous interests.

According to Theodorakopoulos and Theodoropoulou (2024), the application of big data enables companies to adapt marketing strategies to individual consumers, thereby increasing satisfaction, engagement and the relevance of communication. Consumer segmentation is the basis of successful

personalisation. Traditional approaches to segmentation mainly rely on demographic data, such as age, gender, income or location. However, contemporary digital campaigns require more precise segmentation based on actual user behaviour. Adelusi et al. (2023) indicate that traditional segmentation models often fail to capture the dynamic nature of contemporary consumer behaviour, as they overlook interactions across multiple platforms, changes in interests and differences in device usage. For this reason, models based on behavioural, technographic and contextual data are increasingly used, as they enable the creation of more precise and usable consumer profiles. In e-commerce, consumer behaviour analytics is particularly important, as it enables the understanding of purchasing patterns and the prediction of users' future decisions. Caroline, Yuswardi and Rofi'i (2023) emphasise that data on transactions, customers and products can be used to identify purchasing patterns, understand trends and improve service personalisation. Such insights help companies create more effective marketing strategies, improve the user experience and increase customer loyalty. Similarly, Pande et al. (2025) point out that consumer behaviour analytics enables an understanding of how users search for products, what they are interested in, how they make decisions and which factors influence purchasing.

Contemporary personalisation increasingly relies on machine learning and artificial intelligence. These approaches enable consumers to be grouped according to behaviour, frequency of interactions, purchase history, devices used and responses to previous campaigns. On this basis, it is possible to predict which users are more likely to make a purchase, which content interests them most and which communication channel is the most effective for them. Swetha et al. (2025) emphasise that systems based on artificial intelligence can analyse changes in user behaviour in real time and adjust campaigns through personalised messages, advertisement optimisation and automated performance management. However, campaign personalisation must be implemented carefully, as the collection and analysis of user data raise issues of privacy, trust and the ethical use of information. Consumers expect relevant and useful messages, but at the same time they want their data to be protected and used transparently. Pande et al. (2025) point out that there is a delicate boundary between useful personalisation and the excessive use of data, which is why companies must apply responsible data management practices. Adelusi et al. (2023) also emphasise the importance of informed consent, data minimisation and algorithmic transparency in consumer profiling processes.

Based on the above, it can be concluded that consumer behaviour analytics and campaign personalisation represent key mechanisms for improving digital marketing. By analysing the customer journey, purchasing patterns, responses to content and interactions across different channels, companies can create more relevant, precise and effective campaigns. Personalisation enables marketing messages to be better aligned with users' needs, while the proper use of data contributes to greater engagement, a higher conversion rate and the strengthening of the long-term relationship between consumers and the brand.

4. PREDICTIVE ANALYTICS, MACHINE LEARNING AND THE OPTIMISATION OF MARKETING DECISIONS

Predictive analytics and machine learning play an increasingly important role in the optimization of digital marketing campaigns, as they enable decisions to be made on the basis of predictions of future consumer behavior, rather than solely on the analysis of previous results. Unlike traditional analytics, which mainly describes what happened in the past, predictive analytics uses historical and current data to assess the likelihood of future user responses, such as a click, purchase, registration, cart abandonment or a higher level of engagement. Agboola et al. (2022) emphasize that predictive analytics enables the identification of potentially valuable customers, the improvement of lead ranking and the personalization of marketing activities, thereby increasing conversion rates and reducing customer acquisition costs. Similar findings confirm that predictive analytics, machine learning and artificial intelligence can improve direct marketing through more accurate prediction of user responses, personalization of offers and optimization of marketing strategies in digital and financial environments (Theodora kopoulos, Theodoropoulou, & Klavdianos, 2025; Zaki et al., 2024).

Machine learning further improves this process, as it enables the analysis of large and complex datasets from different sources, such as websites, mobile applications, social media, email, customer relationship management systems and purchase history. Algorithms can identify patterns that are difficult to detect using traditional methods, particularly when dealing with changing user behavior and multichannel communication. Al Rafi (2023) emphasizes that models such as Random Forest and AdaBoost can improve the prediction of user engagement and sales, as they use data on interaction frequency, recent activities, purchases and responses to campaigns.

The application of predictive analytics is particularly useful in making marketing decisions related to the selection of the target group, budget allocation, advertisement display timing, channel selection and the design of message content. In the field of digital advertising, systems based on artificial intelligence can analyze indicators such as click-through rate, conversion rate, user engagement and the demographic characteristics of the audience, and then automatically recommend or adjust advertisements, formats and budgets in real time (Swetha et al., 2025).

However, the effectiveness of these approaches depends on data quality, proper processing, the selection of an appropriate model and the ethical use of user information. If data are incomplete, inaccurate or biased, predictions may lead to incorrect marketing decisions. For this reason, predictive analytics and machine learning represent powerful tools for campaign optimization, but they require responsible data management and continuous monitoring of results.

5. CONCLUSION

Data analytics plays a key role in the optimization of digital marketing campaigns, as it enables organizations to understand consumer behavior more precisely, monitor campaign results and make decisions based on measurable indicators. In the contemporary digital environment, users generate a large amount of data every day through visits to websites, interactions on social media, email, mobile applications and e-commerce platforms. Through the proper processing and interpretation of these data, companies can gain deeper insight into consumers' needs, interests and purchasing habits. Key performance indicators enable the continuous monitoring of campaigns and the assessment of their effectiveness. Through indicators such as click-through rate, conversion rate, user engagement, customer acquisition costs and return on investment, marketers can determine which activities produce the best results and which need to be improved. In addition, customer journey analysis and consumer segmentation enable the creation of personalised messages that are more relevant to the target audience. Predictive analytics, machine learning and artificial intelligence are of particular importance, as they enable the prediction of user behaviour, better ranking of potential customers, budget optimisation and campaign adjustment in real time. In this way, digital marketing becomes more efficient, more precise and more focused on concrete business results. However, the successful application of data analytics requires high-quality, accurate and connected data, as well as responsible management of user information. Particular attention should be paid to privacy protection, transparency and the ethical use of data. It can be concluded that data analytics represents the foundation of contemporary digital marketing and an important instrument for increasing the efficiency, personalisation and overall success of marketing campaigns.

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THE IMPORTANCE OF DYNAMIC SECURITY FOR MAINTAINING ORDER, LEGITIMACY AND THE PREVENTION OF VIOLENCE IN PRISON

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Abstract: The paper examines the importance of dynamic security for maintaining order, legitimacy and the prevention of violence in the prison environment. It is based on the contemporary understanding that prison security cannot be founded exclusively on static measures, such as walls, locks, cameras, physical separation and formal supervision, but depends to a considerable extent on the quality of everyday relationships between prison officers and convicted persons. Dynamic security involves the constant professional presence of officers in prison life, communication with prisoners, observation of the prison atmosphere, knowledge of individual behaviour and the ability to identify risks at an early stage. The main aim of the paper is to show that dynamic security has an important preventive function. Violence in prison does not arise solely as a consequence of the individual characteristics of convicted persons, but also as a result of the prison regime, institutional culture, the quality of management, living conditions and relationships between staff and prisoners. For this reason, the role of prison officers is particularly significant, as through everyday contact they are able to recognise changes in behaviour, tensions among prisoners and situations that may develop into conflict. Timely intervention, conflict de-escalation and the adjustment of responses to the specific situation represent key elements of dynamic security. The paper also considers the relationship between dynamic security and the legitimacy of prison authority. When convicted persons perceive prison officers as professional, consistent, fair and capable of maintaining order without unnecessary repression, the likelihood of voluntary compliance with rules increases. In this way, dynamic security contributes to a more stable prison climate, the reduction of tensions and the strengthening of trust in the institution. The paper concludes that dynamic security is not a replacement for static security, but its necessary complement. Its value lies in the fact that it connects control, communication and prevention, thereby contributing to the maintenance of order, the reduction of violence and the creation of a more humane and safer prison environment.

Keywords: *dynamic security, prison, maintaining order, prison officers, prevention of violence.*

Field: Social Sciences, and Humanities.

1. INTRODUCTION

Security in the prison system represents one of the fundamental prerequisites for achieving the purpose of the enforcement of criminal sanctions. The traditional understanding of prison security is most often associated with static measures, such as walls, locks, bars, cameras, the physical separation of convicted persons and formal supervision. Although these measures are necessary for the functioning of every prison institution, contemporary penological research shows that they are not sufficient on their own to maintain a stable and secure prison environment. Order in prison does not depend exclusively on physical control, but also on the quality of everyday relationships between prison officers and convicted persons, as well as on the broader prison culture and the way in which the institution is managed (Wooldredge, 2020).

In this context, the concept of dynamic security occupies a particularly important place. Dynamic security involves the continuous professional presence of officers in prison life, communication with convicted persons, knowledge of their behaviour, monitoring of the atmosphere within the institution and the ability to recognise risks at an early stage. Its essence does not lie in abandoning control, but in connecting control, communication and prevention. Sørensen, Midtlyng and Boe (2024) emphasise that dynamic security cannot be reduced merely to maintaining good relationships with prisoners, but also involves officers' ability to 'read' situations, assess risks and adapt their responses to specific circumstances.

The importance of dynamic security is particularly evident in the prevention of violence and the maintenance of order. Violence in prison does not arise solely as a consequence of the individual characteristics of convicted persons, but is also influenced by the prison regime, institutional culture, living conditions, management style and staff attitudes towards prisoners (Wooldredge, 2020). When convicted persons perceive officers as professional, consistent, fair and capable of maintaining order without unnecessary repression, the likelihood of voluntary compliance with rules and the strengthening of the legitimacy of prison authority increases (Ryan & Bergin, 2022).

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The aim of this paper is to highlight the importance of dynamic security as an important element of the contemporary prison system, particularly in terms of maintaining order, strengthening the legitimacy of prison authority and preventing violence.

The paper consists of five chapters. Following the introductory considerations, which point to the importance of dynamic security for the contemporary prison system, the second chapter examines its concept and basic elements, such as the professional presence of officers, communication, observation of the prison atmosphere and risk assessment. The third chapter is devoted to the relationship between prison officers and convicted persons as the basis of security, with an emphasis on the importance of fair, consistent and professional conduct. The fourth chapter analyses the role of dynamic security in the prevention of violence and the maintenance of order, with particular reference to the early identification of risks and the prevention of conflict escalation. The conclusion summarises the main findings of the paper and emphasises that dynamic security does not replace static security, but complements it by linking control, communication, prevention and legitimacy.

2. THE CONCEPT AND BASIC ELEMENTS OF DYNAMIC SECURITY

Dynamic security represents a contemporary approach to maintaining order and safety in prison institutions, which is not based exclusively on physical, technical and formal control measures, but on the daily professional work of prison officers with convicted persons. Unlike static security, which includes walls, locks, cameras, bars, physical separation and formal supervision, dynamic security involves the active presence of officers in prison life, their communication with convicted persons, the monitoring of behaviour, an understanding of the atmosphere within the institution and the ability to identify potential risks before they develop into a serious security problem. In this sense, it is primarily preventive in character, as it is based on the early recognition and resolution of possible threats to security (Sørensen et al., 2024).

The literature emphasises that the concept of dynamic security is often used in prison practice and policy, but that it is not always clearly defined. Sørensen et al. (2024) point out that dynamic security is often associated with officers being present among prisoners, talking to them, listening to them and being attentive to the prison atmosphere and the possibility of incidents occurring. However, Sørensen et al. (2024) emphasise that such an understanding is not sufficiently precise, particularly when working with highly violent prisoners. For this reason, dynamic security cannot be reduced merely to a “good relationship” between an officer and a convicted person, but must be understood as a complex professional ability to observe, assess and adapt one’s response to a specific situation (Sørensen et al., 2024).

One of the basic elements of dynamic security is knowledge of convicted persons. A prison officer who is present in the daily lives of convicted persons can notice changes in their behaviour, mood, communication and relationships with other prisoners. Such changes may be early indicators of conflict, pressure, fear, planning of violence or disruption of order. Dynamic security is therefore based on the idea that an officer does not react only when an incident has already occurred, but acts preventively on the basis of information obtained through everyday contact. This understanding is close to definitions according to which dynamic security exists when officers are attentive, know the prisoners, move among them, talk to them and are able to “sense” a problem before it develops (Sørensen et al., 2024).

Another important element is communication. Professional communication with convicted persons enables officers to better understand their needs, frustrations and mutual relationships. It does not imply leniency or a loss of authority, but represents a means of maintaining control in a less repressive and more effective way. Through conversation, an officer can reduce tension, clarify a misunderstanding, prevent the escalation of conflict and demonstrate that rules are applied consistently and fairly. This approach is important because authority in prison is not based solely on the officer’s formal position, but also on the way in which officers use their power in everyday relationships with convicted persons (Ryan & Bergin, 2022).

The third element is the continuous observation of the prison atmosphere. Dynamic security requires officers to observe not only individual convicted persons, but also group dynamics, informal hierarchies, changes in relationships among prisoners and the general climate within the institution. Wooldredge (2020) emphasises that prison violence cannot be understood solely through the individual characteristics of prisoners, but also through prison culture, management style and the role of prison officers in the everyday maintenance of order. This means that officers must understand the broader context in which the behaviour of convicted persons takes place, because prison culture and the way in which the institution is managed can influence the emergence of conflict, violence and the sense of safety within the institution (Wooldredge, 2020).

A particularly significant element of dynamic security is the ability to assess risk and adapt one's response. Sørensen et al. (2024) emphasise that working with violent prisoners requires officers to be able to "read" prisoners, situations and changes in the environment, as well as to align their responses with the specific threat. This means that an officer must know when it is necessary to talk, when to issue a warning, when to involve other officers and when to apply formal security measures. Such conduct requires experience, training, teamwork and trust among staff (Sørensen et al., 2024). Sørensen et al. (2024) particularly emphasise the importance of teamwork and a shared understanding of situations among officers. In their research, officers describe a successful team as a group with a common goal, divided roles, mutual trust and the ability to adapt to changes in prisoners' behaviour. Such team coordination enables a rapid, discreet and harmonised response in risky situations. For this reason, dynamic security is not only the individual ability of a single officer, but also the collective ability of the service to identify risk and respond in a coordinated manner (Sørensen et al., 2024).

Dynamic security involves linking control and legitimacy. The authority of prison officers is not based solely on their formal power, but also on whether convicted persons perceive them as fair, consistent, professional and capable of maintaining order. Ryan and Bergin (2022) indicate that fair and respectful treatment by prison officers can contribute to the perceived legitimacy of authority, which may then encourage normative, that is, voluntary, compliance with rules. For this reason, dynamic security is important not only as a security mechanism, but also as a means of strengthening trust, stability and order within a prison institution (Ryan & Bergin, 2022). In this sense, dynamic security can be understood as a combination of professional presence, communication, observation, knowledge of convicted persons, risk assessment, teamwork and timely response. It does not replace static security, but complements it and makes it more effective, as it enables risks to be identified and controlled before they develop into violence or a serious disruption of order. This understanding is particularly important for the contemporary prison system, as it links control, prevention and the legitimacy of prison authority.

Table 1 presents the basic elements of dynamic security and their practical implications for the work of prison officers. The findings presented show that dynamic security cannot be reduced merely to communication with convicted persons, but includes a broader set of professional skills: observation, risk assessment, understanding of the prison atmosphere, adaptation of response and the building of legitimate authority.

Table 1. Basic elements of dynamic security and their importance

Element of dynamic security	Important finding / significance	Source
Clearer understanding of the concept	Dynamic security is often used in practice, but is not always precisely defined; it is therefore important to distinguish it from physical control alone.	Sørensen et al., 2024
Professional presence and communication	The presence of officers among convicted persons and everyday communication enable a better understanding of behaviour, needs and possible tensions.	Sørensen et al., 2024
Observation of the prison atmosphere	Security risks do not arise only from individuals, but also from prison culture, regime, relationships and management style.	Wooldredge, 2020
Risk assessment and response adaptation	Officers need to "read" situations and convicted persons, and adapt their response to the specific level of risk.	Sørensen et al., 2024
Legitimacy of authority	Fair, consistent and professional conduct by officers increases the likelihood of rule compliance and the stability of the prison environment.	Ryan & Bergin, 2022
Complement to static security	Dynamic security does not replace walls, locks, cameras and formal supervision, but complements them through communication, prevention and early risk identification.	Sørensen et al., 2024

Source: Author' research

3. THE RELATIONSHIP BETWEEN PRISON OFFICERS AND CONVICTED PERSONS AS THE BASIS OF SECURITY

The relationship between prison officers and convicted persons represents one of the key foundations of security within a prison institution. Although prison security is often associated with formal rules, physical control and technical surveillance measures, everyday practice shows that the stability of the prison environment largely depends on the quality of direct relationships between staff and prisoners.

Prison officers are the most visible representatives of prison authority, and it is through their everyday actions that convicted persons assess whether prison authority is professional, fair and legitimate (Wooldredge, 2020). Within the framework of dynamic security, the relationship between officers and convicted persons is not a secondary element, but a basic instrument for maintaining order. Officers who are present among convicted persons, who talk to them, listen to them and know their habits, can identify changes in behaviour and in the prison atmosphere at an earlier stage. Sørensen et al. (2024) state that dynamic security is based on the presence of officers, interaction with prisoners and the ability to recognise potential problems before they develop into incidents. Such a relationship does not imply leniency, but rather professional closeness that enables better risk assessment and a timely response (Sørensen et al., 2024).

The quality of this relationship is particularly important because prison is a closed and tense social environment in which conflicts can escalate quickly. If convicted persons perceive officers as unfair, harsh or inconsistent, distrust towards the institution increases, as does the possibility of resistance to rules. Conversely, when officers act consistently, respect the dignity of convicted persons and clearly explain the rules, prisoners are more likely to accept their authority. Ryan and Bergin (2022) emphasise that procedurally fair treatment contributes to the perceived legitimacy of the prison regime, and legitimacy is an important basis for voluntary compliance with rules.

The relationship between officers and convicted persons therefore also has a preventive function. It enables the officer to recognise tensions, fear, changes in group relations, pressure among prisoners or situations that may lead to violence. Wooldredge (2020) emphasises that the actions and attitudes of officers influence the way prisoners perceive prison authority, as well as prison culture and the adjustment patterns of convicted persons. In other words, if prisoners see officers as capable of solving problems and maintaining order, there is less need for them to seek protection or conflict resolution through informal prison groups or violence (Wooldredge, 2020).

It is important to emphasise that a professional relationship does not mean eliminating the distance between officers and convicted persons. On the contrary, dynamic security requires a balance between communication and control. An officer must be approachable, but not unprofessionally close; must show respect, but also clearly maintain boundaries; must understand the needs of convicted persons, while at the same time protecting order and security within the institution. Miranda (2024) points out that prison staff have a complex dual role: on the one hand, they develop a supportive relationship with prisoners, while on the other hand, they retain a control function. For this reason, the relationship between prison officers and convicted persons can be viewed as the central space in which prison security is produced or undermined on a daily basis. A professional, consistent and fair relationship contributes to trust, the legitimacy of authority and the reduction of tensions.

In this sense, security is not only the result of physical barriers and formal rules, but also the result of everyday communication, observation, assessment and the officer's ability to identify and prevent risks in a timely manner. The most important elements of the relationship between prison officers and convicted persons, as well as their significance for maintaining security, are presented in Table 2.

Table 2. The relationship between prison officers and convicted persons as the basis of security

Key aspect of the relationship	Significance for security	Source
Professional presence of officers	The everyday presence of officers among convicted persons enables a better understanding of the prison atmosphere and earlier identification of risks.	Sørensen et al., 2024
Communication with convicted persons	Communication with convicted persons helps officers understand needs, tensions and possible conflicts before they escalate.	Sørensen et al., 2024
Fair and consistent treatment	When officers act fairly and consistently, convicted persons are more likely to perceive them as a legitimate authority.	Ryan & Bergin, 2022
Legitimacy of authority	The perception of legitimacy increases the likelihood of voluntary compliance with rules and reduces the need for coercion.	Ryan & Bergin, 2022
Influence of officers on prison culture	Officers' attitudes and actions influence the prison climate, the adjustment of convicted persons and the possibility of violence occurring.	Wooldredge, 2020
Balance between control and support	A professional relationship requires communication and respect, but also the clear maintenance of boundaries and authority.	Miranda, 2024

Source: Author' research

4. DYNAMIC SECURITY IN THE PREVENTION OF VIOLENCE AND THE MAINTENANCE OF ORDER

Dynamic security plays a particularly important role in the prevention of violence and the maintenance of order within a prison institution. Unlike approaches that rely exclusively on repressive and static measures, dynamic security is based on the view that many risks can be identified before they develop into open conflict. Violence in prison does not arise solely as a consequence of the individual characteristics of convicted persons, but also as a result of prison culture, management style, the quality of relationships between officers and prisoners, everyday routines and the general climate within the institution (Wooldredge, 2020). For this reason, the prevention of violence requires continuous monitoring of prison life, not merely a response after an incident has occurred. The basic value of dynamic security is reflected in the early recognition of changes in the behaviour of convicted persons and relationships within the prison community. Officers who are present among convicted persons and who know their habits, mutual relationships and everyday behaviour can notice changes that indicate increasing tension, fear, pressure, conflict or preparation for violent behaviour. Sørensen et al. (2024) particularly emphasise officers' ability to "read" prisoners and situations, as well as to align their responses with the specific risk. This means that an officer does not act according to a fixed pattern, but assesses when conversation is sufficient, when a warning is necessary, and when other officers should be involved or formal security measures applied.

Dynamic security also contributes to the maintenance of order because it strengthens the legitimacy of prison authority. When convicted persons perceive officers as professional, consistent and fair, they are more likely to comply with rules voluntarily, rather than merely out of fear of punishment. Ryan and Bergin (2022) point out that procedural justice and legitimacy play an important role in the acceptance of authority and compliance with rules in the prison environment. This reduces the need for the frequent use of coercion, while prison order is maintained in a more stable and long-term manner.

The prevention of violence also depends on the organisation of everyday routines and the conditions in which convicted persons are accommodated. Howard et al. (2020) show that the prison environment, activities, accommodation conditions and level of supervision influence the risk of physical assaults among prisoners. This means that dynamic security is not only an individual skill of officers, but also part of the broader system of institutional management. It links the presence of officers, communication, risk assessment, timely intervention and fair treatment. In this way, dynamic security contributes to reducing tensions, preventing the escalation of conflicts and creating a more stable, humane and secure prison environment.

In addition to the direct relationship between officers and convicted persons, security is also influenced by the broader conditions of prison life. Research shows that the quality of the prison climate, the physical environment, the availability of activities, prisoners' mental health and the way technology is used can contribute to either reducing or increasing tensions within the institution. In this regard, the study by Mjåland et al. (2023) is also significant, as it shows that convicted persons evaluate the experience of being held in open-type prisons more positively than in closed-type prisons, with the "pains of imprisonment" being experienced as less intense and more bearable. This finding indicates that the degree of restrictiveness of the regime, the level of autonomy and the general prison climate can have an important impact on prisoners' everyday experience and, indirectly, on the maintenance of order and the reduction of tensions. Auty and Liebling (2024) indicate that harmony, professionalism and a sense of safety are associated with lower levels of serious forms of violence in prison. Engstrom and van Ginneken (2022) emphasise that architecture and physical space influence the well-being of those who use the prison space, while Testoni et al. (2021) show that work with prisoners with mental health difficulties requires cooperation between different professionals and additional support for staff.

Contemporary technologies can contribute to better institutional management and communication, but Hofinger and Pfliegerl (2024) and Miranda (2024) warn that, if not applied thoughtfully, technology may lead to expanded surveillance and the displacement of the direct professional relationship between officers and convicted persons.

5. CONCLUSION

Dynamic security represents an important element of the contemporary prison system, as it shows that the maintenance of order and safety cannot be based solely on static control measures. Walls, locks, cameras, physical separation and formal supervision remain necessary, but they are not sufficient unless accompanied by the everyday professional work of prison officers with convicted persons. The fundamental value of dynamic security lies in its ability to enable the early identification of risks, timely response and prevention of conflict escalation. The paper has shown that dynamic security rests on several interconnected elements: the professional presence of officers, communication with convicted persons, knowledge of their behaviour, observation of the prison atmosphere, risk assessment, teamwork and the adaptation of responses to specific situations. It is particularly significant that the relationship between officers and convicted persons is not merely a matter of everyday communication, but also a basis for building legitimate authority. When convicted persons perceive officers as fair, consistent, professional and capable of maintaining order without unnecessary repression, the likelihood of voluntary compliance with rules increases.

The prevention of violence in prison requires a broader understanding of security. Violence does not arise solely as a consequence of the individual characteristics of convicted persons, but also as a result of prison culture, regime, living conditions, the organisation of everyday activities, prisoners' mental health, the architecture of the space and the way in which contemporary technologies are used. For this reason, dynamic security must be part of the overall system of institutional management, and not merely an individual skill of a single officer. It can be concluded that dynamic security does not represent a replacement for static security, but its necessary complement. Its particular value lies in the fact that it connects control, communication, prevention and legitimacy, thereby contributing to a more stable prison climate, the reduction of violence and the creation of a more humane and secure prison environment.

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INTELLIGENT FOREIGN LANGUAGE EDUCATION: PRACTICES AND MODELS IN THE ERA OF ARTIFICIAL INTELLIGENCE

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Abstract: The rapid advancement of artificial intelligence has accelerated the transition from adaptive technologies to more complex forms of intelligent language learning. This paper explores contemporary practices and emerging models in foreign language education shaped by AI-driven tools and systems. It examines how adaptive platforms, intelligent feedback mechanisms, and data-informed instructional strategies contribute to the development of more personalized and flexible learning environments. The analysis focuses on the shift from technology as a supplementary resource to its role as an integral component of pedagogical design. Special attention is given to the ways in which intelligent systems support individualized learning paths, enhance learner engagement, and enable continuous monitoring of progress. At the same time, the study highlights the importance of pedagogical mediation in ensuring that technological applications remain aligned with educational objectives and learner needs.

The paper also considers the evolving structure of language learning models, where interaction between human and digital elements creates hybrid educational environments. These environments combine automation with pedagogical guidance, offering new opportunities for communicative competence development while preserving the central role of the teacher. The findings suggest that the effectiveness of intelligent language learning depends on a balanced integration of technological innovation and pedagogical expertise. Rather than replacing traditional teaching practices, artificial intelligence contributes to their transformation, supporting more adaptive, responsive, and learner-centered approaches in foreign language education.

Keywords: *artificial intelligence; adaptive intelligent systems; hybrid learning environments.*

Field: Foreign Language Teaching Methodology

1. INTRODUCTION

In recent decades, education has undergone a profound transformation driven by the rapid development of digital technologies and, in particular, the emergence of artificial intelligence (AI). This transformation extends beyond the mere introduction of new tools; it affects the very nature of teaching and learning (Williamson, 2024). In the context of foreign language education, this shift is especially significant, as language acquisition inherently involves communication, adaptability, and continuous interaction among participants in the educational process (Kessler, 2020; Todorova, 2021). Traditional teaching methodologies, long dominated by teacher-centered approaches, are gradually giving way to more flexible, interactive, and learner-oriented models (Ivanova, 2022). Digitalization has enabled access to a wide range of resources, multimedia content, and online learning environments (Ministry of Education and Science, 2024). Within this evolving landscape, adaptive technologies have established themselves as important tools, allowing for the personalization of learning through alignment with learners' levels, pace, and individual needs (Richter et al., 2020). However, the development of artificial intelligence marks a qualitatively new stage in this evolution. Unlike earlier digital solutions that primarily supported instruction, intelligent systems are increasingly involved in the organization and implementation of the learning process itself (Chen et al., 2020). They are capable of analyzing data in real time, generating personalized learning materials, providing immediate feedback, and simulating communicative situations (UNESCO, 2023). As a result, AI not only expands the technological toolkit available to educators but also reshapes instructional strategies and approaches to developing language competence. In this context, there is a growing need to rethink the methodology of foreign language teaching. The central question is no longer whether technology should be used, but how it can be integrated in a way that preserves pedagogical coherence and enhances effective learning (Luckin, 2022). The transition from adaptive technologies to intelligent language learning requires new approaches that combine technological innovation with pedagogical expertise (Holmes et al., 2022). Particular importance is placed on the interaction between the human factor and technological systems. Despite the increasing capabilities of artificial intelligence, learning remains a process deeply influenced by motivation, emotional engagement, and social interaction (Selwyn, 2020). It is within this framework that the role of the teacher becomes especially significant—as a mediator, organizer, and interpreter of the learning process, who gives meaning and direction to the

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use of technology. This paper aims to examine this transition—from adaptive technologies to intelligent educational models—and to explore contemporary practices in AI-supported foreign language learning. The focus is placed on how technology can be effectively integrated into the pedagogical process while preserving its human-centered and social nature (UNESCO, 2023). In this sense, the study seeks to outline both the opportunities and the limitations of intelligent learning, as well as the evolving role of the teacher in the modern educational environment (Kasneji et al., 2023).

2. FROM ADAPTIVITY TO INTELLIGENCE IN LEARNING

The transition from adaptive technologies to intelligent educational systems represents a key stage in the development of modern education, particularly in the field of foreign language learning (Holmes et al., 2022). This process reflects not only technological progress but also a shift in the understanding of the learning process itself—from standardized knowledge transmission to a dynamic, individualized, and context-oriented educational environment (Williamson, 2024). Adaptive technologies can be considered the first step toward the personalization of learning. Their primary function is to collect and analyze data on learners' performance—such as test results, time spent on tasks, and frequency of errors—and, based on this data, to regulate the learning process. For example, if a student consistently makes mistakes in a grammatical structure such as verb tenses in English, the system can automatically provide additional exercises targeting that specific area. If the learner performs well, the system increases the level of difficulty or introduces new material. This type of adaptation is widely used in digital language learning platforms, where tasks are adjusted according to individual progress. For instance, when acquiring new vocabulary, the system may repeat words that were previously answered incorrectly, thereby supporting retention. Despite these advantages, adaptive technologies remain limited to responding within predefined behavioral patterns. They do not generate new content, nor can they interpret the deeper context of learning. With the emergence of artificial intelligence, a qualitative shift in this paradigm can be observed. Intelligent systems not only analyze data but also interpret it within a broader context, generating new content and adapting instruction in real time. Unlike adaptive technologies, which follow predefined scenarios, AI enables more flexible and dynamic interaction between the learner and the system (UNESCO, 2023).

One of the clearest examples of this is the use of intelligent chatbots in foreign language learning. These systems allow learners to engage in dialogue in the target language within environments that simulate real-life communication. For example, a learner may participate in a conversation related to everyday situations such as ordering food in a restaurant or making a hotel reservation. The system not only evaluates the correctness of the learner's responses but also suggests alternative expressions, explains mistakes, and guides the conversation based on the learner's input (Kasneji et al., 2023). This creates a sense of authentic communication and supports the development of communicative competence (Kessler, 2020). Another example is the use of systems capable of automatically generating texts and exercises. These systems can create personalized learning tasks tailored to the learner's interests and proficiency level. If a student shows interest in a particular topic—such as travel or technology—the system can generate texts, dialogues, or questions related to that topic. This increases motivation and engagement, as learning becomes more relevant and meaningful for the individual (Ivanova, 2022). Intelligent systems also provide a more advanced form of feedback. Instead of simply marking an answer as correct or incorrect, they can explain the reasons behind errors, suggest corrections, and guide learners toward additional resources (UNESCO, 2023). For example, in a writing task, the system can analyze not only grammar but also style, structure, and coherence, offering detailed suggestions for improvement (Williamson, 2024). Simulations and virtual environments represent another important dimension of intelligent learning. Through these tools, learners can immerse themselves in realistic language situations without leaving the classroom. For instance, a virtual environment may simulate an international meeting, a job interview, or a cultural event in which the learner is required to actively use the target language. This type of learning combines theory and practice, supporting the development of both linguistic and social skills (Todorova, 2021). Despite these advantages, the transition toward intelligent learning does not imply full technological autonomy. Intelligent systems expand the possibilities of education, but their effectiveness depends on how they are integrated into the pedagogical process (Selwyn, 2020). They create conditions for deeper learner engagement but cannot replace the role of the teacher as organizer and interpreter of the learning experience. In this sense, the shift from adaptive learning to intelligent learning should be understood as an evolutionary process in which technologies gradually expand their functions while remaining part of a broader pedagogical framework (Luckin, 2022). This process opens new opportunities for foreign language learning by combining personalization, interactivity, and communicative orientation, ultimately

leading to more effective and engaging language acquisition (Chen et al., 2020).

3. PRACTICES IN INTELLIGENT LANGUAGE LEARNING

Contemporary educational practices increasingly incorporate artificial intelligence (AI) in ways that fundamentally transform foreign language teaching and learning (Holmes et al., 2022). These practices extend beyond simple digital support and move toward the creation of intelligent, responsive, and learner-centered environments (Williamson, 2024). At the core of this transformation is the ability of AI-driven systems to combine data analysis, real-time interaction, and content generation, thereby enabling more effective and personalized language acquisition. One of the most significant developments in this area is the use of intelligent learning platforms that support the creation of individualized learning trajectories. Unlike traditional linear curricula, these platforms continuously adapt to the learner's level, pace, and preferences (Luckin, 2022). For example, a learner at an intermediate level of English B1 may receive a sequence of tasks that gradually increase in complexity, while another learner at the same nominal level but with different strengths—such as strong vocabulary but weaker grammar—may be guided through a different set of activities. The system dynamically adjusts content based on performance indicators such as accuracy, response time, and consistency, ensuring optimal engagement and progression (Kessler, 2020). Automated feedback represents another crucial component of intelligent language learning practice. In traditional settings, feedback is often delayed and limited by time constraints, whereas AI systems can provide immediate, detailed, and continuous responses (UNESCO, 2023). For instance, when a learner completes a writing task, the system can instantly identify grammatical errors, suggest lexical improvements, and offer alternative sentence structures. In speaking exercises, speech recognition technologies can analyze pronunciation, intonation, and fluency, providing learners with specific guidance on how to improve. This immediacy supports self-directed learning, as students are able to reflect on their performance and make corrections in real time (Ivanova, 2022). Interactive environments and simulations play a particularly important role in the practical application of language skills. These environments allow learners to engage in realistic communicative scenarios that mirror everyday situations. For example, a virtual simulation may place the learner in the role of a traveller navigating an airport, requiring them to ask for directions, respond to announcements, or interact with service staff. In another scenario, learners might participate in a simulated job interview, where they must answer questions, describe their experience, and respond appropriately to follow-up prompts. Such activities not only develop linguistic competence but also enhance pragmatic and sociocultural awareness. AI-powered chatbots further expand opportunities for interaction by enabling continuous conversational practice (Kasneci et al., 2023). Unlike static exercises, chatbots can sustain dialogues, respond to unpredictable input, and adapt the conversation to the learner's level. For instance, a beginner learner might engage in simple exchanges such as greetings and basic questions, while an advanced learner could participate in discussions on abstract topics like environmental issues or cultural differences. The system can correct errors subtly within the conversation, suggest more natural expressions, and encourage the learner to elaborate their responses, creating a more natural and engaging learning experience (Kessler, 2020).

Another important practice involves the use of AI for content generation and contextualized learning (Chen et al., 2020). Intelligent systems can create texts, dialogues, and exercises tailored to specific themes, professional domains, or learner interests (UNESCO, 2023). For example, a student studying business English may receive email and negotiation scenarios relevant to corporate communication, while a learner interested in tourism might work with dialogues related to travel planning and customer interaction. This contextualization increases the relevance of learning materials and strengthens the connection between language use and real-world application (Ivanova, 2022). Data analytics also plays a central role in intelligent language learning. By collecting and processing large amounts of learner data, AI systems can provide detailed insights into progress, strengths, and areas for improvement (Richter et al., 2020). Teachers can access dashboards that display patterns such as frequently made errors, time spent on specific tasks, or levels of participation. For example, if a group of learners consistently struggles with listening comprehension, the teacher can introduce targeted activities to address this difficulty. Similarly, individual learners can receive personalized reports that help them understand their own learning patterns and set specific goals for improvement. Moreover, intelligent systems support formative assessment by continuously monitoring performance rather than relying solely on summative evaluation (UNESCO, 2023). This allows for a more nuanced understanding of learning development and enables timely pedagogical intervention. Instead of waiting for final tests, teachers can identify issues early and adjust instruction accordingly. Despite these advancements, it is important to recognize that the effectiveness of these practices depends on their thoughtful integration into the pedagogical process. AI tools provide

powerful support, but they do not replace the need for structured guidance, meaningful interaction, and professional judgment. The teacher remains essential in selecting appropriate tools, interpreting data, and ensuring that technological applications align with educational objectives (Todorova, 2021). In conclusion, practices in intelligent language learning demonstrate a shift toward more personalized, interactive, and data-informed education. Through intelligent platforms, automated feedback, simulations, conversational agents, and analytics, learners are provided with richer and more flexible opportunities to develop their language skills (Kasneji et al., 2023). At the same time, these innovations highlight the importance of maintaining a balanced approach in which technology enhances, rather than replaces, pedagogical practice (Selwyn, 2020).

4. NEW MODELS OF LEARNING

The integration of artificial intelligence (AI) into education has led to the emergence of new learning models that can be defined as hybrid, combining technological innovation with pedagogical guidance (Luckin, 2022). These models represent a shift from traditional, linear forms of instruction toward more dynamic, flexible, and responsive educational environments (Williamson, 2024). Rather than replacing existing pedagogical frameworks, AI contributes to their transformation by expanding the ways in which teaching and learning can be organized and experienced (Selwyn, 2020).

At the core of these new models is the concept of intelligent learning environments, where the educational process is no longer structured as a fixed sequence of activities but evolves through continuous interaction between the learner, the technology, and the teacher (Chen et al., 2020). In such environments, learning becomes a non-linear and adaptive process. Learners do not follow identical paths; instead, their progression is shaped by their individual needs, performance, and engagement. For example, two students studying the same foreign language may encounter entirely different sets of tasks, resources, and feedback mechanisms depending on their level of proficiency, learning pace, and areas of difficulty. This shift toward non-linearity allows for a higher degree of personalization (Kessler, 2020). Intelligent systems can dynamically adjust content, propose alternative learning strategies, and provide targeted support (UNESCO, 2023). At the same time, this personalization does not eliminate the social dimension of learning. On the contrary, hybrid models aim to preserve and even enhance interaction, collaboration, and communication among learners. For instance, digital platforms may combine individual learning modules with group activities such as collaborative projects, peer feedback sessions, or virtual discussions. In this way, learners benefit from both individualized instruction and collective learning experiences (Ivanova, 2022). A key feature of these models is the integration of synchronous and asynchronous learning modes. Students may engage with AI-supported tasks independently—such as completing exercises, interacting with chatbots, or reviewing feedback—while also participating in real-time sessions led by the teacher. This blended structure allows for greater flexibility, as learners can control the timing and pace of certain activities, while still benefiting from direct pedagogical support and interaction. For example, a learner might practice vocabulary and grammar through an intelligent platform before participating in a live discussion session where these elements are applied in communicative contexts. Another important aspect of hybrid learning models is the redistribution of roles within the educational process. The learner becomes a more active participant, taking responsibility for their own progress and engaging in self-regulated learning. AI tools support this autonomy by providing continuous feedback, learning recommendations, and opportunities for independent practice (Kasneji et al., 2023). However, this increased learner autonomy does not diminish the role of the teacher. Instead, it redefines it. The teacher acts as a designer of learning experiences, a facilitator of interaction, and a mediator who ensures that technology is used effectively and meaningfully (Todorova, 2021). For example, in a foreign language classroom, an intelligent system may identify that a group of learners struggles with listening comprehension. Based on this data, the teacher can design targeted activities, such as guided listening exercises, group discussions, or contextual tasks that reinforce understanding (Richter et al., 2020).

In this way, technology informs pedagogical decisions, but it is the teacher who interprets the data and translates it into appropriate instructional strategies. Furthermore, hybrid models often incorporate elements of experiential and scenario-based learning. Through simulations, role-playing activities, and virtual environments, learners can engage in authentic communicative situations (Kessler, 2020). These experiences bridge the gap between theoretical knowledge and practical application. For instance, learners may participate in a simulated international meeting, negotiate in a business context, or collaborate on a project with peers from different cultural backgrounds. Such activities not only develop language skills but also enhance intercultural competence and real-world communication abilities (UNESCO, 2023). An essential characteristic of these new models is that technology does not replace the teacher but extends the

teacher's capacity to support learning. AI tools can handle repetitive tasks, provide immediate feedback, and offer individualized resources, thereby allowing teachers to focus on higher-level pedagogical functions such as guiding discussions, fostering critical thinking, and supporting emotional and social development (Holmes et al., 2022). This complementary relationship ensures that the human dimension of education is preserved while benefiting from technological innovation. At the same time, the implementation of hybrid models requires careful pedagogical planning and critical awareness. The effectiveness of these models depends not only on the availability of technology but also on how it is integrated into the curriculum and aligned with educational goals (Ministry of Education and Science, 2024). Teachers must be able to evaluate the relevance of technological tools, adapt them to specific contexts, and maintain a balance between digital and human interaction. In conclusion, the emergence of new learning models shaped by artificial intelligence reflects a broader transformation of education toward more flexible, personalized, and interactive approaches. These hybrid models create opportunities for combining the strengths of technology with the irreplaceable value of human teaching. By fostering continuous interaction between learners, technology, and educators, they support the development of more effective and meaningful learning experiences while maintaining the central role of the teacher in the educational process (Chen et al., 2020).

5. THE ROLE OF THE TEACHER

In the context of intelligent learning environments, the role of the teacher undergoes a significant transformation, yet it remains fundamentally central to the educational process (Holmes et al., 2022). The integration of artificial intelligence and digital learning systems does not reduce the importance of the educator; instead, it redefines their responsibilities, expanding them into new dimensions that are essential for ensuring meaningful and effective learning. The teacher is no longer positioned primarily as the sole source of knowledge. Instead, they assume a multifaceted role that includes being an organizer, facilitator, and interpreter of the learning process (Luckin, 2022). As an organizer, the teacher structures the educational experience, selecting appropriate content, sequencing learning activities, and ensuring coherence between learning objectives and instructional methods. In AI-supported environments, this also involves choosing suitable technological tools and integrating them into pedagogical practice in a purposeful way (Ministry of Education and Science, 2024).

As a facilitator, the teacher supports learners in actively engaging with knowledge rather than passively receiving it (Ivanova, 2022). This includes guiding students through problem-solving tasks, encouraging collaboration, and fostering independent learning strategies. In foreign language education, for example, the teacher may design communicative activities where students use AI tools for preparation but rely on human interaction to develop fluency, spontaneity, and confidence in real communication. Equally important is the teacher's role as an interpreter of the learning process. While artificial intelligence systems can generate data, analytics, and automated feedback, this information requires pedagogical interpretation (Chen et al., 2020). The teacher must evaluate whether the data reflects meaningful learning progress, identify underlying difficulties, and translate technological outputs into actionable instructional decisions (Richter et al., 2020). For instance, if an AI system indicates repeated errors in listening comprehension, the teacher must determine whether the issue is related to vocabulary gaps, pronunciation difficulties, or a lack of contextual understanding, and then adjust the teaching strategy accordingly. Another critical aspect of the teacher's role is ensuring balance between technological tools and pedagogical objectives. In intelligent learning environments, there is a risk that technology may become overly dominant, shifting attention away from educational goals toward technical efficiency (Selwyn, 2020). The teacher acts as a mediator who prevents this imbalance by ensuring that all technological applications serve a clear pedagogical purpose (UNESCO, 2023). This involves continuously evaluating the relevance, effectiveness, and appropriateness of digital tools in relation to learner needs and curriculum goals. The teacher also plays a crucial role in maintaining the human dimension of education. While AI can simulate interaction and provide automated responses, it cannot fully replicate the emotional, social, and ethical aspects of teaching and learning. The educator contributes empathy, motivation, encouragement, and personal connection—elements that are essential for student engagement and development. In foreign language learning in particular, the teacher supports learners in overcoming communication anxiety, building confidence, and developing intercultural awareness (Todorova, 2021). Furthermore, the teacher is central to the development of higher-order skills such as critical thinking, creativity, and value-based reasoning. These competencies require reflection, discussion, and guided interpretation, which cannot be fully automated. The teacher encourages learners to question information, evaluate different perspectives, and construct meaningful understanding beyond surface-

level responses generated by technological systems (Kasneci et al., 2023). In this sense, the role of the teacher in the era of artificial intelligence is not diminished but enriched. It shifts from information delivery toward complex pedagogical mediation, combining instructional design, technological integration, and human interaction. The teacher becomes a key figure who ensures that technology enhances rather than replaces the educational experience (Selwyn, 2020).

Ultimately, effective intelligent learning environments depend on the teacher's ability to navigate between technological innovation and pedagogical integrity (UNESCO, 2023). By doing so, educators ensure that learning remains structured, purposeful, and deeply human-centered, even in highly digitalized educational contexts (Chen et al., 2020).

6. CONCLUSION

The transition from adaptive technologies to intelligent language learning represents a significant milestone in the ongoing evolution of education. It reflects a broader shift in how learning processes are conceptualized, moving from technology-assisted instruction toward deeply integrated, data-informed, and interactive educational ecosystems (Holmes et al., 2022). Artificial intelligence introduces new possibilities for personalisation, real-time feedback, and enhanced learner engagement, thereby reshaping the structure and dynamics of foreign language education (UNESCO, 2023). At the same time, the integration of intelligent systems into teaching and learning processes requires careful pedagogical reflection. The effectiveness of AI-supported education does not depend solely on technological advancement, but on the way these tools are designed, implemented, and interpreted within specific educational contexts (Selwyn, 2020). Without a clear pedagogical framework, even the most advanced systems risk becoming fragmented tools that lack meaningful educational direction (Williamson, 2024). A key finding of this analysis is that the most effective learning outcomes are achieved through a balanced integration of technological innovation and pedagogical expertise. Artificial intelligence can significantly support the learning process by offering adaptive content, individualized learning paths, and immediate feedback (Richter et al., 2020). However, these functions remain supportive rather than substitutive; they enhance the learning experience but do not replace the deeper human dimensions of education. Human interaction remains an essential component of effective language learning (Kessler, 2020). Communication, motivation, emotional engagement, and cultural understanding are central elements of language acquisition that cannot be fully replicated by automated systems (Todorova, 2021). The presence of the teacher ensures that learning remains socially grounded, emotionally responsive, and pedagogically coherent (Ivanova, 2022). In this sense, the educator continues to play a decisive role in shaping the quality and direction of the learning process. Furthermore, the future of foreign language education is increasingly defined by synergy rather than substitution. The most promising educational models are those in which artificial intelligence and pedagogy operate in complementary roles. AI provides analytical power, scalability, and responsiveness, while the teacher provides interpretation, guidance, and ethical and educational orientation (UNESCO, 2023). This interaction creates a more flexible and responsive learning environment that can adapt to the needs of diverse learners while maintaining pedagogical integrity (Chen et al., 2020). In conclusion, intelligent language learning should not be understood as a replacement of traditional teaching practices, but rather as their transformation and enrichment (Kasneci et al., 2023). The teacher remains the central figure who gives meaning, structure, and direction to the learning process, ensuring that technological tools are used in ways that serve educational goals (Luckin, 2022). The future of foreign language education thus lies in a carefully balanced integration of artificial intelligence and human pedagogy, where technology enhances learning, but the educator remains its guiding force (Selwyn, 2020).

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DEVELOPMENT PRESSURES AND SUSTAINABILITY: A LOCAL COMMUNITY PERSPECTIVE-EVIDENCE FROM KOTOR

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Abstract: The development of tourism in modern conditions, especially in destinations of exceptional cultural and historical value, is increasingly accompanied by a series of challenges arising from the growth in the number of visitors and their concentration in limited space and time. In addition to infrastructural pressures, an increasingly pronounced challenge is the preservation of resources and the spatial-cultural values of the destination. Cultural heritage cannot be viewed only through material resources, but also through intangible dimensions that shape the sense of belonging and social relations. Cultural identity and authenticity do not represent static categories, but are shaped through everyday practices and the experience of space, which is why intensive tourist flows can lead to their redefinition, but also their degradation. These processes are particularly evident in Kotor, a city under UNESCO protection, where the concentration of tourist flows in a spatially limited historical core generates pressures reflected in the cultural structure and the everyday functioning of the city. Within this context, the perception of the local population represents an important framework for understanding the actual effects of tourism development. This paper examines the perception of the local community regarding the impact of tourism development on cultural identity, authenticity, and the atmosphere of space, as well as on the use of cultural heritage. The research was conducted on a sample of 321 respondents using a structured questionnaire, while the data analysis was carried out using the chi-square test of independence. The results indicate that a higher intensity of tourism development is associated with a more pronounced perception of a threat to cultural identity, degradation of authenticity, and changes in the cultural atmosphere of the city. At the same time, the majority of respondents recognize the commercialization of cultural heritage as a pronounced process, indicating a shift in its function and meaning in contemporary tourism flows. Although certain dimensions (communal order and concern for the preservation of UNESCO status) are not statistically related to the intensity of tourism, they are recognized as problematic, pointing to broader and more complex patterns of perception within the local community. In addition, there is a perception that tourism pressures alter the function of cultural heritage and create a sense of insecurity regarding the future preservation of the city's values. Overall, the findings indicate the need for balanced and strategically oriented management of tourism development. Such an approach implies the improvement of management mechanisms and the active involvement of the local community in decision-making processes. In this regard, tourism policies should be directed towards preserving cultural values, authenticity, and the long-term sustainability of the destination.

Keywords: *tourism development, cultural heritage, local community, sustainability, identity, Kotor.*

Field: Social Sciences

1. INTRODUCTION

The development of tourism in modern conditions, especially in destinations of exceptional cultural and historical value, is increasingly accompanied by a series of challenges arising from the growth in the number of visitors and their concentration in limited space and time. Despite the economic benefits, primarily reflected in income growth, employment, and the improvement of the local economy, such dynamics and increased tourism pressure impose additional demands on destination management. Pressures arising from intense tourism flows result in overcrowding, degradation of public spaces, and disruptions in the daily functioning of the city, which is why the quantitative growth of tourism is no longer a reliable indicator of positive development (UNWTO, 2018; Hospers, 2019). In addition to infrastructure overload as a dominant issue, particular emphasis is placed on resource conservation and the protection of the spatial and cultural values of the destination (Milano et al., 2019; UNWTO, 2018).

Kotor, one of the most attractive tourist destinations in Montenegro, is a representative example of a destination where these processes are particularly pronounced. As a city of exceptional cultural and historical value and with the status of a protected area, in recent years it has been facing an increasingly significant growth in tourism flows, as well as the pressures they generate. An excessive number of visitors within a temporally and spatially limited historical core leads to crowding, traffic congestion, degradation of communal order, and changes in everyday life practices. These challenges are further intensified by a pronounced imbalance between the relatively small number of residents, around 22,000 (MONSTAT, 2024), and the large number of daily visitors, around 8,000 - during peak season (Media

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biro, 2025), which significantly complicates development management and increases pressure on urban space, infrastructure, and cultural heritage (Bogdanović & Radović, 2025).

An additional dimension of the problem lies in the fact that Kotor is inscribed on the UNESCO World Heritage List, which implies recognition of its “Outstanding Universal Value”, as well as strict standards of protection and site management (UNESCO World Heritage Centre, 2021). In this regard, reports from 2025 indicate the necessity of improving management mechanisms and sustainable development, accompanied by a warning that, in the absence of an adequate response to existing challenges, the site could be placed on the UNESCO List of World Heritage in Danger (Portal Analitika, 2025). Such circumstances emphasize the importance of examining development pressures not only through economic, but primarily through social and cultural aspects of destination management.

Cultural and historical assets not only attract visitors but also shape local identity and contribute to socio-economic development (Richards, 1996, 2011). Cultural identity is not a static category, but a dynamic process that is continuously redefined through the interaction of the local community with its environment. The preservation of cultural identity is not merely an act of remembering the past, but an active strategy that ensures that the city maintains its “spiritual” integrity in the face of the challenges of globalization and uncontrolled tourism commercialization (Jelinčić, 2006).

According to UNESCO guidelines, the authenticity of cultural heritage is viewed through several dimensions. In addition to material characteristics, they also include the setting, context, as well as non-material aspects such as the “spirit of the place” and the experience of the space (spirit and feeling), which indicates the complexity of the concept of authenticity itself. (UNESCO, Operational Guidelines, 2021).

The intensification of tourism flows and the accompanying pressures result in an increasingly pronounced commercialization of cultural and historical assets, as well as their adaptation to tourism demand (Moraru et al., 2021). This is significantly reflected in the lives of local residents, so that the consequences of these changes are not limited only to the physical environment and cultural assets, but are also manifested in everyday life (UNWTO, 2018). In such cases, tourism development goes beyond the purely economic dimension and becomes a complex social process. This process affects the perception of belonging, the use of public space, as well as the overall quality of life of residents. Contemporary literature increasingly points to the emergence of feelings of pressure and loss of control over their environment among the local population in destinations experiencing intensive tourism growth (Gössling et al., 2020; Díaz-Parra & Jover, 2021).

Recent research indicates that the perception of the local population plays a key role in understanding these processes, as residents are the ones who most directly experience the consequences of tourism development (Moraru et al., 2021). These studies also indicate the need for the active involvement of the local community in planning and management processes in order to ensure the long-term sustainability of the destination (Popescu, 2024; GSTC, 2021). In this sense, the attitudes of the local population become essential for understanding the actual effects of tourism development on cultural heritage, identity, and the function of space.

Although there is a significant amount of research that deals with the impact of tourism on destinations, there is a lack of empirical studies that focus on local community perceptions in the context of development pressures and sustainability, especially in smaller Mediterranean destinations with a strong cultural heritage. This perspective enables a deeper understanding of the relationship between tourism development and the preservation of the identity of place, as well as the identification of key challenges faced by the local population.

Based on the above, the aim of this paper is to examine the perception of the local community regarding the impact of tourism development pressures on destination sustainability, with a particular focus on changes in cultural identity, authenticity, and the cultural atmosphere, as well as on the use of cultural heritage in contemporary tourism flows. By analyzing the attitudes of residents of Kotor, the study seeks to identify patterns of perception and determine implications for improving tourism management in support of sustainable development. It also aims to assess the level of concern among the local population regarding the future and the preservation of the cultural identity of the destination.

2. MATERIALS AND METHODS

The study is designed as a quantitative cross-sectional study, with the aim of examining the perceptions of the local population regarding development pressures and their implications for the sustainability of urban space.

The target population consisted of adult residents of Kotor municipality. Data were collected through a structured online questionnaire, and the final sample included $N = 321$ respondents. The sample was formed based on key demographic variables (gender, age, level of education, and place of residence within the municipality), which enabled the inclusion of different segments of the local community.

The questionnaire was designed as a set of closed-ended questions, with respondents expressing their level of agreement with specific statements using a five-point Likert scale (ranging from “strongly disagree” to “strongly agree”). The questions were aimed at assessing perceptions of the intensity of tourism development, as well as its implications for key dimensions of sustainability, including cultural identity, site authenticity, cultural atmosphere, the commercialization of cultural heritage, communal order, and concern for the preservation of UNESCO status.

For the purpose of examining the relationship between the perceived intensity of tourism development and the aforementioned aspects of sustainability, contingency table analysis and the chi-square (χ^2) test of independence were applied. This procedure was used to test the statistically significant association between the intensity of tourism pressure (as the independent variable) and the perception of key dimensions of sustainability (cultural identity, authenticity, cultural atmosphere, etc.) as dependent variables.

The analysis was conducted using Microsoft Excel, applying the CHISQ.TEST function, whereby matrices of observed and expected frequencies were constructed for each combination of variables. The results were interpreted based on p-values, with the level of statistical significance set at 0.05. These procedures enabled the identification of statistically significant relationships between the observed variables.

3. RESULTS AND DISCUSSION

The results of the chi-square (χ^2) analysis indicate that the perception of the intensity of tourism development significantly shapes the attitudes of the local population toward key aspects of destination sustainability. The effects of tourism pressure are particularly reflected in the domains of cultural identity, authenticity, and cultural atmosphere, where statistically significant associations were identified. However, this relationship is not consistent across all observed dimensions. In the case of perceptions of communal order and concern for UNESCO status, no statistically significant association was confirmed. These findings suggest that certain aspects of perception are formed under the influence of a broader set of factors, contributing to a more nuanced understanding of the effects of tourism pressure.

A statistically significant association between the perceived intensity of tourism and the perceived threat to cultural identity ($p = 0.035$) indicates that respondents who perceive higher tourism pressure more frequently express concern about the preservation of the city's identity. Notably, as many as 84.1% of respondents believe that cultural identity is threatened to some extent or to a great extent, suggesting that the perception of its endangerment is not marginal, but rather dominant among respondents. The results confirm that the local community recognizes changes that are not only related to physical space, but also to the way the community perceives and understands its own identity. This finding can be further interpreted in the context of cultural contact generated by tourism. As Jelinčić (2006) points out, the encounters between tourists and the local population often lead to changes in the identity of the community, whereby tourism development can act as a factor that disrupts existing cultural patterns and creates a sense of discomfort in the everyday life of the local population.

A particularly pronounced association was identified in the perception of the impact of tourism on the authenticity of cultural and historical sites ($p = 0.0004$), representing the most notable statistical finding in the study. This result confirms that the intensification of tourism development significantly shapes the perception of the degradation of the authenticity of space. Although authenticity is often linked to the material preservation of cultural assets, Wang (1999) distinguishes between objective and existential authenticity, whereby the latter implies the experience of authenticity in everyday life. The findings suggest that in Kotor not only the physical authenticity of space is affected, but also the way in which residents perceive its originality and distinctiveness. These changes are accompanied by increasingly pronounced feelings of alienation among the local population in their own city.

A significant association between the intensity of tourism and the perception of changes in the

cultural atmosphere ($p = 0.002$) further confirms that tourism development also affects the intangible dimensions of space, including the setting, social relations, and the everyday life of the community. Such findings go beyond a narrow understanding of tourism as an economic phenomenon and point to the transformation of the city as a social space, rather than merely a tourist destination. Furthermore, the findings show that the consequences of tourism pressure are directly reflected in the everyday functioning of the local community, as also confirmed by the research of Jelinčić (2006). Accordingly, intensive tourism flows may lead to disruptions in established patterns of life, generate discomfort, and alter the use of urban space, particularly in destinations with a high concentration of visitors.

Evidence related to the commercialization of cultural heritage further confirms the perception that cultural resources are increasingly used for tourism-related consumption, which may result in their functional and symbolic transformation. At the same time, 83.2% of respondents believe that cultural heritage has been commercialized to some extent or to a great extent, indicating the widespread nature of this perception among the local population. This interpretation is supported by a statistically significant result ($p = 0.019$), suggesting that respondents who perceive more intensive tourism development are more likely to recognize the use of cultural resources for commercial purposes. The findings point to a transformation in the function of cultural heritage—from a public and identity-based resource to a market-oriented value. In this sense, as Tileaga (2026) points out, cultural heritage is a limited resource whose excessive commercialization may lead to its physical and symbolic depletion. In the case of Kotor, such processes may contribute to the gradual shaping of the city as a tourism-oriented space devoid of authentic social life, thereby raising concerns about the long-term sustainability of its UNESCO World Heritage value. Consequently, traditions and customs are adapted to tourist expectations, which may result in their transformation or the loss of their original function (Jelinčić, 2006).

In contrast to the previous findings, no statistically significant association was found between the perception of tourism intensity and the perception of communal order ($p = 0.569$). However, this result does not diminish the importance of the issue in this area. On the contrary, the findings indicate that the perception of communal order among respondents is generally unfavorable, regardless of the perceived intensity of tourism pressure, suggesting that this is a systemic challenge. In other words, problems in the functioning of the urban system are recognized as widespread and are not exclusively related to the subjective perception of tourism intensity, but also to the broader managerial and infrastructural capacities of the destination.

A similar pattern was observed in the case of concern for UNESCO status. Although no statistically significant association was found with the perception of tourism intensity ($p = 0.137$), the results indicate a high level of concern among respondents, with as many as 202 out of a total of 321 respondents reporting being “quite” or “very concerned.” This finding clearly indicates that the issue of preserving World Heritage status represents an important dimension of the collective perception of the local community. The absence of a statistical association in this case suggests that concern is not formed solely on the basis of the personal perception of tourism pressure, but also under the influence of a broader institutional and social context, including public debates and international warnings.

Taken together, the findings indicate that the effects of tourism development in heritage destinations cannot be fully understood through isolated indicators, but require an integrated approach that includes the interaction of material, social, and perceptual dimensions of space. The absence of consistent relationships across all analyzed variables suggests that tourism-related changes are influenced by broader structural and management contexts, rather than being driven solely by the intensity of tourist flows.

In this regard, the results point to the need to shift the focus from purely economic and physical effects of tourism toward experiential and perception-based aspects of sustainability. By emphasizing the role of the local community, the sustainability of a destination cannot be understood only through the condition of cultural heritage, but also through the extent to which residents recognize and identify with the values of the space.

These findings have important implications for destination management. Instead of relying only on quantitative control measures, such as limiting the number of visitors, a more comprehensive approach is needed—one that includes social sustainability, strengthens institutional coordination, and ensures the active involvement of the local population in decision-making processes. Such an approach is particularly relevant for destinations with protected status, where the preservation of UNESCO World Heritage values depends not only on formal compliance with conservation standards, but also on the long-term alignment between tourism development and the lived experience of the local community.

4. CONCLUSIONS

Overall, the results indicate that intensive tourism development in destinations such as Kotor generates significant socio-cultural effects that go beyond economic benefits and substantially influence perceptions of identity, authenticity, and the overall character of place. A pronounced level of concern among residents, together with the perception of the growing commercialization of cultural heritage, indicates a transformation in the function and meaning of cultural resources under tourism pressure. At the same time, the absence of statistically significant associations in certain dimensions suggests the influence of a broader set of structural and governance-related factors in shaping the attitudes of the local community. Based on the above, these findings emphasize the need for a balanced and integrated approach to tourism management, aimed at preserving cultural sustainability, authenticity, and the functional integrity of space, with the active involvement of the local population in decision-making processes.

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IMPACT OF ARTIFICIAL INTELLIGENCE ON MONITORING AND MANAGEMENT OF STOCK LEVELS

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Abstract: Inventory management is one of the main issues facing businesses in the current business environment because of the increased unpredictability, quick changes in the market, and increasing complexity of supply chains. Through the use of sophisticated analytical and predictive models, artificial intelligence (AI) becomes a crucial tool for enhancing inventory level monitoring and management. This paper's goal is to examine how artificial intelligence affects inventory management efficiency, with a particular emphasis on automating inventory monitoring, optimizing ordering, and cutting expenses associated with both excess and inadequate inventory. The theoretical examination of contemporary inventory management techniques and the identification of critical domains where the use of artificial intelligence enhances decision-making serve as the foundation for this work. The use of machine learning algorithms in demand forecasting, identifying obsolete and slow-moving goods, and enhancing supply chain coordination are all given particular attention. Along with possible dangers related to data quality and reliance on automated judgments, organizational and information conditions for the effective adoption of VI systems in inventory management are also covered.

The study's conclusions show that artificial intelligence can greatly increase inventory level monitoring accuracy and help make better use of resources, but that its full impact requires integration with current information systems and sufficient management oversight. Managers, accountants, and researchers interested in the digital transformation of inventory management procedures may find the study interesting as it offers a foundation for more empirical research.

Keywords: *artificial intelligence, inventory management, automation, inventory costs, predictive analytics*

Field: Social Sciences

1. INTRODUCTION

The accounting function of the enterprise will be significantly affected by the use of artificial intelligence in inventory management, especially in the areas of inventory recording, valuation, control and reporting. Since inventories constitute a significant part of current assets, the accuracy of information about their condition has a direct impact on the accuracy of financial statements, liquidity and management choices. Periodic inventories, manual controls, and retrospective data processing are major components of traditional inventory accounting systems. Delays in identifying differences, estimation errors, and mismatches between actual and book inventory levels are often caused by such a method. AI-based solutions would enable continuous and automatic recording of inventory changes, significantly improving the timeliness and quality of accounting data.

Inventory, one of the most important components of a company's current assets, directly affects liquidity, profitability and overall financial stability. Large financial outlays and costs are necessary for any inventory holding at any stage of the process. One of the most important and complex aspects of working capital management in companies is inventory management. In addition to being a major source of cost and risk, inventories enable continued production and sales. Serious business consequences, including excessive financial liability, higher storage costs, product obsolescence, write-offs and losses, as well as loss of customers due to shortages, can result from improperly balancing inventory levels. Conventional inventory management methods, such as min-max inventory systems, ABC analysis, and EOQ (economic order quantities), are based on overly simplistic assumptions about linear correlations between variables, consistent lead times, and demand stability. Despite the fact that these models have long served as the basis for the theory and practice of inventory management, their relevance in modern circumstances is becoming less and less.

The following are the main problems with conventional methods:

- dependence on the average demand in the past,

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- static inventory thresholds
- poor ability to adapt to transient changes,
- inadequate communication with other corporate operations,
- There is a lot of manual decision making.

Inadequate inventory control can lead to capital being locked up in excess inventory, higher storage costs, product obsolescence or, conversely, shortages that threaten the continuity of production and sales. Because of this, these systems often lead to less-than-ideal choices when the market is volatile, which directly affects rising costs and reducing corporate efficiency.

Artificial intelligence systems enable data from production, sales, procurement and logistics to be combined with inventory accounting records to create a single, real-time database. This reduces the possibility of discrepancies between operating and financial data, which is critical to balance sheet accuracy and cost of goods sold calculations.

In terms of inventory valuation, the use of artificial intelligence allows for a more sophisticated estimate of the net realizable value of inventory, especially in situations with fluctuating demand and short product life cycles. Artificial intelligence systems can quickly detect inventory at risk of obsolescence or depreciation by analyzing turnover rate, seasonality and market trends. According to accounting standards, this allows earlier and more objective recognition of losses based on the decline in the value of inventory.

Inventory management assumes a strategic role in the context of international markets, dynamic supply chains and increasingly noticeable disruptions in input availability. Businesses are now forced to implement modern, adaptable and flexible systems that enable a quick response to changes in the environment, instead of relying solely on static planning models.

2. MATERIALS AND METHODS

The empirical research of this paper is based on the analysis of how the use of artificial intelligence in inventory management affects the company's business performance and accounting metrics. A case study was used in a descriptive and analytical research methodology, which allows for a thorough examination of the causal relationships between the implementation of artificial intelligence, inventory management modifications and financial impacts.

Company financial statements, internal inventory data, and operational indicators relevant to inventory management serve as the basis for empirical research. The observed period covers the time frame before and after the implementation of AI-based solutions, allowing a comparative examination of changes in inventory levels, turnover and structure. Predictive analytics were used in demand planning, purchasing decisions were automated, and inventory tracking was improved as part of research to operationalize the use of artificial intelligence. The variables of total inventory level, average inventory value, inventory turnover ratio, and inventory share in current assets were used to examine the effects on inventory. While business results were examined using liquidity indicators (current and quick liquidity ratios) and profitability indicators, the effect of stock optimization on the company's accounting position was observed through changes in the balance sheet, mainly through the structure of current assets. In this way, the connection between the financial performance of the company and the operational impact of the use of artificial intelligence is guaranteed.

The methodological framework of the research, which is based on a cause-and-effect approach, allows testing the basic assumption that the use of artificial intelligence through inventory optimization improves the financial performance and balance sheet structure of the company.

3. RESULTS

An integrated cause-and-effect diagram linking technology solutions, accounting categories, and company business success can be used to illustrate how artificial intelligence is applied to inventory management. AI → inventory → balance → performance is a conceptual representation of this relationship.

By improving the collection, processing and analysis of inventory data, artificial intelligence serves as the first catalyst for change. Artificial intelligence technologies enable demand estimation, identification of slow turnover, more accurate tracking of inventory movements and automation of the ordering process. As a result, excess quantities are reduced, inventory structure and levels are optimized, and essential items are rapidly replenished.

The paper uses the example of the consumer goods wholesale company "T" to demonstrate the

empirical approach. In 2025, the company implemented an artificial intelligence-based system to monitor inventory levels and manage the procurement process. Optimizing the width of the assortment, avoiding the accumulation of slow-moving items and automating the ordering of items with low stock are all things that were given special attention during the implementation of the system.

By comparing relevant indicators before and during the implementation of the artificial intelligence system, operational effects on inventory, as well as accounting and financial implications, were examined.

- Modifications to the trading company's inventory management

After implementing an artificial intelligence system, the business improved sales tracking by item, identified products with reduced turnover, and implemented dynamic inventory thresholds based on customer behavior and seasonality. Organization and inventory levels have changed significantly as a result, as shown in Table 1.

Table 1: Inventory indicators before and after the implementation of AI (example)

Indicator	Before applying AI	After applying AI
Average inventory value (mil. RSD)	260	190
Inventory turnover ratio	5,2	7,1
Share of inventory in current assets (%)	61%	46%
Share of slow-moving items (%)	18%	9%

Source: Authors' research

The collected results show that the trading company was able to improve the assortment structure, achieve a faster turnover of items and drastically reduce the capital tied up in the inventory by using artificial intelligence.

- Impacts on financial performance and balance sheet

The company's accounting position is directly affected by inventory optimization. Working capital was relieved as a result of the decline in inventory value, and the freed money was used to reduce short-term liabilities and increase liquidity.

Table 2: Selected financial indicators - trading company (example)

Indicator	Before applying AI	After applying AI
Liquid ratio	1,20	1,65
Brzi racio	0,75	1,10
Net profit margin (%)	4,8	6,9
Cash cycle (days)	54	37

Source: Authors' research

The financial performance and business efficiency of a trading company are directly and quantitatively affected by the use of artificial intelligence in inventory management, which can be seen by improving liquidity indicators and reducing the cash cycle. These findings support the validity of the empirical mini-model of work:

Artificial intelligence → inventory optimization → better balance sheet structure → increased profitability and liquidity

The accounting approach to inventory on the balance sheet directly reflects better inventory management. Reduced differences between the actual and book balance, quick recognition of damage and more realistic stock valuation are made possible by more accurate data. This improves the quality of financial reporting, strengthens the structure of the balance sheet and increases the reliability of the reported current assets. A company's key performance indicators are also affected by changes in cost of goods sold and the balance sheet. While more efficient inventory management helps reduce operating costs and increase profitability, reducing equity tied up in inventory has a beneficial effect on liquidity. Increased profit margins, liquidity ratios, and inventory turnover are examples of improved financial metrics that testify to the direct and quantitative effects of investing in artificial intelligence in inventory

management on a company's overall business performance. Artificial intelligence therefore affects not only the operational procedures of inventory management, but also plays a significant role in improving the accounting system and strategic business management, linking technological progress with the company's financial results.

4. DISCUSSIONS

The fact that the example is illustrative in nature and is based on a simplified situation of a trading corporation is the first indication of the limitations of empirical research. The results show the possible consequences of using artificial intelligence in inventory management, but cannot be applied to the entire retail industry.

Another shortcoming is the concentration of the analysis on accounting and financial metrics, rather than on a wider range of qualitative elements, such as organizational changes, the degree of digital maturity of the company and the costs associated with the introduction of artificial intelligence systems. In addition, the impact of the use of artificial intelligence may vary depending on the size of the company, the nature of the product, the state of the market and the stability of supply chains.

Despite the above shortcomings, the empirical analysis unequivocally shows the direction and strength of AI's impact on inventory optimization and financial performance, offering a solid foundation for further, more thorough research based on larger sample sizes and more sophisticated statistical techniques.

5. CONCLUSIONS

Inventory management is one of the key areas where operational, accounting and strategic decision-making intertwine in today's corporate environment, characterized by high demand uncertainty, complex supply chains and an increasing need for effective working capital management. The theoretical part of the paper highlighted the potential of artificial intelligence as a technological framework that enables dynamic, data-driven and predictive inventory management, while at the same time highlighting the shortcomings of conventional inventory management methods.

Examining modern theoretical methods has shown that the use of artificial intelligence helps in improving demand forecasting, automating the ordering process and more precisely tracking inventory movements, all of which foster conditions for optimizing inventory levels and structures. This method improves the quality of balance sheet data, strengthens the internal control system, and enables a more current and realistic valuation of assets, all of which have important consequences for inventory accounting.

The theoretical assumptions are additionally supported by the empirical part of the work, which used a trading company as an example. The results showed that the use of artificial intelligence in inventory management results in lower average inventory levels, higher inventory turnover and a lower proportion of slow-moving items. By improving the structure of current assets and freeing up financial resources, these modifications had a favorable impact on the balance sheet. This further improved the liquidity and increased the profitability of the company.

Efekti primene veštačke inteligencije mogu se sažeto predstaviti kroz validirani mini-model koji integriše teorijska razmatranja i empirijske nalaze: primena sistema veštačke inteligencije → optimizacija zaliha → poboljšana struktura bilansa stanja → poboljšanje pokazatelja likvidnosti i profitabilnosti. Ovaj lanac jasno pokazuje da veštačka inteligencija utiče ne samo na operativni nivo upravljanja zalihama, već igra i značajnu ulogu u poboljšanju računovodstvenog sistema i finansijskih performansi preduzeća.

Artificial intelligence should be used gradually and carefully to accounting and inventory management procedures, concentrating on tasks that have the biggest effects on working capital, like order automation, inventory tracking, and identifying slow-moving commodities. Close integration with ERP and accounting systems is required to fully appreciate the benefits of such solutions, which guarantees the prompt connection of inventory data with financial records and boosts the dependability of financial reporting. Artificial intelligence systems' analytical outputs should be actively utilized at the management level, particularly for procurement planning, working capital management, and cost control. Because accountants and financial analysts play a crucial role in data interpretation, evaluating the impact on financial statements, and guaranteeing adherence to accounting rules, the strengthening of accounting's role is particularly highlighted in that process. In order to make prompt adjustments to business decisions, it is also required to regularly evaluate the effects of the use of artificial intelligence through changes in the level and turnover of stocks as well as through pertinent financial indicators. Despite the limitations of

empirical analysis, the study's findings demonstrate that artificial intelligence is a potent tool for enhancing inventory control and the quality of accounting data. Future research can concentrate on sectoral variations and long-term impacts on the sustainability and financial stability of businesses.

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THE WAR IN IRAN AND THE NEGATIVE EXTERNALITIES FOR LIBERAL INTERVENTIONISM

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Abstract: The 2026 war between the USA and Israel, on the one hand, and Iran, on the other, has eluded the initial hopes of the Trump administration that a decisive victory could be achieved in a quick fashion and in addition to having wide-ranging impacts across many different spheres, including on the world economy as a whole, also appears likely to significantly reduce the prospects for European involvement in humanitarian interventions taking place beyond the borders of the continent, at least in the conceivable future. The paper employs qualitative methodology, which is reliant on the integrated analysis of a vast collection of primary and secondary sources that fall within the international relations, political science, and international security disciplines. Following a literature review, in which it examines the main assumptions that underpin the philosophy of liberal interventionism and some of the relevant trends, it advances a threefold argument. Firstly, it contends that military operations inspired by liberal interventionist principles, in order to be able to stake a claim for credibility, need to at least pay lip service to multilateralism. However, Trump's embrace of unilateralism and frequent disregard for the opinions of European allies, as it occurred during the prelude to the Iranian crisis, makes it increasingly likely that US-led interventions would be associated with the pursuit of narrow Realpolitik interests, resulting in them being unpalatable for European politicians and the general public in European countries. Secondly, the strategic vulnerability of Europe due to the war in Ukraine not appearing to be winding down, with Trump widely perceived as having done less than the bare minimum in terms of putting pressure on the Russian side in order to negotiate in good faith and make concessions, coupled with the economic fallout for Europe courtesy of the Iran war, is quite likely to dampen European enthusiasm for the use of force in order to end human rights violations in Africa, Latin America or Asia, especially given that they would detract from or at least be perceived to be detracting from the support offered for the Ukrainian war effort or be viewed as economically unsustainable. Thirdly, the war in Iran may give a significant boost to nuclear proliferation around the world and in the long-term possibly increase the number of "rogue" states possessing some sort of nuclear capacity, which would further reduce the space for humanitarian interventions due to Western countries' risk aversion and general unwillingness to test certain red lines pertaining to sovereignty in the case of nuclear powers.

Keywords: *United States, Donald Trump, Iran, liberal interventionism, nuclear proliferation*

Field: Social Sciences

1. INTRODUCTION

On 28 February 2026, in the context of the Iran-Israel proxy conflict and as part of the Middle Eastern crisis, the United States and Israel began airstrikes on Iran, with the major targets being various military and government installations, while on the same date the country's Supreme Leader Ali Khamenei and a number of senior military and intelligence officials were assassinated. The war has widely been described as illegal, under both US and international law, with many experts depicting it as a crime of aggression and not coming close to meeting the threshold for the use of pre-emptive force, (Siddique, 2026) with the large-scale attacks taking place prior to a scheduled fourth round of negotiations in Vienna, Austria concerning the reaching of an agreement pertaining to the nuclear program of Iran. Iran's response to the onslaught, which has included the closure of the Strait of Hormuz, a key global economic chokepoint, has according to the International Energy Agency (IEA), resulted in an unprecedented disruption in the history of the global oil market (Nelson, 2026) as well as negative impacts on international trade, aviation and tourism, in addition to sparking a rise in volatility in the case of financial markets. The Trump administration has offered multiple rationales and shifting justifications for starting the war, including the need to orchestrate regime change and pave the way for the Iranian opposition to assume power, ostensibly largely in response to the Iranian authorities' brutal crackdown on the protests that began on 28 December 2025, which resulted in possibly the largest massacres of civilians in the modern history of Iran. On 13 January 2026, Donald Trump informed Iranian demonstrators in a social media post that "help was on the way", (Elwelly & Erickson, 2026) urging them to take control over their institutions. In the days preceding the war as well as during its initial phase, a number of prominent political figures such as Republican Senator Lindsey Graham maintained that the invocation of humanitarianism as a factor behind the USA's decision-making calculus in toppling the country's leadership was far from misplaced, while opponents of the war who ascribed more cynical motives to the US president's decision to pursue

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a military solution in relation to Iran, nonetheless acknowledged that the Responsibility to Protect (R2P) global political commitment, which has helped entrench the perception that humanitarian needs can supersede the rules on sovereignty and non-intervention under international law, had proved at least somewhat useful in allowing Trump to dress up the war with faith-based legitimacy. (Taub, 2026) However, there are ample grounds on which to argue that liberal interventionism may turn out to be a major casualty even after the dust from the war, frequently appraised by foreign policy experts to be a major strategic blunder stumbled into by the USA, to a degree at the behest of Israel, starts to settle.

Liberal interventionism represents a doctrine, according to which it is acceptable to go beyond economic coercion and deploy military forces (with the expectation that they may have to be combat ready rather than simply “keep the peace”, depending on the situation) in order to intervene in the domestic affairs of other states, sometimes at least partially for the sake of securing national interests, especially in situations in which the adversarial country in question systematically denies basic human rights to its citizens. (Olsen, 2024) As mentioned above, one of its cornerstones is the R2P political proposal, which was approved by the United Nations General Assembly at the 2005 World Summit, and stipulates (in paragraphs 138-139 of the Outcome Document) that it is not only permissible, but even required by the international community to step in and take concrete actions, not limited to peaceful means, if citizens are being subjected to or are at a risk of facing mass atrocities. (Geis & Schröder, (2024) In the opinion of American political theorist Michael Walzer, such interventions are justified when the acts that are perpetrated “shock the conscience of mankind”. (Nardin, 1995) Support for liberal interventionism often goes hand in hand with the promotion of democratic governance, which is premised on the belief that democracies are intrinsically more peaceful and are significantly less likely to deliberately put their citizens in situations in which their fundamental freedoms will be violated. (Geis & Schröder, (2024) Thus, in certain instances liberal interventionism may be justified with reference to the advancement of liberal norms and values rather than in response to a concrete event that is likely to endanger the life and well-being of specific cultural, ethnic, religious or social groups. The end of the Cold War is deemed to have contributed to an “unprecedented level of liberal intrusiveness”. Liberal interventionism, which was buoyed by the “unipolar moment” (Olsen, 2024) and the “end of history” outpouring of optimism regarding the ineluctable spread of democratic norms, remained a pillar of the new US-led liberal international order throughout the 1990s. Multilateralism, largely in contrast to the Cold War era, also displaced unilateralism as the primary means through which to pursue humanitarian ends. The UN Security Council’s approval was sought – and quite often granted – in every instance of humanitarian intervention that occurred during this decade. (Jones, 2015) However, even though the global consensus on humanitarian interventions had begun to erode by the early 2000s, it continued to occupy a prominent place within the US (and by extension European) political landscape in the 2000s and 2010s as well, as evidenced, for instance, by the ideological alignment between the proponents of the “democratic peace” theory and neoconservative thinkers during the first presidency of George W. Bush, with many political liberals and “human rights hawks” showing support for the Bush doctrine during the lead-up to the Iraq war. (Olsen, 2024) The Obama doctrine did not constitute a sharp break from his predecessor’s one, similarly combining liberal internationalism with conservative realist assumptions, drawing on both pragmatic and principled considerations in its foreign policy approach, entailing a degree of selectivity, as evidenced by the US intervention in Libya in 2011 (contributing to the toppling of the Muammar Gaddafi regime) and the non-intervention in Syria in 2013 (when, albeit strongly considering it, the Americans eventually refrained from pursuing a norm-enforcement action in the Middle Eastern country after receiving intelligence concerning the Bashar al-Assad loyalists’ use of sarin gas against civilians in Ghouta, southwestern Syria). (Ibid) Critics of liberal interventionism have denounced it as constituting little more than a global hegemonic or neo-imperialist project that frequently fails to show the required level of understanding of the local social and political contexts, as well as a cure that often turns out to be worse than the disease itself due to often encouraging ill-fated interventions that do not empower the right actors, resulting in blowback effects because of increasing instability, in addition to creating power vacuums to be filled by warlords or terrorist organizations. In part due to factors such as the emphasis on combating terrorism through other means, dismay over the nation-building costs incurred in Afghanistan and Iraq, and the relative decline in the power of the USA, (Yukaruç, 2024) liberal interventionism has lost popularity among NATO members in comparison to its heyday in the early years after the Cold War, though it is clear that American foreign policy elites still firmly believe that interventions in foreign countries, often under the guise of humanitarianism, can still be beneficial in terms of safeguarding US national interests. (Balthasar, 2017) However, many of the developments surrounding the war in Iran, especially when viewed through the prism of Trump’s style of foreign policy-making, seem quite likely to further delegitimize and reduce the appetite for liberal interventionism among the European member countries of NATO.

2. MATERIALS AND METHODS

The paper gives the nod to qualitative research, (Lim, 2025) striving to analyze a multitude of secondary sources of information that deal with topics falling within a number of social science disciplines, while also remaining cognizant of the insights that can be gleaned from primary works, which are of course as a rule the most up-to-date when it comes to rapidly unfolding current events. The literature review is part of the introduction of the article and is intended to provide proper context to the issues under consideration. In the subsequent sections the article veers between theoretical propositions concerning liberal interventionism and country-specific examples, on occasions evaluating certain matters through a social constructivist framework, paying special attention to the linguistic tools employed by major political figures such as Donald Trump and their trickle-down effects on the wider society. While not intended to be prescriptive and to call upon the Western European political figures to adopt a certain course of action, it may not necessarily tick all the possible boxes when it comes to full scientific detachment.

3. RESULTS AND DISCUSSION

With regard to the liberal interventionist angle, Trump's purported humanitarian justifications in relation to Iran have from the outset had a rather hollow ring to them from the standpoint of many European politicians. In January 2026, the US president explicitly encouraged protesters against the Iranian authorities to keep demonstrating and promised that help was on the way, but during the critical window when thousands of protesters lost their lives, his administration took no action and he subsequently reversed course, claiming that the Iranian regime had agreed to put a stop to the crackdown, leading to a feeling among many of the Iranians committed to democracy that they had been led down the primrose path by the US political elites. (Serjoie, 2026) While in 2002 and 2003 George W. Bush built a long (albeit in many respects misguided and convoluted) case for overthrowing the Saddam Hussein regime in Iraq, Trump's argument in favor of engaging in military action was viewed as hastily put together without too much of an effort to properly explain the US position, with allied countries such as the UK kept out of the official loop when it came to operational details prior to the Americans' joint strikes with Israel. (Mason et al., 2026) The option of making a more persuasive case for going to war that could have referred to the renewed missile build-up by Iran, which might play out in such a fashion as to eventually overwhelm the defense systems of the other Middle Eastern countries, a credible threat even without nuclear warheads being in the picture, was not really pursued by the Trump administration. (Meyer-Resende, 2026) In contrast to previous US administrations, Trump's prior record is also a blemish against him in terms of being in a good position to argue that he is strongly committed to humanitarianism. The George W. Bush administration oversaw a doubling of foreign aid worldwide between 2001 and 2009, the largest increase since the Truman administration, and used it to encourage developing countries to take steps conducive to political and economic reform. In particular, total US government development aid to the continent of Africa increased from \$1.3 billion in 2001 to more than \$5 billion in 2008. (Natsios, 2008) In contrast, preliminary data from the Organization for Economic Co-operation and Development (OECD) indicates that international development aid from its member countries fell by approximately 23 percent from 2024 to 2025. Much of that decline stemmed from a major reduction in funding from the United States, as part of the Trump administration's moves to freeze US foreign aid and development work. (Stepansky, 2026) Perhaps more ominously, Trump's history of incendiary rhetoric that appeared to portray Islam and Muslims as being dangerous and not necessarily an integral part of the US social fabric, which some sources have linked to an increase in hate crimes against this demographic, (Byman, 2021) has been markedly dissimilar to that of the previous American presidents. On 17 September 2001, Bush spoke at the Islamic Center of Washington, D.C., and emphasized that the face of terror is not the true faith of Islam. In the same speech, he further recognized Muslim Americans as legitimate and valuable contributors to U.S. society while also going to great lengths to prevent public backlash against US Muslims, stating that intimidation of fellow Americans due to different religious beliefs was to be considered beyond the pale. (Ching, 2020) In addition to the more than a one-month gap between the Iranian regime's mass killings of protesters and the launch of the strikes, US Secretary of Defense Pete Hegseth's references to Iran being driven by prophetic Islamic delusions and Trump's threat on 7 April 2026 that a whole civilization will perish if no deal was reached, (Gritten, 2026) while eventually not acted upon, could in some respects be interpreted as blurring the distinction between pro- and anti-regime forces within Iran because of tacitly evoking imagery of a religious struggle between Christians and Muslims. (Khokhar, 2026) Even though Trump's military intervention in Iran represents a sharp break from his previously declared goal not to start new wars, but to end them, Trump's behavior has nevertheless been consistent with his inclination to

eschew detailed consultations with allies and the clear preference that he exhibits for unilateral activities. Notably, in the 2025 US National Security Strategy, the USA sets out to oppose “intrusive” international organizations and human rights regimes. The main enemies of freedom, democracy, and rights are no longer the autocratic powers, but the transnational institutions such as the EU or traditional American allies in Europe that are sensitive to the plight of minority groups and are motivated by a desire not to allow executive overreach. Accordingly, this new document is virtually bereft of references to democracy and Western values. (Acton et al., 2026) One of the main features enhancing the credibility of liberal interventionism, as manifested during the humanitarian missions in the 1990s, is its endorsement of multilateralism, (Jones, 2015) with the underlying assumption being that there is a broad consensus among the intervening countries and the dominant Western power is unquestionably committed to liberal democracy as well as eager to lead by example. By essentially abandoning many principles of the US-led alliance system, thus no longer appearing to be on the same side as the Europeans with regard to a steadfast commitment to a post-1945 international liberal order as well as his opaque and often self-contradictory intentions, (Baer & Brown, 2026) Trump seems to have made it inordinately difficult for any European allies to jump on board when it comes to future interventions (unless they represent truly open-and-shut cases in terms of which countries are in the right). This is partly due to the European politicians being liable to suffer reputational costs worldwide and having to walk a tightrope in terms of successfully convincing their own citizens that following Trump’s lead is likely to pay off, with a December 2025 poll for the Paris-based European affairs debate platform *Le Grand Continent*, which covered nine European countries, revealing that on average 48% of the respondents saw the US president as an enemy of Europe. (Henley, 2025) Over the course of the January 2026 Greenland crisis, Trump’s desire to annex the autonomous Danish territory, justified to some degree by the supposed inability of Denmark to take good care of it and guarantee its security, was arguably coached in the language of liberal interventionism, though explicitly directed against the sovereignty of a democratic European country, which did not make for good optics from the standpoint of the Europeans. Thus, it is hardly surprising that with regard to the Iranian situation, Trump has at no point come anything close to forming a semblance of a coalition of the willing such as the one that participated in the Iraq war, with NATO’s major allies – Germany, the UK, and France – keeping their distance, and even the Trump-friendly leaders of Italy, Hungary, and Slovakia remaining lukewarm in their assessments of the wisdom of the American campaign. (Webber, 2026) If we are to borrow British diplomat Robert Cooper’s terminology, (Cooper, 2003) the United States under Trump appears to be metamorphosing into a full-fledged modern state (in contrast to the post-modern states of the European Union that prioritize cooperative security and have ruled out state-to-state wars against other democracies) or even into a “rogue” power (Da Silva, 2026) that is willing to break international taboos at a whim and treats allies with warlike aspirations. In that regard, a number of political pundits have actually voiced concerns that a quick Trump triumph in Iran could be somewhat dangerous for the Europeans due to once again encouraging the US president to set his sights on Greenland. (Meyer-Resende, 2026)

Another issue, in part traceable to the previously identified ruptures in the trans-Atlantic alliance, that is likely to contribute to a waning European interest in humanitarian interventions, at least until Trump’s second term comes to an end, is connected to Europe’s increased strategic and economic vulnerability engendered by the Trump administration’s actions both prior to and after the start of the Iran war. (Shariati, 2026) Unlike over the course of previous decades, such as the 1990s and 2000s, Europe is currently not in the enviable position to enjoy a situation of internal tranquility because of having to contend with the reality of the ongoing Russo-Ukrainian war for the fourth year in a row. While before the beginning of Trump’s second term many analysts and politicians may not have had particularly high hopes regarding the likelihood that the US president would be able to broker a peace deal at least somewhat favorable to Ukraine, there is still unease and disappointment that the Europeans now have to provide the bulk of the funding for the arms transfers to Ukraine and the Trump administration does not seem to be fully in the embattled country’s corner even when it comes to offering moral support. Ukrainian president Volodymyr Zelenskyy’s changed approach to dealing with Trump following their much publicized Oval Office bust-up on 28 February 2025, for instance by becoming conciliatory and willing to toe the line with regard to US peace proposals, has mostly failed to bear fruit, due to the US president still shying away from piling serious pressure on his Russian counterpart Vladimir Putin to budge from his maximalist demands. (Pifer, 2026) Zelenskyy has also, up until recently, (Zadorozhnyy, 2026) been one of the European leaders who has been the most supportive of Israel and USA’s war against Iran, volunteering Ukrainian help when it comes to drone defense, but his offer was unceremoniously rebuffed by the US president. (Chiappa, 2026) Even though it would be disingenuous to apportion all (or even most of the blame) for the continuing carnage in Ukraine to Trump, the American president has been unable to live

up to his campaign promise of a quick resolution to the conflict and has to a large extent only heightened the Ukrainians' and Europeans' feelings of insecurity in relation to Russia. In this regard, it is worth noting that the Iran war has contributed to the exhaustion of Patriot interceptor stocks, with Zelenskyy expressing concerns in April 2026 that the USA and the Middle Eastern countries had expended more than 800 PAC-3 interceptor missiles during the first three days of the war. (Haavik, 2026) During the same month Polish Defense Minister Władysław Kosiniak-Kamysz, in response to report that the USA had informally requested a redeployment, confirmed that Poland had no intention to relocate one of its air defense Patriot batteries to the Middle East, emphasizing the need for Polish airspace and NATO's eastern flank to remain sufficiently protected. (Jack & Cienski, 2026) Poland has been among the closest US allies within NATO, notably breaking ranks with many of the other European countries by refusing to send military personnel to Greenland as part of the Operation Arctic Endurance that began in January 2026 and was widely viewed as a deterrence exercise directed against the United States, (Wojdyga, 2026) which is another indication that as long as the Russian threat remains present, even the most pro-US countries will be quite reluctant to extend finite resources on far-flung conflicts. One uniquely favorable aspect undergirding the pro-intervention consensus of the 1990s was that decade's generally magnanimous economic climate. Economic growth in many Western nations, attributable to a degree to the post-Cold War peace dividend, made the fiscal costs of humanitarian intervention seem more manageable. (Jones, 2015) However, in a contemporary Europe that is plagued by a multitude of economic uncertainties, voters in Western nations have become more likely to cast their lots for "nation-building at home" projects than for those associated with nation-building in foreign countries. (Ibid) The Iran war has only made the overall economic picture even less optimism-inducing. Many economists caution that it will take months for the full impact of the conflict to be truly felt, with the risks of stagflation assessed as elevated while it is dubious whether many of Europe's cash-strapped governments will be in a position to shield their citizens from the expected economic fall-outs. (Treeck, 2026) Thus, it is almost certainly the case that unless the economic outlook drastically improves, the pursuit of ambitious and far-reaching humanitarian aims will be rather low on the list of Europe's priorities, at least until the end of the 2020s. In essence, a continent that sees itself as vulnerable in terms of both economic- and security-related metrics will likely shun liberal interventionism not only in geographically distant regions, but also in the near abroad, unless vital security interests are appraised to be at stake.

In addition, it is worth noting that the long-term impacts of the Iran war may entail a further reduction of the scope for liberal interventionist pursuits due to being likely to spur nuclear proliferation and thus potentially swell the ranks of the nuclear states. The global non-proliferation regime was facing significant challenges even prior to the onset of the war, but according to security experts such as Ramesh Thakur and Jennifer Kavanagh, acquiring nuclear weapons has now essentially become a matter of existential importance for a less restrained and more defiant Iranian regime, (Stancati et al., 2026) with the new supreme leader Mojtaba Khamenei appearing to be more well-disposed towards the development of nuclear weapons than his father. (Campbell, 2026) Unless the USA succeeds in forcing regime change, which currently does not seem to be feasible unless the Americans commit a substantial amount of troops for a ground invasion, Iran may continue along the uranium enrichment path, also potentially creating a domino effect by pushing neighboring countries and US allies such as Saudi Arabia to seek ways to acquire nukes, especially given that these states have been targeted by Iranian retaliation strikes. (Cole, 2026) The lack of sufficient trust in the extended deterrence provided by the Trump administration has also caused shifts in attitudes in South Korea where 76.2 % of citizens answered in the affirmative in a 2025 Asan Institute for Policy Studies poll regarding whether they were in favor of indigenous nuclear weapons. (Campbell, 2026) The belief in the necessity of hedging one's bets when it comes to both conventional and nuclear weapons has in recent years also manifested itself in the public policy discourses in other countries such as Ukraine, Poland, and Brazil. (Dalton, 2026) Even though building a nuclear bomb in secret is exceptionally difficult, it is still doable, as evidenced by South Africa's announcement in 1993 that it had developed nuclear weapons in the 1980s (albeit it retained them for a rather short period), a development that it had largely managed to keep under wraps, (Dizikes, 2022) so a country that slips under the US radar and receives technical assistance from a major power that is adversarial to the Americans, might be able to pull it off. Even though it is only speculative at this stage, a world that consists of an increased number of states with nuclear warheads, especially when they are not electoral democracies, will essentially make more places virtually off limits for liberal interventionists, (O'Hanlon, 2000) as is the case with regard to North Korea, because of the disproportionate risks that such interventions would carry due to the targeted countries' ability to retaliate in a devastating fashion.

4. CONCLUSION

With the curtains appearing to drop when it comes to US unipolar primacy as well as the return of politics based on spheres of influence, the current international environment is in many respects unfavorable from the standpoint of the proponents of liberal interventionism. The Trump administration's ill-fated decision to attack Iran is likely to only further stifle their hopes – in addition to disillusioning isolationists within the Make America Great Again (MAGA) wing of the Republican Party (which will make them less inclined to support future interventions, countenanced by either Republicans or Democrats, even if they could convincingly be argued to be fully justifiable on humanitarian grounds and to be in line with US national interests), it has exposed additional trans-Atlantic fault lines, and will potentially fuel nuclear proliferation, which means that at least until the conclusion of Trump's second term, European enthusiasm for humanitarian interventions may remain at a nadir.

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