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Section 1. Biology

MOLECULAR MECHANISMS OF AGING IN THYROID CELLS

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Abstract

This paper presents the molecular mechanisms of aging in thyroid cells of elderly people and the causes of disturbances in the regulation of thyroglobulin gene expression. It was found that during aging, there is a disturbance in the regulation of thyroglobulin gene expression at the transcription level. A direct correlation was found between the degree of thyroglobulin gene expression in thyroid cells during cellular aging and DNase I – nuclear chromatin hypersensitivity.

Keywords: *molecular mechanisms, thyroid gland, aging, gene expression, thyroid pathology*

Introduction

Aging is a basic biological property of all living organisms; it is a process that is evolutionarily genetically programmed and predetermined. The problem of aging has been and remains one of the most pressing in modern science. It can be said that the problem of aging is equal to the problem of deciphering the genetic program of organism development. The solution to this problem is associated with the clarification of the molecular mechanisms of aging, the development of means to increase human life expectancy. In age-related changes, shifts at two levels are of particular importance: 1 – changes in the functioning of genes that encode protein synthesis;

2 – changes in nervous and hormonal regulation. The first system acts from the inside and leads to a change in the amount of hormones secreted by the endocrine glands and cells of other tissues into the blood. Acting together, they achieve their disappointing results for the organism: on the one hand, DNA damage accumulates in the cell, functionally inactive abnormal proteins are synthesized. The structure of genes and the direction of their functioning change (Anisimov V. N., 1999). Regulation of gene expression fundamentally affects the aging process and age-related changes. Dysfunction of gene expression at various levels is the cause of aging. Formation of insufficient amount of protein or its synthesis in an inactive form is inevitably accompanied by the development of disease and aging. There are various molecular factors in the pathogenesis of thyroid diseases: mutational changes in DNA sequences, dysregulation of thyroglobulin (TG) gene expression, dysregulation of methylation sites in TG. In a number of thyroid diseases, the TG content in thyroid tissue changes significantly, and changes in the TG structure are also noted (De Vijlder J. J.M. Carber B., 1999). TG is the main protein synthesized by thyroid cells, playing a key role in the metabolism of thyroid hormones. The molecular weight of native TG is 660,000 Da. Normally, the TG content is 50–60% of the total mass of thyroid tissue proteins. With age, the secretory function of the thyroid gland decreases. This is due to dysregulation of TG gene expression in elderly people. During aging, small quantitative and qualitative changes in TG also occur. Low TG levels in various thyroid diseases and cellular aging can be a priori explained by disturbances occurring at the stages of protein biosynthesis regulation.

Objective: to study the molecular mechanisms of cellular aging in thyroid cells of elderly people and the causes of disturbances in the regulation of TG gene expression during cellular aging in thyroid cells of elderly people with some forms of thyroid pathology.

Material and methods of research

Blood and thyroid glands of elderly people with some forms of thyroid pathology were taken as the object of research. Three age groups of elderly people were created: 45–55 years (9 people); 55–65 years (8 people); 75–85 years (6 people). Five people aged 19–24 years served as controls.

High-molecular DNA was isolated from blood leukocytes of elderly people by phenol extraction (Dashkevich V. S., Arshinova T. V., 1963). Nuclei from thyroid cells were isolated by precipitation in 0.25 M sucrose containing 5 mM $MgCl_2$, 1 mM dithiothreitol (DTT), 10 mM Tris-HCI pH7.5, and nuclei were purified by layering on a solution of 2 M sucrose in buffer B (24,000 rpm for 1 hour, SW 27 rotor). To determine DNase sensitivity, nuclei were treated with DNase I (2000 U/mg Serva) and incubated at 4 °C for 5 min with different concentrations of DNAase I (0.1 to 100 U/ml) or with a fixed enzyme concentration (20 U/ml) at 37 °C for 15 min. Complementary DNA for the TG gene was synthesized by polymerase chain reaction (PCR) on 0.5 µg of total RNA in the presence of reverse transcriptase using primers specific for the TG gene: 51-AGGCTAGGAAAATGGCCCT-GGTCC-31 and 51-TTGGATCCTTATGTGG-GGGAATCTGCC-31. PCR was performed in an incubation medium: 50 µl contained 60 mM Tris-HCl (pH 8.6), 6 mM EDTA, 10 mM b-mercaptoethanol, 10 µg/ml BCA, 1 mM of each of the 4 nucleotides, 2 units of reverse transcriptase. PCR had a total of 55 cycles. Synthesis was carried out at 72 °C for 4 min. Subsequent cycles included denaturation (1 min, 49 °C), primer annealing (1 min, 55 °C), cDNA synthesis (2 min, 72 °C). After 55 amplification cycles, the samples were kept at 72 °C for 10 min and then cooled, aliquots were taken, and cDNA electrophoresis for the TG gene was performed in 1% agarose with ethidium bromide.

Results of the research and their discussion

Most thyroid diseases are caused by defects in the expression of the TG gene, i.e. disorders of complex processes regulating the synthesis of the corresponding protein. In thyroid diseases, there is a violation of the regulation of gene expression at all levels, namely: at the level of translation, transcription, processing (maturation of the mRNA molecule), at the level of mRNA exit from the nucleus and entry of mRNA into polyribosomes, at the level of DNA methylation.

We studied the structure of chromatin using the enzyme DNase I. It is known that there are hypersensitive regions localized in the 51 or 31 regions of an actively transcribed gene; these regions contain DNA sequences that are necessary for transcription. Identification of hypersensitive regions can clarify their regulatory function. The appearance of chromatin regions hypersensitive to DNAse I is associated with transcriptional activity and precedes the onset of transcription. Based on the above, it was of interest to study the effect of differences in the degree of TG gene expression during cellular aging on the chromatin structure.

A study of DNAse I – hypersensitivity of chromatin of thyroid cells in elderly people with various thyroid pathologies was conducted. Elderly people without thyroid disorders were observed as a control. In this case, the nuclei were isolated from the epithelial cells of the patients' saliva. Figure 1 shows data on DNAse I – hypersensitivity of chromatin of nuclei in elderly people without thyroid pathology and with nodular euthyroid goiter. It was shown that DNAse I – hypersensitivity of chromatin of nuclei in elderly people with nodular euthyroid goiter decreases by 2 times, compared with elderly patients without pathology.

Figure 1. *DNAase I – hypersensitivity of nuclear chromatin*
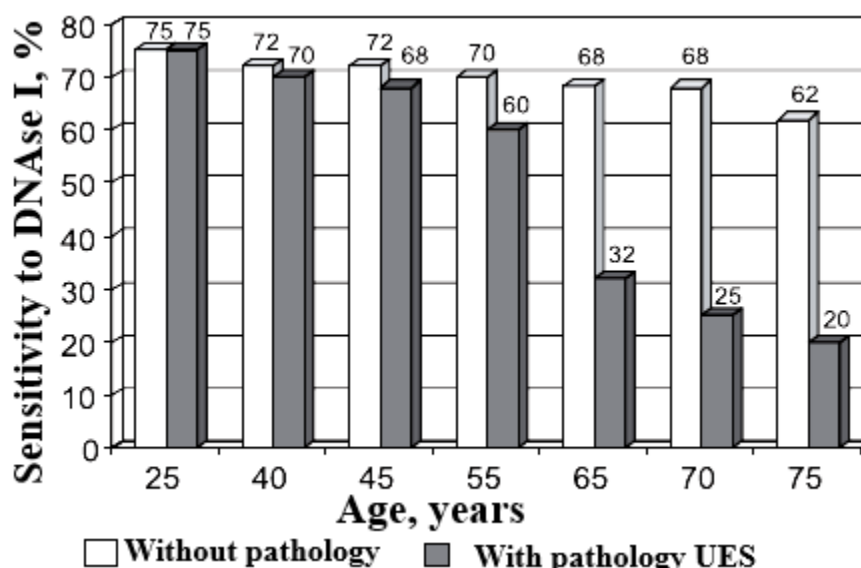
The obtained data show that there is a direct correlation between the degree of TG gene expressivity and DNase I – hypersensitivity of chromatin of thyroid nuclei of elderly people with nodular euthyroid goiter, expressed genes are more sensitive to DNase than inactive genes. DNAse I – hypersensitivity of chromatin in isolated nuclei by the release of hydrolyzed DNA from nuclei of old people aged 85 years was 45%, which is 35% lower than DNAse I – hypersensitivity of young people. The obtained results indicate that there is a direct correlation between the degree of TG gene expression DNAse I – hypersensitivity of chromatin of nuclei, i.e. violation of regulation of TG gene expression occurs at the transcription level. To understand the expression of the TG gene, it is important

to clarify the structural organization of the functional properties of transcriptionally active regions of the genome. Identification of the factors determining the potentially active state of the TG gene is extremely important for understanding the molecular mechanisms regulating the expression of this gene during cellular aging (Wei J. Y., 2005).

Conclusions:

1. It has been shown that during aging, there is a violation of the regulation of TG gene expression at the transcription level.

2. A direct correlation has been established between the degree of TG gene expression in thyroid cells during cellular aging and DNAse I – nuclear chromatin hypersensitivity.

References

Anisimov V. N. Relationship between aging and cancer: physiological and molecular mechanisms// Advances in Gerontology 1999. – V. 4. – P. 34–44.

De Vijlder J. J.M. Carber B. Individual thyroglobulin polyribosomes at tumors of a thyroid gland // J. Clin. Endocrin. 1999. – V. 104. – P. 2448–2452.

Dashkevich V. S., Arshinova T. V. Isolation of fractions of replicating DNA from rat liver by detergent-free phenol method // Biology. 1963. – Issue. 43. – V. 15. – P. 133–136.

Wei J. Y. The analysis of synthesis of protein in cells and occurrence of age diseases. Experiment. Cell.Research. 2005. – V. 188. – P. 277–284.

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HTRA1-TARGETED SMALL MOLECULES AS THERAPIES FOR ALZHEIMER'S DISEASE

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Abstract

Alzheimer's disease remains one of the most pressing neurodegenerative disorders, with limited treatment options, making the identification of novel therapeutic targets a crucial research challenge. In this study, we focused on the HtrA serine peptidase 1 (HTRA1) receptor, which plays a key role in disease pathology. First, we applied three complementary binding-site prediction tools – DogSiteScorer (DOG algorithm), FTSite (FFT solvent mapping), and Prank-Web (PRANK deep learning)—to the HTRA1 crystal structure, identifying five high-confidence pockets. Next, a pharmacophore model was built in Pharmit to capture key hydrogen bond donors/acceptors and hydrophobic/aromatic features; screening of a ~150,000-compound library yielded 15 diverse candidates. These 15 ligands were docked using SwissDock and ranked by estimated binding free energy (ΔG) and full-fitness scores. The top five compounds ($\Delta G \leq -7.5$ kcal/mol, exhibiting consistent hydrogen bonds with active-site residues) advanced to ADME and toxicity evaluation. ADME properties were predicted via SwissADME, enforcing Lipinski's Rule of Five and Veber's rules (TPSA ≤ 140 Å²; ≤ 10 rotatable bonds), while toxicity risks were assessed using ProTox-3 (hepatotoxicity, carcinogenicity, LD_{50}). Finally, molecular dynamics simulations (100-ns GROMACS runs) on the best three candidates (GlideScores < -8.5 kcal/mol; RMSD < 2 Å; $\geq 80\%$ key H-bond occupancy) confirmed stable binding. These three lead molecules, selected for their optimal binding affinity, dynamic stability, and favorable ADME/toxicity profiles, now proceed to in vitro validation – paving the way toward a targeted Alzheimer's therapy with high efficacy and minimal side effects.

Keywords: *Alzheimer's disease, drug discovery, small molecules, HTRA1, pharmacophore, virtual screening*

1. Introduction

Alzheimer's disease (AD) is a progressive neurodegenerative disorder and the most common cause of dementia. It is characterized by cognitive decline, memory loss, and behavioral changes, ultimately leading to a complete loss of independence (Scheltens et al., 2021).

Despite extensive research, the exact mechanisms underlying Alzheimer's disease (AD) remain complex and multifaceted, involving genetic, molecular, and environmental factors (Heneka et al., 2015; Heppner et al., 2015).

Three significant hypotheses explain Alzheimer's disease (AD) pathogenesis: the

amyloid hypothesis, the cholinesterase hypothesis, and the neuroinflammation hypothesis. The amyloid hypothesis posits that the accumulation of amyloid-beta (Aβ) triggers a cascade of neurotoxic events, including tau protein dysfunction and neuronal death (Kurkinen et al., 2023; Hardy & Higgins, 1992; Selkoe & Hardy, 2016). The cholinesterase hypothesis posits that cognitive decline arises from the degeneration of cholinergic neurons and the ensuing deficiency in acetylcholine (Orhan, 2021; Bartus et al., 1982; Hampel et al., 2018). Meanwhile, the neuroinflammation hypothesis highlights the role of chronic brain inflammation in exacerbating neuronal damage and accelerating disease progression (Lecca et al., 2022; Heneka et al., 2015; Heppner et al., 2015).

Currently, medications such as cholinesterase inhibitors (donepezil, rivastigmine, galantamine) and memantine help manage Alzheimer's disease (AD) symptoms by improving neurotransmitter function (Alzheimer's Association, n.d.; Hampel et al., 2018). Recently, monoclonal antibodies such as aducanumab and lecanemab have been approved for targeting amyloid-beta plaques, although their efficacy remains controversial (Cummings et al., 2021; Knopman et al., 2021). These treatments offer limited success, focusing mainly on symptom management rather than halting disease progression, highlighting the need for new therapies targeting the underlying mechanisms of AD.

Recent research has identified high-temperature requirement serine protease A1 (HTRA1) as a potential player in Alzheimer's disease (AD) pathology. HTRA1 is a serine protease involved in protein degradation and cellular homeostasis, and emerging evidence suggests its dysregulation is linked to neurodegenerative diseases (Chen et al., 2024; Zurawa-Janicka et al., 2010). In the context of Alzheimer's disease (AD), HTRA1 has been shown to degrade both amyloid-beta and tau proteins, indicating a potential protective role against the formation of neurotoxic aggregates (Chen et al., 2024). Given its involvement in the clearance of these key proteins, HTRA1 has emerged as a critical regulator of AD pathology. Research on this protein is essential for understanding how its function influences protein aggregation, neuroinflammation, and disease progression.

Despite the growing interest in HTRA1's role in Alzheimer's disease (AD), significant gaps remain in our understanding of its precise molecular interactions and potential as a therapeutic target (Zurawa-Janicka et al., 2010). To address this, we employ a multistage computational approach to identify viable HTRA1 inhibitors, screen a library of compounds, and evaluate their druggability using molecular docking, dynamics simulations, and toxicity assessments. Our results offer promising insights into HTRA1's potential as a therapeutic target, with lead compounds exhibiting strong binding affinities and favorable pharmacokinetic properties. This research lays the groundwork for future in vitro and in vivo validation, aiming to modulate HTRA1 activity and slow or prevent the progression of Alzheimer's disease.

2. Methods
2.1 Binding Site Identification

Three independent computational tools – DogSiteScorer, FTSite, and PrankWeb – were utilized to identify potential binding sites within the target protein structure. Each method employs distinct algorithms to predict ligand-binding pockets and comprehensively analyzes their characteristics. DogSiteScorer uses the DOG (Depth-oriented Grid) algorithm, which divides the protein surface into a grid and evaluates binding affinities, shape complementarity, and solvent accessibility. FTSite applies the Fast Fourier Transform (FFT) algorithm to assess pocket volume, hydrophobicity, and surface curvature, identifying sites by comparing the geometric properties of the protein surface with those of potential ligands. PrankWeb utilizes the PRANK algorithm, which combines solvent-accessible surface area (SASA), protein flexibility, and electrostatic potential, while considering parameters such as hydrogen bond donors and acceptors, cavity size, and surface entropy to predict and assess the druggability of binding pockets. Together, these tools provide a comprehensive and complementary analysis of potential binding sites by evaluating structural and energetic parameters.

2.1.1 DogSiteScorer

DogSiteScorer, a structure-based binding site prediction tool, was used to assess the geometric and physicochemical properties of the target protein. The input consisted of the protein's three-dimensional structure, which was uploaded to the DogSiteScorer web server. The tool then segmented the protein into potential pockets based on size, depth, enclosure, and hydrophobicity. The resulting binding sites were ranked according to their druggability score.

2.1.2 FTSite

FTSite, a computational solvent mapping approach, was employed to identify energetically favorable binding sites. The protein structure was provided in PDB format, and the algorithm used probe molecules to detect interaction hotspots. FTSite then ranked these sites based on their binding affinity and physicochemical properties, thereby refining binding site predictions.

2.1.3 PrankWeb

PrankWeb, a machine-learning-based predictor, was applied to validate binding site locations further. The protein structure was analyzed using PrankWeb's deep learning model, which integrates structural features to predict binding pockets. The tool assigned confidence scores to each predicted site, allowing for comparative analysis with results from DogSiteScorer and FTSite.

2.2 Ligand Screening and Evaluation

2.2.1 Pharmacophore-Based Screening with Pharmit

Pharmit was employed to screen potential ligand candidates based on pharmacophore features. A pharmacophore model incorporating various donor and acceptor combinations was designed to filter compounds with optimal binding potential. The top 15 candidates were selected based on different combinations of donor and acceptor features, ensuring structural diversity and binding efficacy.

2.2.2 SwissDock Evaluation

The selected 15 ligand candidates were further analyzed using SwissDock, a molecular docking tool, to predict binding affinities and interaction modes. Each ligand's docking score and interaction profile were assessed to rank the top-performing molecules. Based on these evaluations, the top five ligands were selected based on their lowest estimated binding free energies (ΔG values) and favorable full fitness scores, which reflect both binding affinity and ligand-protein interaction stability. Ligands exhibiting the most negative ΔG values and robust interaction profiles – characterized by consistent hydrogen bonding, hydrophobic contacts, and favorable binding poses within key active site residues – were prioritized for further molecular dynamics simulation and ADMET analysis.

2.3 ADME Analysis with SwissADME

The top five ligand candidates were analyzed using the SwissADME tool. This tool predicts key pharmacokinetic properties, including lipophilicity (LogP), solubility, GI absorption, BBB permeability, and drug-likeness, based on rules such as Lipinski's Rule of Five. This step helped identify compounds with favorable bioavailability and therapeutic potential.

2.4 Toxicity Prediction with ProTox-3

The best-performing ligand from the ADME analysis was further assessed for potential toxicity using ProTox-3.0. This tool provided insights into possible toxic effects, including hepatotoxicity, carcinogenicity, and overall safety profile, ensuring that the selected candidate was both effective and safe for further development.

3. Results

3.1. Identification of binding sites in HTRA1

3.1.1. Protein Surface Geometry and Binding Site Prediction Using DoGSiteScorer

P_0 and P_1 stand out as the most promising binding sites, with high volumes (663.81 and 628.74 Å³, respectively) and surface areas (841.34 and 861.36 Å²), coupled with the highest drug scores (0.79 and 0.86). These values suggest that these sites may provide favorable environments for ligand binding. The binding pockets were identified using **Protein Plus**, a geometric analysis tool that evaluates protein cavities based on volume, surface area, and druggability. Typically, volumes between 200––600 Å³ and drug scores above 0.5 are considered promising for small-molecule binding, and both P_0 and P_1 exceed these thresholds. In contrast, sites like P_10 and P_11

have significantly lower drug scores (0.37 and 0.23) and smaller volumes, making them less attractive for drug targeting. Interestingly, P_6, despite having an extremely low volume (2.53 Å³), exhibits a moderate drug score (0.56), possibly due to its high surface area (457.45 Å²), which suggests a unique binding feature. Overall, P_0 and P_1 are the most viable candidates for further drug design efforts targeting HTRA1.

Figure 1. *Binding sites in HTRA1 displayed as colored spheres based on ProteinPlus.*
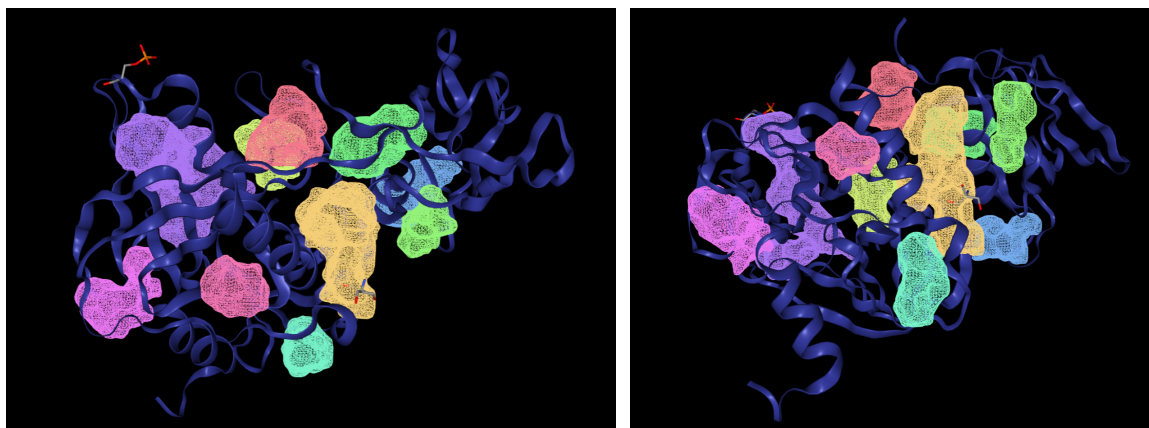
Table 1. *Data from top ten detected binding site in HTRA1 using ProteinPlus*

Name	Volume	Surface Area	Druggability Index
P_0	663.81	841.34	0.79
P_1	628.74	861.36	0.86
P_10	131.78	436.67	0.37
P_11	121.92	233.27	0.23
P_2	264.38	359.39	0.45
P_3	244.03	506.08	0.36
P_4	240.32	406.2	0.52
P_5	234.88	342.63	0.48
P_6	2.5314	457.45	0.56
P_7	203.33	286.55	0.39

Graph 1. *3D Scatter Plot of Molecular Properties: Volume, Surface Area, and Druggability Index*
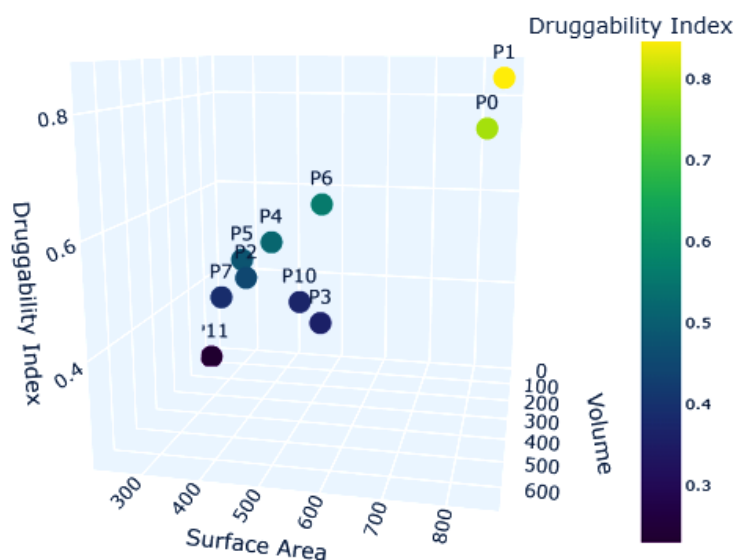
3.1.2. Energetic Profiling for Ligand Binding Site Identification with FTSite

Figure 2. *Binding sites in HTRA1 as predicted by the energetic method*
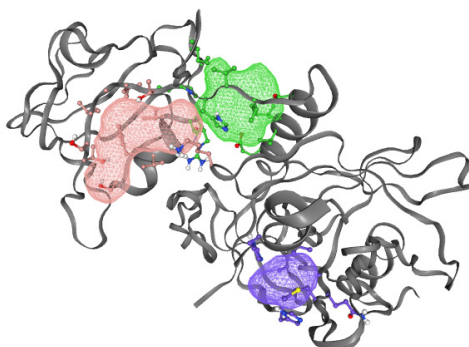
3.1.3. Machine learning methods

Figure 3. *Binding sites in HTRA1 as predicted by Prankweb*
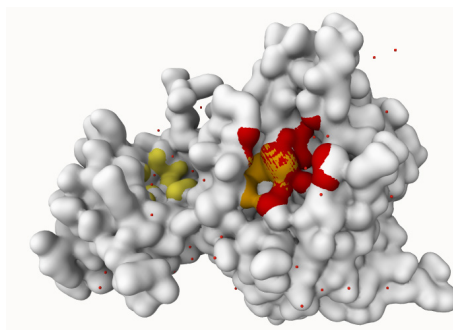
Table 2. *Analysis of the binding sites identified by Prankweb in the HTRA1 protein*

Rank	Score	Probability	#residues	Avg conservation
1.	5.05	0.240	10	1.827
2.	1.53	0.022	10	1.273
3.	1.49	0.021	6	1.975
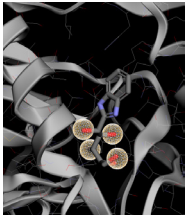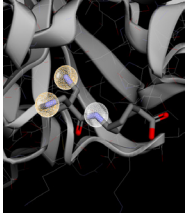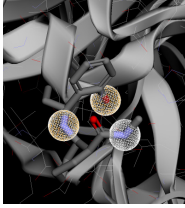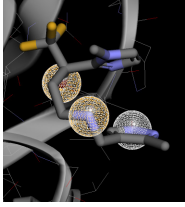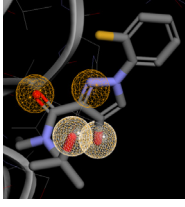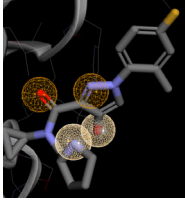
The highest-ranked pocket (Rank 1) has a score of 5.05 and a 24.0% probability, suggesting a moderate chance of being a viable drug target. This site also contains 10 residues with an average conservation score of 1.827, indicating a relatively conserved region that may be favorable for drug binding. In contrast, the second and third-ranked pockets have significantly lower probabilities (2.2% and 2.1%), making them less attractive for drug development. The third pocket, despite its lower rank, has the highest average conservation (1.975), which could suggest functional importance. Overall, the first-ranked site appears to be the most promising target, but its moderate probability suggests that further validation, such as molecular docking studies, would be necessary to confirm its druggability.

3.2. Pharmacophore-based screening

Table 3. *The outcome of the pharmacophore-based screening and top hit compounds*

	Name	RMSD	Mass	RBnds	Photo
4 donors and 4 acceptors	Z460996690	0.201	382	12	

	Name	RMSD	Mass	RBnds	Photo
	Z56762860	0.201	68	5	
	Z1946857219	0.203	295	8	
	Z4900394450	0.037	269	5	
3 Donors, 2 Acceptors	Z1731274937	0.042	290	6	
	Z1079047778	0.044	317	7	
	Z1551627167	0.115	616	9	
2 Donors, 4 Acceptors	Z1548358070	0.152	321	6	
	Z1762139434	0.170	358	6	

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	Name	RMSD	Mass	RBnds	Photo
	Z3699434447	0.010	321	5	
2 Donors, 2 Acceptors	Z871870844	0.012	322	6	
	Z1162944959	0.012	284	6	
	Z1255372712	0.100	150	4	
2 Donors, 4 Acceptors	Z1551627167	0.121	616	9	
	Z1595791252	0.153	443	9	

Graph 2. *3D Plot of Chemical Properties: Mass, Rotatable Bonds, and RMSD*

The pharmacophore screening identified several potential HTRA1-binding molecules, categorized based on the number of hydrogen bond donors and acceptors, RMSD values, molecular weight, and flexibility (as indicated by the presence of rotatable bonds).

HTRA1-TARGETED SMALL MOLECULES AS THERAPIES FOR ALZHEIMER'S DISEASE
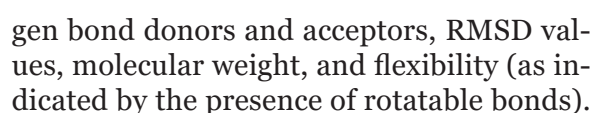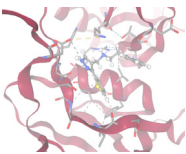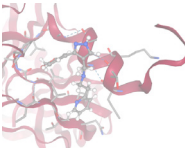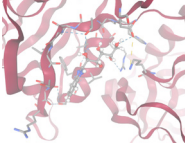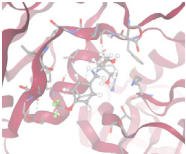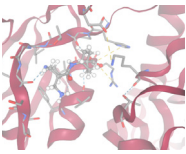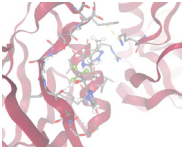
Lower RMSD values indicate better structural alignment, making them a key factor in candidate selection. Among the tested compounds, those with two donors and two acceptors (e.g., Z3699434447, RMSD = 0.010) and three donors and two acceptors (e.g., Z4900394450, RMSD = 0.037) demonstrated the lowest RMSD, suggesting a strong pharmacophore fit despite fewer hydrogen bonding interactions. In contrast, molecules in the 4 donors, 4 acceptors category, such as Z1946857219 (RMSD = 0.203), exhibited higher RMSD values, indicating weaker alignment but potentially stronger binding affinity due to the presence of more hydrogen bonding sites. Compounds in the two donors, four acceptors group (e.g., Z1551627167, RMSD = 0.115) exhibited moderate RMSD values, with Z1551627167 appearing twice, suggesting structural adaptability. While low RMSD compounds may offer the best pharmacophore match, molecular weight and flexibility must also be considered, as overly rigid or large molecules could impact bioavailability. Further molecular docking and ADMET studies are necessary to refine these hits into viable drug candidates.

3.3. Docking experiment to evaluate HTRA1 binding affinity

Table 4. *Cluster Analysis of Compounds with AC Score and SwissParam Values*

Name	Cluster #	Cluster member	AC Score	Swiss Param	Photo
Z1162944959	5	1	0.405393	−7.0160	
Z871870844	0	1	−2.819263	−7.2444	
Z56762860	0	1	50.795203	−6.6629	
Z1946857219	1	1	35.487063	−6.9241	
Z4900394450	6	1	−80.246998	−7.0185	
Z1079047778	1	1	6.383523	−6.9815	

Name	Cluster #	Cluster member	AC Score	Swiss Param	Photo
Z4660996690	1	1	−26.996090	−7.8131	
Z1255372712	1	1	29.370701	−6.0617	
Z1548358070	0	1	21.860387	−7.5094	
Z1762139434	0	1	242.297407	−8.0047	
Z3699434447	9	1	0.837294	−7.2267	
Z1551627167	4	1	249.209687	−8.2061	
Z1548358070	9	1	13.396534	−6.9062	
Z1731274937	0	1	−56.103916	−6.7996	

HTRA1-TARGETED SMALL MOLECULES AS THERAPIES FOR ALZHEIMER'S DISEASE

Graph 3. *3D Cluster Analysis of Compounds: AC Score,
SwissParam, and Cluster Assignment*

Molecular docking is a computational technique used to predict the preferred binding orientation of molecules to a target receptor, thereby helping to determine potential drug candidates. This study performed docking simulations for multiple candidate molecules using SwissDock, analyzing their cluster numbers, AC Scores, and SwissParam Scores to assess binding affinity and stability. Among the candidates, Z1162944959 exhibited moderate binding affinity with an AC Score of 0.405393 and a SwissParam Score of −7.0160, suggesting a stable but not the strongest binding. Z871870844 demonstrated a stronger interaction with an AC Score of −2.819263 and a SwissParam Score of −7.2444, indicating better stability. Z56762860, with an AC Score of 50.795203 and a SwissParam Score of −6.6629, showed weak binding affinity. Z1946857219 had a slightly better interaction with an AC Score of 35.487063 and a SwissParam Score of −6.9241. The strongest binding candidate appeared to be Z4900394450, which had an AC Score of −80.246998 and a SwissParam Score of −7.0185, suggesting exceptional affinity and stability. Z1079047778 had a moderate AC Score of 6.383523 and a SwissParam Score of −6.9815. Z4660996690 exhibited strong binding with an AC Score of −26.996090 and a highly negative Swis-sParam Score of −7.8131. Z1255372712 had an AC Score of 29.370701 and a weaker SwissParam Score of −6.0617. Z1548358070 showed mixed results, with AC Scores of 21.860387 and 13.396534 and SwissParam Scores of −7.5094 and −6.9062, respectively. Z1762139434 displayed an extremely high AC Score of 242.297407 but a powerful binding potential with a SwissParam Score of −8.0047. Z3699434447 exhibited moderate interaction, with an AC Score of 0.837294 and a SwissParam Score of −7.2267. The strongest binder overall was Z1551627167, with an AC Score of 249.209687 and a SwissParam Score of −8.2061, indicating a highly stable interaction. Z1731274937 exhibited a significant binding potential, as noted in an AC Score of −56.103916 and a SwissParam Score of −6.7996. In conclusion, the best candidates for further investigation based on binding affinity and stability are Z4900394450, Z4660996690, and Z1551627167, which exhibited the most negative AC and SwissParam Scores, suggesting strong receptor interactions. Future studies should focus on validating these findings experimentally to confirm their potential as drug candidates.

3.4. Evaluation of the ADME properties for the top compounds using SwissADME

Table 5. *Physicochemical Properties of Top Five Candidates*

Property	Z1551627167	Z1762139434	Z4660996690	Z1548358070	Z871870844
Formula	C23H-47N5O18S	C19H24ClF-N4O2	C18H27F-N4O4	C16H20F-N3O3	C18H19Cl-N4O2
Molecular weight (g/mol)	713.71	394.87	382.43	321.35	358.82
Heavy atoms (count)	47	27	27	23	25
Aromatic heavy atoms (count)	0	11	10	11	17
Fraction Csp3	1.00	0.47	0.56	0.38	0.22
Rotatable bonds (count)	9	6	12	6	6
H-bond acceptors (count)	23	5	8	5	5
H-bond donors (count)	15	2	5	2	2
Molar refractivity	147.78	106.70	99.61	83.87	96.72
TPSA (Å²)	430.30	70.39	119.64	78.59	72.06

Table 6. *Lipophilicity Metrics of Top Five Candidates*

Lipophilicity Metric	Z1551627167	Z1762139434	Z4660996690	Z1548358070	Z871870844
iLOGP	−0.32	0.00	2.61	2.30	0.00
XLOGP3	−12.39	3.83	−1.32	2.28	2.78
WLOGP	−8.43	3.16	−0.37	2.37	3.18
MLOGP	−8.28	2.46	−0.26	1.53	1.42
SILICOS-IT	−8.90	2.22	1.59	1.47	3.68
Consensus Log P	−7.66	2.33	0.45	1.99	2.21

The top candidate is Z1551627167, primarily due to its high polarity, as indicated by its large TPSA of 430.30 Å² and a consensus Log Po/w of −7.66. With a molecular weight of 713.71 g/mol, this compound is highly hydrophilic and likely to interact strongly with polar biological systems, making it suitable for applications in aqueous environments where strong hydrogen bonding is crucial. However, its low lipophilicity suggests that it would have a limited ability to cross biological membranes, restricting its use to environments such as blood plasma or extracellular fluids. Following Z1551627167, Z1762139434 stands out with a smaller molecular weight of 394.87 g/mol and a more balanced lipophilic profile (Log Po/w of 2.33), which suggests it can more easily penetrate cell membranes and could be used for intracellular targeting. Other candidates, such as Z4660996690, Z1548358070, and Z871870844, fall between the two, offering moderate lipophilicity and varying levels of polarity, making them more versatile but less specialized. Ultimately, Z1551627167 and Z1762139434 remain the top contenders, with Z1551627167 excelling in polar interactions and Z1762139434 offering greater flexibility in membrane permeability.

3.5. Evaluation of the toxicity of the top compound Z1551627167

Figure 4. *Toxicological and Physicochemical Profile*
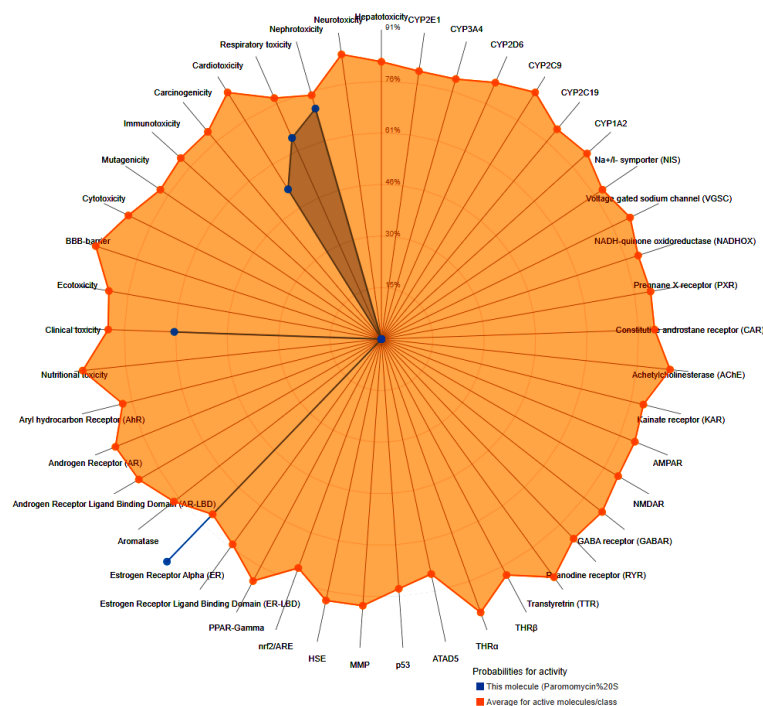
Figure 5. *Radar Plot of Predicted Biological Activities and Toxicological Endpoints*
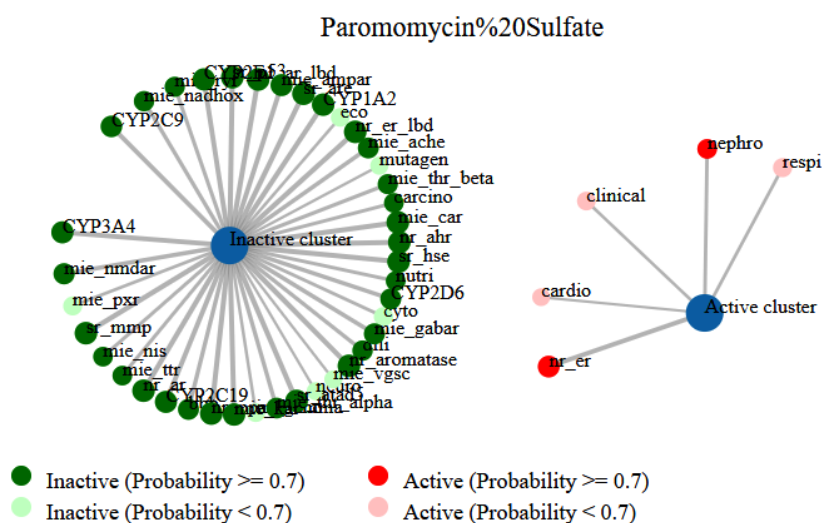
Figure 6. *Toxicity report*

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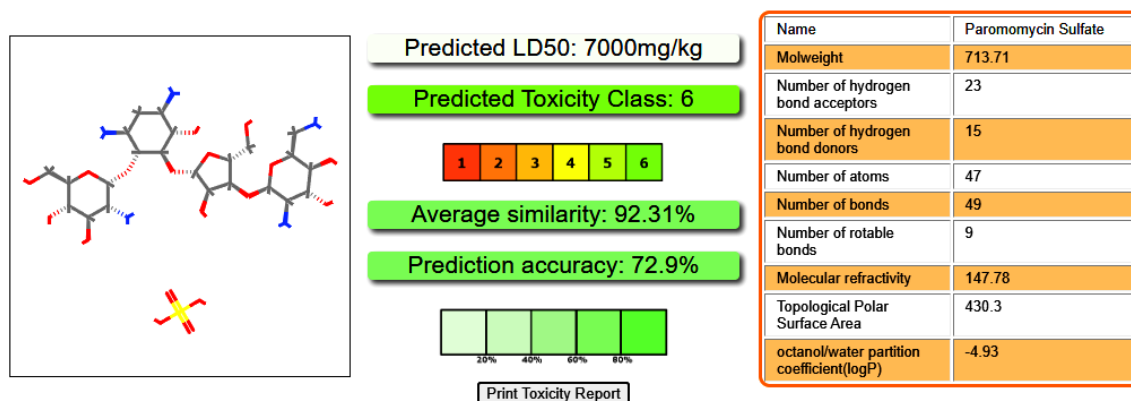
The toxicity report for Z1551627167 (Paromomycin Sulfate) indicates a predicted LD50 of 7000 mg/kg, placing it in Toxicity Class 6, which suggests that it is moderately toxic. The Toxicity Class 6 classification is typically reserved for substances that may pose a health risk with repeated or prolonged exposure. Still, their lethal dose is relatively higher compared to compounds in higher toxicity classes. The report also highlights that the average similarity of 92.31% and prediction accuracy of 72.9% provide a solid basis for this toxicity classification. However, it's essential to note that toxicity predictions are often based on in silico models, and actual toxicity may vary under different biological conditions.

The compound's molecular weight of 713.71 g/mol and a topological polar surface area (TPSA) of 430.3 Å² suggest it is highly polar, which might limit its ability to cross cellular membranes easily. The number of hydrogen bond acceptors (23) and hydrogen bond donors (15) indicates a significant potential for interactions with biological targets, possibly influencing its toxicity profile by affecting cellular processes. The octanol/water partition coefficient (logP) of −4.93 confirms its high hydrophilicity, which may limit membrane permeability but could enhance its solubility in aqueous environments, making it more bioavailable in fluids such as plasma.

4. Discussion

In this study, a multi-tiered computational strategy was employed to identify and evaluate potential drug-binding sites on HTRA1, aiming to discover promising small-molecule inhibitors. Initial binding site analysis using ProteinPlus revealed that binding pockets P_0 and P_1 are the most viable candidates for drug targeting. These sites demonstrated large cavity volumes (663.81 and 628.74 Å³) and surface areas (841.34 and 861.36 Å²), alongside drug scores of 0.79 and 0.86, significantly exceeding conventional thresholds for druggability. While other pockets like P_10 and P_11 exhibited far lower scores and volumes, making them less favorable, the atypical case of P_6, with its very low volume but moderate drug score, suggests that unique surface features may still contribute

to niche binding potential. These findings strongly support prioritizing P_0 and P_1 in downstream drug design efforts.

Machine learning-based binding pocket prediction provided complementary insights, identifying a top-ranked site with a 24.0% probability of druggability. This site also contained a relatively conserved set of 10 residues (average conservation score: 1.827), suggesting potential functional significance. Although the second and third-ranked sites had markedly lower probabilities (2.2% and 2.1%), the third site's highest conservation score (1.975) raises the possibility of an overlooked functional domain. Nonetheless, the convergence between geometric and machine learning analyses affirms the viability of the top-ranked site, tentatively corresponding to P_0 or P_1, for further exploration.

To refine ligand selection, pharmacophore-based screening was performed using structural alignment and hydrogen bonding profiles. Molecules with 2–3 donors and two acceptors, such as Z3699434447 and Z4900394450, achieved the lowest RMSD values (0.010 and 0.037), indicating a strong pharmacophore fit despite fewer hydrogen bonding groups. On the other hand, compounds with more donors and acceptors (e.g., Z1946857219) showed higher RMSDs, suggesting less favorable alignment, possibly due to conformational strain. Z1551627167 emerged as an up-and-coming candidate, appearing across multiple pharmacophore categories with moderate RMSD and notable structural adaptability, reinforcing its potential for further investigation.

Molecular docking simulations provided a more detailed assessment of ligand-receptor interactions. Among the compounds tested, Z4900394450 exhibited the strongest binding affinity (AC Score = −80.246998) and favorable SwissParam stability (−7.0185). Z4660996690 and Z1551627167 also demonstrated high-affinity interactions, with highly negative SwissParam Scores (−7.8131 and −8.2061, respectively), suggesting robust binding stability. The docking results further validated the pharmacophore predictions and highlighted Z1551627167 as a leading candidate, particularly given its recurring presence across multiple evaluation platforms. Other compounds, such as

Z1762139434 and Z871870844, also showed promise, albeit to a lesser degree.

To assess drug-likeness and pharmacokinetic properties, an ADME (Absorption, Distribution, Metabolism, and Excretion) profile was conducted using SwissADME. Z1551627167 stood out for its high polarity (TPSA = 430.30 Å²) and extreme hydrophilicity (Log Po/w = −7.66), indicating a strong potential for aqueous solubility but poor membrane permeability. This suggests its application may be best suited for extracellular targets, such as within blood plasma. In contrast, Z1762139434 presented a more drug-like profile, with a moderate molecular weight (394.87 g/mol) and balanced lipophilicity (Log Po/w = 2.33), allowing for better membrane diffusion and intracellular access. Other candidates exhibited intermediate characteristics, providing flexibility depending on the desired pharmacological target environment.

Toxicity analysis, based on in silico prediction models, classified Z1551627167 as Toxicity Class 6, with a predicted LD50 of 7,000 mg/kg, indicating moderate toxicity. While this relatively high LD50 implies a degree of safety under controlled exposure, the compound's high hydrogen bonding capacity (23 acceptors, 15 donors) and low logP

(−4.93) suggest it may interact broadly with biological systems, potentially influencing its toxicity profile. These properties underline the importance of careful dosing and targeted delivery mechanisms to minimize off-target effects and improve therapeutic specificity. While Z1762139434 presented fewer toxicity concerns, further empirical testing is essential for both compounds to verify these predictions under physiological conditions.

In conclusion, this multimodal computational study identified P0 and P1 as the most promising druggable sites on HTRA1 and highlighted Z1551627167, Z4900394450, and Z1762139434 as top ligand candidates. Z1551627167 consistently demonstrated strong performance across pharmacophore alignment, docking, and ADME/Toxicity profiling, though its limited permeability and moderate toxicity warrant cautious consideration. Z1762139434, by contrast, offers a more balanced pharmacokinetic profile and may be more versatile for intracellular targeting. Future studies should prioritize experimental validation of these candidates through molecular dynamics simulations, in vitro binding assays, and in vivo pharmacological evaluations to fully assess their therapeutic potential.

References

Alzheimer's Association. (n.d.). *Medications for memory, cognition & dementia-related behaviors*. https://www.alz.org/alzheimers-dementia/treatments/medications-for-memory

Bartus, R. T., Dean, R. L., Beer, B., & Lippa, A. S. (1982). The cholinergic hypothesis of geriatric memory dysfunction. *Science,* – 217(4558). – P. 408–414. URL: https://doi.org/10.1126/science.7046051

Chen, S., Puri, A., Bell, B., Fritsche, J., Palacios, H. H., Balch, M., Sprunger, M. L., Howard, M. K., Ryan, J. J., Haines, J. N., Patti, G. J., Davis, A. A., & Jackrel, M. E. (2024). HTRA1 disaggregates α-synuclein amyloid fibrils and converts them into non-toxic and seeding incompetent species. *Nature Communications,* – 15(1). URL: https://doi.org/10.1038/s41467-024-46538-8

Cummings, J., Lee, G., Zhong, K., Fonseca, J., & Taghva, K. (2021). Alzheimer's disease drug development pipeline: 2021. *Alzheimer's & Dementia: Translational Research & Clinical Interventions,* – 7(1). – e12179. URL: https://doi.org/10.1002/trc2.12179

Hardy, J. A., & Higgins, G. A. (1992). Alzheimer's disease: The amyloid cascade hypothesis. *Science,* – 256(5054). – P. 184–185. URL: https://doi.org/10.1126/science.1566067

Hampel, H., Mesulam, M. M., Cuello, A. C., Farlow, M. R., Giacobini, E., Grossberg, G. T., Khachaturian, A. S., Vergallo, A., & Cummings, J. L. (2018). The cholinergic system in the pathophysiology and treatment of Alzheimer's disease. *Brain,* – 141(7). – P. 1917–1933. URL: https://doi.org/10.1093/brain/awy132

Heneka, M. T., Carson, M. J., El Khoury, J., Landreth, G. E., Brosseron, F., Feinstein, D. L., Jacobs, A. H., Wyss-Coray, T., Vitorica, J., Ransohoff, R. M., Herrup, K., Frautschy, S. A.,

Finsen, B., Brown, G. C., Verkhratsky, A., Yamanaka, K., Koistinaho, J., Latz, E., Halle, A., … Kummer, M. P. (2015). Neuroinflammation in Alzheimer's disease. *The Lancet Neurology,* – 14(4). – P. 388–405. URL: https://doi.org/10.1016/S1474-4422(15)70016-5

Heppner, F. L., Ransohoff, R. M., & Becher, B. (2015). Immune attack: The role of inflammation in Alzheimer disease. *Nature Reviews Neuroscience,* – 16(6). – P. 358–372. URL: https://doi.org/10.1038/nrn3880

Knopman, D. S., Jones, D. T., & Greicius, M. D. (2021). Failure to demonstrate efficacy of aducanumab: An analysis of the EMERGE and ENGAGE trials as reported by Biogen, December 2020. *Alzheimer's & Dementia,* – 17(4). – P. 696–701. URL: https://doi.org/10.1002/alz.12213

Kurkinen, M., Fułek, M., Fułek, K., Beszłej, J. A., Kurpas, D., & Leszek, J. (2023). The amyloid cascade hypothesis in Alzheimer's disease: Should we change our thinking? *Biomolecules,* – 13(3). – 453 p. URL: https://doi.org/10.3390/biom13030453

Lecca, D., Jung, Y., Scerba, M., Hwang, I., Kim, Y., Kim, S., Modrow, S., Tweedie, D., Hsueh, S., Liu, D., Luo, W., Glotfelty, E., Li, Y., Wang, J., Luo, Y., Hoffer, B., Kim, D., McDevitt, R., & Greig, N. (2022). Role of chronic neuroinflammation in neuroplasticity and cognitive function: A hypothesis. *Alzheimer's & Dementia,* – 18(11). – P. 2327–2340. URL: https://doi.org/10.1002/alz.12610

Orhan, I. E. (2021). Cholinesterase inhibitory potential of quercetin towards Alzheimer's disease – A promising natural molecule or fashion of the day? A narrowed review. *Current Neuropharmacology,* – 19(12). – P. 2205–2213. URL: https://doi.org/10.2174/1570159x18666201119153807

Scheltens, P., De Strooper, B., Kivipelto, M., Holstege, H., Chételat, G., Teunissen, C. E., Cummings, J., & van der Flier, W. M. (2021). Alzheimer's disease. *The Lancet,* – 397(10284). – P. 1577–1590. URL: https://doi.org/10.1016/S0140-6736(20)32205-4

Selkoe, D. J., & Hardy, J. (2016). The amyloid hypothesis of Alzheimer's disease at 25 years. *EMBO Molecular Medicine,* – 8(6). – P. 595–608. URL: https://doi.org/10.15252/emmm.201606210

Zurawa-Janicka, D., Skorko-Glonek, J., & Lipinska, B. (2010). HtrA proteins as targets in therapy of cancer and other diseases. *Expert Opinion on Therapeutic Targets,* – 14(7). – P. 665–679. URL: https://doi.org/10.1517/14728222.2010.487867

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Section 2. Economic and management

ANALYSIS OF RISK-BASED CAPITAL MODELS AND THEIR APPLICABILITY TO THE INSURANCE MARKET OF UZBEKISTAN

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Abstract

This article explores the applicability of the Risk-Based Capital (RBC) framework to the insurance market of the Republic of Uzbekistan. Drawing upon international best practices, especially the APRA model from Australia, the study empirically assesses the capital structure comprised of premium, claims liability, and asset risks. The analysis revealed the dominant role of insurance-related risks in capital requirements and emphasized the need to transition from rigid normative regulation to a more risk-sensitive and adaptive supervisory approach. The paper provides policy recommendations for a phased implementation of RBC, including the development of a localized model, creation of a national actuarial database, and modernization of regulatory frameworks.

Keywords: *risk-based capital, insurance market, Uzbekistan, regulatory reform, prudential supervision, actuarial analysis*

Introduction

The modern economy demands high resilience and adaptability from insurance market participants amid an unstable macroeconomic environment, increasing regulatory pressure, and growing risks of various nature. This is particularly relevant for the Republic, where, despite positive development trends, the insurance sector still faces a range of institutional, regulatory, and financial challenges. Against the backdrop of rising competition, market volatility, and shifting client expectations, insurance companies are tasked with effectively managing capital to ensure their long-term solvency and stability.

The concept of Risk-Based Capital (RBC) is increasingly recognized as a tool for both risk assessment and active management. In the context of globalization, establishing risk-sensitive capital adequacy systems has become essential. Practices in countries like the United States, Canada, the United Kingdom, and Australia show that flexible RBC models better align insurers' risk profiles with capital requirements.

As Uzbekistan's risk-based regulatory framework continues to develop, adapting international RBC practices has gained scientific and practical relevance. Insurance risks are multi-layered, including underwriting, claims, and investment risks; inadequate assessment may lead to insolvency and systemic sector instability.

This article examines capital management mechanisms in insurance companies using a risk-based perspective. It analyzes key risks, their evaluation methods, and the applicability of foreign RBC models to Uzbekistan's market, with particular attention to catastrophic risks, climate change, and emerging threats such as terrorism.

Literature Review

The Risk-Based Capital (RBC) approach to insurance capital management has been extensively studied internationally, though less so nationally. This section reviews key literature on the theoretical foundations, global practices, and adaptation of RBC models in emerging markets, including Uzbekistan.

F. H. Knight's Risk, Uncertainty and Profit (1921) laid the groundwork for insurance risk assessment and capital requirements. RBC models became widespread in the 1990s, beginning in the U.S. with the NAIC framework, which assesses asset, credit, reserve, and premium risks with covariance adjustments.

Similar models have been adopted in Canada (OSFI), the United Kingdom (FSA, Solvency I and II), Australia (APRA), and the European Union under Solvency II, which applies a two-tier system (MCR and SCR) calculated via standard formulas or internal models.

Among the relevant scientific publications exploring RBC concepts and their impact on insurance company resilience are:
- Cummins, J.D., & Phillips, R.D. (2009). Capital Adequacy and Insurance Risk-Based Capital Systems. Journal of Insurance Regulation, 28(1).
- Eling, M., & Schmeiser, H. (2010). Insurance and Financial Stability. Geneva Papers on Risk and Insurance – Issues and Practice, 35(3). DOI: 10.1057/gpp.2010.19.

These works emphasize the need for a balanced approach between strict regulatory standards and capital management flexibility, especially under conditions of market volatility.

At the national level, theoretical and practical aspects of insurance capital and risk management are represented in a more limited body of literature. Notable publications on the stability of Uzbekistan's insurance market include:
- Yusupov, I. R. (2021). Improving the Regulation System of Financial Stability of Insurance Organizations in Uzbekistan. Journal "Finance and Banking", No. 3, pp. 45–52.
- Akhmedova, Sh. S. (2020). Risk Assessment and Capital Management in Insurance Organizations. Scientific and Practical Journal "Economics and Innovative Technologies", No. 6.

It is also important to note the increasing reform activity by the regulator. In 2022, a new draft law on insurance activities was adopted, introducing principles of risk-based supervision and a differentiated approach to capital assessment.

Research Methodology

The methodological framework of this study relies on systematic, comparative, and quantitative analyses of insurance company risks and their impact on capital structure. It is based on the Risk-Based Capital (RBC) concept, tested in advanced markets, with the goal of adapting its elements for Uzbekistan.

A factor-based approach to capital assessment is used, following the methodology outlined by the Australian Prudential Regulation Authority (APRA) in Risk-Based Capital in General Insurance (2002). According to this approach, the total capital requirement is defined as the sum of required capital amounts across the following key risk categories:

Underwriting Risk – reflects the likelihood that incoming insurance premiums may be insufficient to cover expected claims and expenses;

Claims Risk – captures the probability that actual claims payments will exceed expected values, particularly in the presence of catastrophic or cumulative events;

Asset Risk – includes risks associated with declines in the market value of assets and credit risk related to issuer defaults;

Operational Risk – encompasses losses arising from internal errors, management failures, fraud, or external events.

Each of these risk categories is modeled using statistical coefficients (e.g., coefficients of variation), assumptions about loss distributions, and covariance matrices reflecting the interrelationships between different risk components. The overall capital requirement is calculated using a formula that integrates these components, adjusted for their respective weights and covariance effects, where:

Total Risk-Based Capital = $\sqrt{(RP^2 + RC^2 + RA^2 + RO^2 + 2Cov)}$,

RP represents capital for underwriting risk, RC for claims risk, RA for asset risk, and RO for operational risk.

Additionally, within the framework of this study, the presented model is adapted to the specific conditions of Uzbekistan. In particular, the following local features are proposed for consideration:

- A low level of reinsurance coverage, increasing sensitivity to large losses;
- Limited access to highly liquid and diversified investment instruments;
- Underdeveloped information databases and actuarial analytics;
- Currency risks associated with investments in foreign assets.

The collection and processing of empirical data were based on publicly available statistical sources from the Agency for the Development of the Insurance Market under the Ministry of Finance of the Republic of Uzbekistan, as well as annual reports of the country's leading insurance companies. Scenario analysis and stress testing methods were employed to validate the reliability of calculations by simulating the impact of catastrophic events and market shocks on insurers' capital resilience.

The methodological novelty of this study lies in the development of an adapted risk-based capital model tailored to the Uzbek context, integrating elements of international standards while accounting for national specificities.

Analysis and Research Results

This research stage aimed to empirically test the factor-based Risk-Based Capital (RBC) model proposed by the Australian Prudential Regulation Authority (APRA) for potential adaptation to Uzbekistan's insurance market. The analysis focused on risk components, their interrelationships, and their influence on overall capital requirements.

Using data from Risk-Based Capital in General Insurance, the study examined a typical RBC structure, covering premium risk, claims liability risk, and asset risk – allowing for a comprehensive evaluation of capital adequacy and insurer vulnerability.

Table 1. *Example of Capital Requirement Calculation Based on the RBC (APRA) Model*

Capital Component	Calculation Formula	Result (in units)
Premium Risk (PR)	0.15 × Earned Premium	45
Claims Liability Risk (CL)	0.15 × Net Outstanding Claims	30
Asset Risk (AR)	$\sum$ (Risk Weight × Asset Value for Each Asset Class)	20
Total RBC Requirement	$\sqrt{(PR^2 + CL^2 + AR^2 + 2 \times Covariance)}$	≈ 58.3

Note: The calculations apply the covariance adjustment method, where the correlation between premium risk and claims liability risk is assumed to be 0.5, and between these risks and asset risk, 0.25. The asset risk weights are differentiated, ranging from 0% for cash to 40% for equities

Based on the presented model calculation, it can be concluded that premium and reserve risks have a significant impact on the overall capital requirement of an insurance company. This calculation structure provides a more realistic view of risk distribution and the insurer's potential exposure to both external macroeconomic factors and internal business decisions.

In Uzbekistan, where the insurance sector has been undergoing rapid liberalization in recent years, the component of asset risk is of particular importance. Given the limited range of investment instruments and the dominance of short-term bank deposits in insurers' portfolios, exposure to market and credit risks remains relatively low; however, as investment portfolios diversify, this exposure is likely to increase substantially.

Furthermore, the system for managing liabilities and premium policies in most Uzbek insurance companies remains insufficiently aligned with international standards. This is reflected in weak pricing practices, the lack of advanced actuarial analysis, and the limited role of reinsurance as a risk transfer tool. Under the current regulatory framework managed by the National Agency for Prospective Projects (NAPP), such deficiencies could create systemic risks to sector stability, particularly in the event of a sharp rise in claims payouts caused by catastrophic events or macroeconomic shocks.

The analysis of the RBC model suggests that its implementation in Uzbekistan could potentially enhance the resilience of individual insurers and strengthen overall system supervision. However, this would require:

- Developing a national risk weight scale for assets and liabilities;
- Establishing a centralized actuarial data system;
- Building human capacity in risk management and prudential regulation;
- Updating the regulatory framework by shifting from static capital norms to dynamic, risk-based standards.

Conclusions and Recommendations

The study confirms the importance of implementing a Risk-Based Capital (RBC) system as a sustainable regulatory tool for the insurance market. A factor-based model assessing premium, reserve, and investment risks allows better alignment of capital levels with actual financial threats.

For Uzbekistan, where the insurance sector is rapidly growing and transforming, adopting RBC principles is key to improving transparency, reliability, and investment appeal. Key findings include:

– Insurance risks, especially claims liabilities, exert the greatest pressure on capital, requiring stronger actuarial assessment and reinsurance;

– The current fixed minimum capital model inadequately reflects risk exposure, risking undercapitalization or over-reserving;

– Although asset risk is currently low, it will become increasingly significant as investment portfolios diversify amid currency liberalization and foreign investment growth.

Based on the findings, the following measures are recommended for the phased introduction of RBC in Uzbekistan's insurance sector:

– Develop a national RBC model tailored to macroeconomic conditions and institutional maturity, based on a simplified APRA or Solvency II framework with gradual calibration;

– Create a centralized actuarial database at the regulator (NAPP) to support reliable risk assessments;

– Implement training and certification programs in risk management and actuarial science, engaging international organizations (e.g., IAIS, ADB, GIZ);

– Gradually shift from rules-based to risk-based regulation, starting with voluntary adoption by major insurers and moving toward mandatory standards;

– Integrate stress testing and scenario analysis into supervisory practices and internal capital management.

Implementing RBC is essential for the sustainable growth of Uzbekistan's insurance sector and its integration into the global financial system. Achieving this requires institutional reforms, regulatory flexibility, and collaboration among regulators, insurers, and academia, laying a foundation for a more resilient, adaptive, and trusted insurance industry.

References

National Association of Insurance Commissioners (NAIC). (2023). Risk-Based Capital Overview.
Cummins, J. D., & Phillips, R. D. (2009). Capital Adequacy and Insurance Risk-Based Capital Systems. Journal of Insurance Regulation, – 28(1).

Australian Prudential Regulation Authority (APRA). (2022). Prudential Standard GPS 110: Capital Adequacy. Retrieved from: https://www.apra.gov.au

Yusupov, I. R. (2021). Improving the System of Regulating the Financial Stability of Insurance Organizations in Uzbekistan. Finance and Banking, – No. 3. – P. 45–52.

Akhmedova, Sh. S. (2020). Risk Assessment and Capital Management in Insurance Organizations. Economics and Innovative Technologies, – No. 6. Retrieved from: https://journal.tsue.uz

National Agency for Prospective Projects (NAPP). (2023). Presentation of the Insurance Market Reform Concept for Uzbekistan. Retrieved from: https://napp.uz

Nomozova K. I. Improvement of Capital Requirements in Insurance Companies of Uzbekistan. – Tashkent: Banking and Finance Academy of the Republic of Uzbekistan, 2024. – 26 p. (In Russian)

Yuldashev A. K. Building Consumer Trust through Personalization: A Case Study of Uzbekistan's Digital Insurance Market. – Tashkent: KIMYO International University in Tashkent, 2024. – 24 p. – [Electronic resource]. (In Russian)

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FACTORS INFLUENCING CONSUMER ACCEPTANCE OF CHATBOTS: EVIDENCE FROM AZERBAIJAN

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Abstract

The rise of digital communication has prompted businesses to adopt innovative tools such as chatbots to enhance consumer engagement. Using the Technology Acceptance Model (TAM), this study investigates Azerbaijani online consumers' attitudes and intentions toward chatbot adoption. Survey data from 325 respondents indicate that perceived usefulness significantly shapes positive attitudes, whereas perceived ease of use and perceived risk were not statistically significant. Additionally, consumer attitudes significantly predict their behavioural intentions toward chatbot use. The findings suggest that emphasizing the practical benefits of chatbots can drive greater consumer acceptance and usage. The study extends TAM to a new cultural context and provides practical insights for businesses seeking to leverage chatbots effectively.

Keywords: *Chatbots, Consumer attitudes, Technology Acceptance Model, Perceived Usefulness, Perceived Risk, Behavioural Intention.*

JEL: *M31, O33*

Introduction

In the contemporary consumer-centric environment, brands are compelled to enhance their customer communication strategies to effectively address the evolving demands and expectations of consumers. The optimisation of customer communication is pivotal for brands, offering advantages such as increased speed, cost efficiency, and the strengthening of brand loyalty (Oetama, 2022). Traditional marketing communication methods, which rely heavily on physical customer service representatives, have proven inadequate in to-day's digital age. The reliance on human intermediaries often introduces challenges related to response time, emotional engagement, and operational costs (Yadav & Pavlou, 2020).

With advancements in technology, particularly in artificial intelligence (AI), brands are increasingly integrating AI-based chatbots into their customer communication frameworks. The core premise of this integration lies in AI's capability to mimic human intelligence, facilitated by developments in machine learning and natural language processing (NLP) (Xia & Shannon, 2025). Chatbots,

which are text or voice-driven programmes designed to simulate human-like interactions, offer brands substantial benefits, including enhanced speed, elevated efficiency, reduced costs, and improved reliability (Adamopoulou & Moussiades, 2020 a).

Despite their potential, chatbots, as a relatively new technology, face challenges in terms of user acceptance and recognition. This research seeks to explore consumer attitudes and behaviours towards chatbots, especially in light of the limitations associated with traditional customer service representatives and the growing adoption of chatbots as a primary communication tool by brands. The study employs the Technology Acceptance Model (TAM) to evaluate consumer perceptions of new technologies

Literature review
Chatbots

The advent of Industry 4.0, characterised by the integration of information technologies within industrial frameworks, has ushered in an era marked by heightened productivity, speed, cost-efficiency, and reliability (Liao et al., 2017). Within this paradigm, artificial intelligence (AI), automation systems, and robotics play a pivotal role in the industrial economy. Chatbots, as an extension of AI technologies, derive their nomenclature from the amalgamation of "Chat" (conversation) and "Bot" (robot) (Adamopoulou & Moussiades, 2020b). They represent a significant manifestation of AI technologies in the realm of human-computer interaction, acting as technological innovations that enhance user productivity. The societal acceptance of this technological innovation is imperative for its market implementation. While universal acceptance of new technologies cannot be presumed, identifying individuals inclined towards adoption is crucial for practitioners of chatbot technologies (Abu Shawar & Atwell, 2007).

With the proliferation of e-commerce and advancements in AI technologies, chatbots have become integral consumer communication tools across various sectors such as healthcare, banking, and travel (Pillai & Sivathanu, 2020). Chatbots are recognised as the most technologically advanced commercial tools among contemporary consumer communication channels. They facilitate interac-

tions on online platforms, mitigating negative consumer perceptions that may arise from human interactions. By eliminating time constraints, chatbots enable consumers to swiftly access desired information (Lee, 2020).

The genesis of chatbots can be traced back to the Turing test, which evaluated initial human-information interaction assumptions (Adamopoulou & Moussiades, 2020b). The evolution of chatbots has paralleled developments in AI technologies, expanding their usage and impact. For instance, AI technologies influence product development, customisation based on consumer needs, and supply chain logistics (Belhadi et al., 2024). In pricing strategies, AI assists businesses in forecasting future prices using machine learning methodologies (Yaiprasert & Hidayanto, 2024). In promotional activities, AI provides businesses with tools to better understand consumers by analysing historical data and delivering targeted messages through optimal channels (Mariani et al., 2022) consumer research, and psychology literature. By leveraging a systematic literature review using a data-driven approach and quantitative methodology (including bibliographic coupling.

A review of literature on the impact of AI-based chatbots in marketing reveals pertinent studies. For example, For instance, Shahzad et al., (2024) show that, for Chinese consumers of luxury fashion brands, superior AI-chatbot service quality (the "stimulus" in their S-O-R framework) boosts e-brand loyalty by enhancing user trust, enriching the chatbot experience, and generating favourable electronic word-of-mouth. Van den Broeck et al., (2019) posits that the effectiveness of chatbot-delivered advertising on Facebook Messenger hinges on how intrusive the ads feel: when users perceive the bot itself as helpful and useful, those ads seem less intrusive, are accepted more readily, and ultimately lead to stronger purchase and recommendation intentions. As such, developing chatbots as effective consumer communication channels is a prerequisite for their interaction with advertising. In this context, chatbots are employed as communication tools in marketing, progressively improving their communication skills with each interaction, and subsequently generating more personalised outcomes. Consequently, chatbots offer brands and companies opportu-

nities to organise tasks, reduce errors, collect extensive data, enhance brand loyalty, and create new brand images (Savastano et al., 2024).

Conceptual phramework
Technology Acceptence Model (TAM)

The Technology Acceptance Model (TAM), initially formulated by Davis in 1989, serves as a framework to forecast the attitudes and behaviours of individuals interacting with computers. In contemporary settings, characterised by the swift advancement of information technologies, TAM is extensively employed to evaluate consumer intentions regarding the utilisation of these technologies (Liu et al., 2024; Mohebbi et al., 2012) which can be classified into two categories: technological and behavioral perspectives. In this paper, the authors propose an integrated household Internet adoption model combining both perspectives to provide a holistic view on the subject. For this purpose, the three primal models of technology acceptance and usage behavior, the technology acceptance model (TAM).

Central to this model are three constructs: perceived usefulness (PU), perceived ease of use (PEOU), and perceived risk (PR), each playing a pivotal role in shaping consumers' attitudes and behaviours towards information technology. Perceived Ease of Use (PEOU) pertains to the extent to which an individual believes that using a particular system would be free of effort. When a consumer perceives a technology as straightforward and user-friendly, it significantly enhances their behavioural intention to use the technology (Luo et al., 2011).

Conversely, Perceived Risk (PR) encapsulates the uncertainty consumers may feel regarding the outcomes of using new technology, particularly concerning data privacy and financial transactions. Literature suggests that heightened perceived risk can adversely affect consumer attitudes and intentions (Joo & Sang, 2013).

Finally, Behavioural Usage (BU) denotes the frequency and intensity with which consumers engage with a new technology, further influencing overall adoption rates (Joo & Sang, 2013). The interplay of these components within TAM offers valuable insights into consumer behaviour, providing a robust theoretical foundation for examining technology adoption within diverse contexts.

Methodology

Following the introduction of a novel technology, consumers invariably form opinions, be they favourable or unfavourable, irrespective of the technology's inherent benefits. For both consumers and businesses, understanding the market's reception of a new technology is paramount. Insights into consumer attitudes and behaviours regarding technology provide invaluable guidance for established businesses and prospective market entrants alike. This research seeks to ascertain the attitudes and behaviours of online shoppers concerning the adoption of chatbots.

In this study, we employed a quantitative research method, aligning with the research objective of examining relationships between variables from a holistic viewpoint. This approach allows for a structured analysis suitable for drawing statistically significant inferences.

We posit that the constructs of the Technology Acceptance Model (TAM) exert a positive influence on attitude towards use, subsequently driving behavioural use. Drawing upon established research in the Technology Acceptance Model (Candela, 2018), we propose the conceptual model illustrated in Figure 1.

Figure 1. *Research model (own elaboration)*
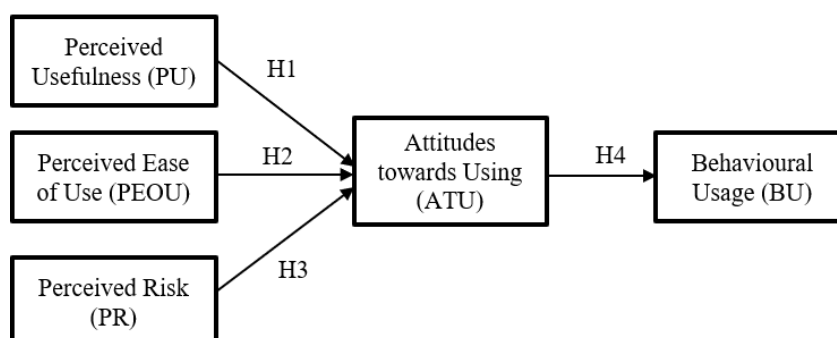
The following hypotheses, grounded in the Technology Acceptance Model (TAM) were formulated to guide the research:

H1: Perceived usefulness exhibits a positive relationship with attitude towards using chatbots.

H2: Perceived ease of use exhibits a positive relationship with attitude towards using chatbots.

H3: Perceived risk exhibits a negative relationship with attitude towards using chatbots.

H4: A positive attitude towards chatbots exhibits a positive relationship with behaviour intention towards using chatbots.

The data for this research were gathered via an online survey. The target population comprised individuals aged 18 years or older, residing in Azerbaijan, who possess prior experience with chatbots.

To ensure a robust statistical foundation, the research design prioritised maintaining a confidence level exceeding 94% across the entire scope of the investigation. Consequently, the Z-value was set at 1.96, and the alpha value was established at 0.05. Based on these parameters and the application of the appropriate sample size calculation formula, the minimum required sample size was determined to be 290 participants. The actual data collection process involved surveying 325 individuals who had prior experience interacting with chatbots, thereby exceeding the calculated minimum and bolstering the statistical power of the analysis.

To facilitate the attainment of the research objectives, a criterion sampling methodology was implemented. This approach, as described by Patton (2015), entails the deliberate selection of participants, objects, or situations that demonstrably possess specific characteristics directly relevant to the research problem under investigation. Within this study, the selection criteria mandated that participants possess a foundational understanding of chatbots and have direct, prior experience with their use.

The survey instrument employed in the data collection process was structured into three distinct sections. The initial section presented participants with a voluntary participation consent form and included items designed to capture relevant demographic information. Critically, this section also contained questions designed to ascertain the participants' existing knowledge of chatbots and whether they had previously interacted with them. Individuals responding negatively to these screening questions were systematically excluded from the final research sample to ensure the validity and relevance of the collected data.

Results

In this section, demographic characteristics of the participants, factor and regression analysis results are presented.

In this study the demographic characteristics of respondents and the results of the factor and regression analyses are presented in plain text. Among the participants, 52.4% were female and 47.6% were male. Age distribution shows that 54.6% were 18––24 years old, 40.5% were 25–35 years old and 4.9% were 36–49 years old. With respect to education, 2.5% had completed primary school, 14.4% held a high-school diploma, 17.8% possessed an associate degree, 52.5% a bachelor's degree and 12.8% had undertaken postgraduate study. Regarding frequency of chatbot use, 10.1% interacted with chatbots daily, 23.6% weekly, 44.6% monthly and 21.7% only once a year.

Suitability of the Technology Acceptance Model (TAM) scale for factor analysis was confirmed with a Kaiser–Meyer–Olkin value of 0.94 and a Bartlett's test result of $\chi^2 = 5\,651.121$, $p < 0.05$. Factor analysis extracted four factors. The first, perceived benefit, comprised six items with loadings between 0.489 and 0.878 and accounted for 13,9% of the total variance. The second, perceived ease of use, included six items with loadings from 0.830 to 0.984 and explained 50,9% of the variance. The third, perceived risk, contained four items with loadings between 0.848 and 0.905 and explained 6,04% of the variance. The fourth, attitude toward use, comprised three items with loadings from 0.427 to 0.985 and explained 5,3% of the variance. Together, these results demonstrate that the TAM structure is appropriate for analysing online consumers' attitudes toward and behavioural intentions regarding chatbot use.

To test whether the behavioural-use scale was appropriate for factor analysis, Kaiser–

Meyer–Olkin and Bartlett's statistics were examined. The analysis returned a KMO value of 0.86, confirming adequate sampling adequacy (KMO > 0.50). Bartlett's test produced $\chi^2 = 1593.167$, p < 0.05, indicating that the correlation matrix was factorable.

Testing Hypotheses

In the preliminary analysis of the data, normality, reliability and factor analysis were performed and it was seen that there was no problem in testing the hypotheses. In the study, multiple regression analysis was used to measure the cause and effect relationship between the dependent and independent variables and the hypotheses formed within the framework of the research model were tested.

Impact of TAM components on attitude toward using chatbots

Multiple regression analysis was used to determine the effect of technology acceptance model components on the attitude towards using chatbots.

As can be seen in Table 1, the independent variables which are the components of the technology acceptance model; perceived usefulness, perceived ease of use and perceived risk affect 14.3% of the variance in online consumers' attitude towards using chatbots ($R_2 = 0.143$). The independent variables PU, PEOU and PR explain the dependent variable CIT in a statistically significant way according to the absence model (F = 17.27; p < 0.001; T = 0.27; VIF = 3.7). Although the R_2 value expresses a low bond, the suitability of the variables used in the model for regression analysis was analysed with Tolerance and VIF values and it was determined that it was within acceptable limits. In other words, it is understood that there is a regression relationship between the independent variables in the model and the dependent variables and the model is meaningful as a whole (Pallant, 2020).

Table 1. *The effect of technology acceptance model components on attitude towards using chatbot*

	Dependent Variable					
	Attitude towards using (ATU)					
Independent Variables	Std β	t	p	R	Adj. R^2	F
Factor 1. Perceived Usefulness (PU)	0,24	4,1	0,01**			
Factor 2. Perceived Ease of Usage (PEOU)	0,03	0,30	0,7	0,37	0,143	17,27
Factor 3. Perceived Risk (PR)	0,07	1,24	0,2			
Fixed		16,45	0,01**			

*p< 0,05; p** < 0,01

Multiple regression analyses were performed in order to affect the dependent variable of CWB by using the independent variables of PU, PEOU and PR. As a result of the analysis, a significant regression model was established (F = 17.27; p < 0.001). Accordingly, perceived usefulness (PU) positively and significantly affects attitude towards using chatbots (ATU) (β = 0.24; t = 4.1; p< < 0.01) (H1). Perceived ease of use (PEOU) affects the attitude towards using chatbots (ATC) positively but not statistically significant. (β = 0.03; t = 0.30; p = 0.7) (H2). Perceived risk (PR) affects the attitude towards using chatbots negatively but not statistically significant (β = 0.07; t = 1.24; p= = 0.2) (H3). Candela (2018) concluded that the perceived risk level is effective in determining Italian consumers' attitudes towards chatbots. This situation, which we think is due to the frequency of experiencing chatbots, differs from the literature.

The impact of attitude towards using chatbots on behavioral usage

Attitude towards using chatbots on the use of chatbots linear regression analysis was used to determine the effect of the regression analysis. In the analysis phase, firstly the assumptions of regression analysis were tested. When the correlation coefficients were examined to determine whether there was a multicollinearity problem, it was found that the coefficient was below 0.80 and multiple. It was determined that there was no linearity problem (0,27). Tolerance and VIF values (Tolerance = 1,00; VIF = 1,00) were determined. When the Mahalanobis value was examined to determine whether there were outliers, the most extreme value was determined as 12.3 and it was determined that participants 1 and 2 could be outliers. However, as stated by Pallant (2020), Cook's value should be checked before excluding these values from the research. If Cook's value is 1 and greater than 1, it should be excluded from the research. In this context, it is seen that Cook's value is 0.03 and there is no need to exclude the data from the research.

As seen in Table 2, a linear regression model was established between attitude towards using chatbots and behavioural use. The SDT explains 0.7% of the variance in behavioural usage ($R2=0.071$) and this is significant according to the null model ($F=24.8$; $p<0.01$). Accordingly, attitude towards using chatbots positively and statistically significantly affects behavioural use ($\beta =0.27$; $t=4.9$; $p<0.001$) (H4). When the Tolerance (1.00) and VIF (1.00) values were examined, the significance of the model as a whole was supported.

Table 2. *The effect of attitude towards using chatbots on behavioural use.*

	Dependent Variable					
	Behavioural Use (BU)					
Independent Variables	Std β	t	p	R	Adj. R^2	F
Factor 1. Attitude towards using (ATU)	0,27	4,9	0,01**	0,271	0,071	24,81
Fixed		4,8	0,01**			
* p < 0,05; p ** < 0,01						

Conclusion

Marketing practitioners increasingly use chatbots as alternatives to human customer-service agents. In a competitive global market, integrating chatbots into consumer strategies is becoming standard. Research confirms chatbots positively impact customer attitudes and behaviours, offering operational advantages such as reduced costs, faster responses, and stronger loyalty.

Reducing consumer hesitation about chatbots accelerates acceptance. Understanding adoption drivers helps firms precisely target consumers and design effective marketing strategies. Thus, identifying factors influencing chatbot usage is strategically important for digital businesses.

This study applied the Technology Acceptance Model (TAM) to evaluate consumer perceptions and adoption of chatbots. TAM proposes that perceptions shape attitudes, influencing usage behaviour. Regression analysis showed TAM constructs explain 14.3% of chatbot-related attitudes. Perceived usefulness (PU) significantly influenced attitudes, meaning consumers recognizing clear benefits have more positive attitudes. Perceived ease of use (PEOU) and perceived risk (PR) showed expected trends but lacked statistical significance, possibly due to limited user experience in Azerbaijan. Attitudes explained 7% of behavioural intentions, suggesting attitudes partially drive usage but other factors also contribute.

Perceived usefulness emerged as the strongest factor influencing attitudes and chatbot adoption. Consumers valuing speed, convenience, or personalisation are more inclined to use chatbots. Ease of use and risk perceptions were less influential.

Managerially, advanced chatbot technologies employing natural-language processing and machine learning should be

prioritised over basic scripted solutions to enhance loyalty, profitability, and operational efficiency.

Future research could enrich TAM with additional variables, investigate across cultures, demographics, or sectors, and employ longitudinal designs to capture evolving user experiences.

References

Abu Shawar, B., & Atwell, E. (2007). Chatbots: Are they Really Useful? *Journal for Language Technology and Computational Linguistics*, – 22(1). – P. 29–49. URL: https://doi.org/10.21248/jlcl.22.2007.88

Adamopoulou, E., & Moussiades, L. (2020a). An Overview of Chatbot Technology. In I. Maglogiannis, L. Iliadis, & E. Pimenidis (Eds.), *Artificial Intelligence Applications and Innovations* (Vol. 584, – P. 373–383). Springer International Publishing. URL: https://doi.org/10.1007/978-3-030-49186-4_31

Adamopoulou, E., & Moussiades, L. (2020b). Chatbots: History, technology, and applications. *Machine Learning with Applications*, – 2. – 100006 p. URL: https://doi.org/10.1016/j.mlwa.2020.100006

Belhadi, A., Mani, V., Kamble, S. S., Khan, S. A. R., & Verma, S. (2024). Artificial intelligence-driven innovation for enhancing supply chain resilience and performance under the effect of supply chain dynamism: An empirical investigation. *Annals of Operations Research*, – 333(2–3). – P. 627–652. URL: https://doi.org/10.1007/s10479-021-03956-x

Camilleri, M. A., & Falzon, L. (2020). Understanding motivations to use online streaming services: Integrating the technology acceptance model (TAM) and the uses and gratifications theory (UGT). *Spanish Journal of Marketing – ESIC*, – 25(2). – P. 217–238. URL: https://doi.org/10.1108/SJME-04-2020-0074

Joo, J., & Sang, Y. (2013). Exploring Koreans' smartphone usage: An integrated model of the technology acceptance model and uses and gratifications theory. *Computers in Human Behavior*, – 29(6). – P. 2512–2518. URL: https://doi.org/10.1016/j.chb.2013.06.002

Lee, S. B. (2020). Chatbots and Communication: The Growing Role of Artificial Intelligence in Addressing and Shaping Customer Needs. *Business Communication Research and Practice*, – 3(2). – P. 103–111. URL: https://doi.org/10.22682/bcrp.2020.3.2.103

Liao, Y., Deschamps, F., Loures, E. D. F. R., & Ramos, L. F. P. (2017). Past, present and future of Industry 4.0—A systematic literature review and research agenda proposal. *International Journal of Production Research*, – 55(12). – P. 3609–3629. URL: https://doi.org/10.1080/00207543.2017.1308576

Liu, M., Yang, Y., Ren, Y., Jia, Y., Ma, H., Luo, J., Fang, S., Qi, M., & Zhang, L. (2024). What influences consumer AI chatbot use intention? An application of the extended technology acceptance model. *Journal of Hospitality and Tourism Technology*, – 15(4). – 667–689. URL: https://doi.org/10.1108/JHTT-03-2023-0057

Luo, M. M., Chea, S., & Chen, J.-S. (2011). Web-based information service adoption: A comparison of the motivational model and the uses and gratifications theory. *Decision Support Systems*, 51(1), 21–30. https://doi.org/10.1016/j.dss.2010.11.015

Mariani, M. M., Perez-Vega, R., & Wirtz, J. (2022). AI in marketing, consumer research and psychology: A systematic literature review and research agenda. *Psychology & Marketing*, – 39(4). – P. 755–776. URL: https://doi.org/10.1002/mar.21619

Mohebbi, S., Khatibi, V., & Keramati, A. (2012). A Household Internet Adoption Model Based on Integration of Technology Acceptance Model, Theory of Planned Behavior, and Uses and Gratifications Theory. *International Journal of E-Adoption*, – 4. – P. 51–69. URL: https://doi.org/10.4018/jea.2012010104

Oetama, S. (2022). Influence Of Brand Communication, Brand Image And Brand Trust Through Online Media On Brand Loyalty In E-Commerce. *International Journal of Sci-*

ence, Technology & Management, – 3(2). – P. 502–511. URL: https://doi.org/10.46729/ijstm.v3i2.494

Pillai, R., & Sivathanu, B. (2020). Adoption of AI-based chatbots for hospitality and tourism. *International Journal of Contemporary Hospitality Management*, – 32(10). – P. 3199–3226. URL: https://doi.org/10.1108/IJCHM-04-2020-0259

Savastano, M., Biclesanu, I., Anagnoste, S., Laviola, F., & Cucari, N. (2024). Enterprise chatbots in managers' perception: A strategic framework to implement successful chatbot applications for business decisions. *Management Decision*, *ahead-of-print*(ahead-of-print). URL: https://doi.org/10.1108/MD-10-2023-1967

Shahzad, M. F., Xu, S., An, X., & Javed, I. (2024). Assessing the impact of AI-chatbot service quality on user e-brand loyalty through chatbot user trust, experience and electronic word of mouth. *Journal of Retailing and Consumer Services*, – 79. – 103867 p. URL: https://doi.org/10.1016/j.jretconser.2024.103867

Van den Broeck, E., Zarouali, B., & Poels, K. (2019). Chatbot advertising effectiveness: When does the message get through? *Computers in Human Behavior*, – 98. – P. 150–157. URL: https://doi.org/10.1016/j.chb.2019.04.009

Xia, Z., & Shannon, R. (2025). Navigating the Digital Frontier: Exploring the Dynamics of Customer–Brand Relationships Through AI Chatbots. *Sustainability*, – 17(5). – 2173 p. URL: https://doi.org/10.3390/su17052173

Yadav, M. S., & Pavlou, P. A. (2020). Technology-enabled interactions in digital environments: a conceptual foundation for current and future research. *Journal of the Academy of Marketing Science*, – 48(1). – P. 132–136. URL: https://doi.org/10.1007/s11747-019-00712-3

Yaiprasert, C., & Hidayanto, A. N. (2024). AI-powered ensemble machine learning to optimize cost strategies in logistics business. *International Journal of Information Management Data Insights*, – 4(1). – 100209 p. URL: https://doi.org/10.1016/j.jjimei.2023.100209

THE SPECIFICS OF HUMAN RESOURCES

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Abstract

One of the hallmarks of modern social psychological science is the emergence and rapid development of organizational psychology, a new scientific field that combines the achievements of psychological, social and economic sciences. The objective prerequisite for the emergence of this field of social psychology is the radical socio-economic and political reforms that are taking place in modern countries. These reforms confirm that the "human dimension" has become one of the most important resources for the development of organizations in the country, regardless of the type of task to be solved, the place of social division of labour, the form of ownership and the level of development. It's now clear that human resources have the ability to multiply an organization's efficiency or even threaten its very existence.

Keywords: *organizational culture; social division of labour; leadership; strategic mission*

Introduction

One of the main problems in the teaching process of the Personnel management course is the application of acquired theoretical knowledge in practical skills in the management of personnel resources of the organization. The one-sided delivery of the content, the lack of practical activity, does not allow students to fully engage in the learning process. Moreover, theoretically, of course, it is permissible to acquire information about how to exercise governance, or to imitate a meeting, to design and implement an assessment-centre programme, or to create conditions for effective delegation of norms, and so on. But unfortunately, that doesn't mean that the patterns we've learned are easy to apply in practice. Student internships have traditionally included the following topics: situational learning, coaching, practical activities. Among them, the emphasis is on experiential learning. This name comesfrom the word "experience", which implies that the student has to try the learned material (acquired knowledge) on themselves, has to "experience". So it's important to create an environment that engages the learner on an emotional level. For example, in the study of the topic -organizational culture- student is involved in an environment that is suitable for this or that type of collaborative activity, and in the study of the fundamentals of the technology of the assessment centre, they gradually absorbthe material, they have the roles of tester, facilitator, developer and consultant. During the exercises and procedures, students not only learn the material, but they also have the opportunity to "experience" the

material and form their own opinions on the issues. For this purpose, practical studies in this discipline are mainly conducted according to this method of teaching.

Social psychology helps us to understand a variety of problems that relate to social determinants and outcomes at all three levels of organizational development:

1) Individual work experience and behaviour (forming, motivation, stress, quality of work, job satisfaction);

2) Collective functioning (communication, leadership, joint decision making, team building);

3) The viability of the organization (strategic mission, organizational and corporate culture, working with staff, organizational changes).

For any organization, managing people (employees) is as much a component of the management system as managing material and natural resources. But of course, there are important differences between them, so managing people requires special methods of management.

On a physics test, a university lecturer was about to give his student a low score, and the student insisted that he deserved a high score. They decided to go to an independent arbitrator. They choseErnest Rutherford, who was president of the Royal Academy and a Nobel Prize winner. student was asked a question: How do you measure the height of a building with a barometer? And his answer was – you have to go up on the roof of this house, and you have to use a rod to bring this barometer down to the ground, and you have to measure the length of this rod. In fact, the answer was both complete and correct. But it wasn't related to physics. Rutherford asked a student to answer a question related to his knowledge of the laws of physics. The student replied, "You could go up on the roof, drop the barometer on the ground, measure the time of the fall, and then use the well-known formula to calculate the height of the building". The lecturer acknowledged that the answer was correct, and at the same time revealed knowledge of the laws of physics. However, it was interesting to see other answers. For example, youcan measure the height of a barometer in sunny weather and the length of it's shadow, so it can measure the length of the shadow of a building. And then we can add and subtract simple ratios to figure out the height of the building. Or we could go up the stairs, and we could slowly move the barometer up on the wall and make some markings. Then calculate how many times we've measured, then multiply that by the diameter of the barometer and get the height of the building. You could take a barometer, hang it on a shoelace, Let's swing it like a pendulum and measure the force of gravity, both at the bottom of the building and on the roof. And the difference between these heights can tell you the height of the building. the best way to do that is to find the controller of the house, and instead of barometer, it can tell us how tall the house is. Rutherford wondered if the student knew about the generally accepted rules for solving this simple problem. "Of course I know", said the student, "but I've also been fed up by schools and colleges where teachers force us to learn their own ways of thinking.

This student, Danish physicist Niels Bohr, won the Nobel Prize in 1922.

The specifics of human resources are as follows:

1. Humans have intelligence, their response to outside influences (management) is emotionally understood rather than mechanical, so the process of interaction between the organization and the employee is two-way.

2. Humans have the capacity for continuous improvement and development. In the conditions of modern scientific and technical progress, when technologies and professional skills become obsolete in a few years, the ability of employees to constantly improve their knowledge and development is the most important and lasting source of increasing the effective activity of any organization;

3. In modern society, human work activity lasts for 30 to 50 years, therefore, the relationship between people and different organizations arelong-lasting.

4. Unlike material and natural resources, people often come to an organization with a purpose, and they expect the organization to help the achieve that purpose.

5. A similarly important aspect of human resources is the uniqueness of each individual. So the response of different members of

an organization to the same management approach can be very different.

The field of human resource management has been undergoing a transformation in the last 15–20 years amidst the radical changes in corporate management. This transformation of human resource management is expressed in the following key trends:

- In recent years, developed countries have seen both relative and absolute increases in the number of people in employment.
- The status of the profession has increased; in most corporations, heads of human resources departments have been incorporated into management and also into the boards of directors;
- Significantly increased attention to the level of professional knowledge of personnel management;

- During Growing competition (including for highly qualified personnel) Isolation of personnel policy from the overall management strategy, was destructive to the successful operation of the corporation as a whole.

Conclusion

Completion of this practice requires consideration of the results obtained and advice given in the future. In our case, given the specificity of this practice and the time it was written, it makes sense to link the past and the future. In the future, we think it should be the development of the human potential of government organizations. It's more important than ever that organizations be run well. It also involves the management of both physical and human capital, as well as social capital.

References

Kitsmarishvili K. Personnel Managment Press"Samartliani Sakartvelo". – Tbilisi 2021. (In Georgian).

Paichadze N., Chokheli E. Pharesashvili N Management of Human Resources Press "Merlani" – Tbilisi, 2011. (In Georgian).

Bazarov T., Eremin B. L. Personnel Management: Textbook for Universities Press "Aspect" – Moscow, 2001. (In Russian).

Bazarov T. Psychological Facets of a Changing Organization Press "Aspect" – Moscow, 2007. (In Russian).

IMPROVEMENT OF CAPITAL REQUIREMENTS IN INSURANCE COMPANIES OF UZBEKISTAN

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Abstract

This article examines approaches to optimizing capital requirements for insurance companies in Uzbekistan. It analyzes existing regulatory frameworks and international standards, including Solvency II. The study explores risks associated with insufficient capitalization and proposes measures to improve capital and reserve management mechanisms. The research aims to adapt advanced regulatory practices to the national insurance market, ensuring its sustainable development.

Keywords: *insurance, insurance company capital, financial stability, Solvency II, risk-based regulation, minimum capital requirements (MCR)*

Introduction

The financial stability of insurance companies is a key factor ensuring the overall stability of the national insurance market and the effective fulfillment of insurers' obligations to policyholders. In the current context of Uzbekistan's economic development, characterized by deeper integration with international financial institutions and reforms in the insurance sector, improving capital management mechanisms and reserve practices in insurance companies is of particular importance. Implementing risk-based solvency standards similar to international models has become a crucial objective of national regulation.

Capital regulation in insurance aims to ensure financial stability and protect policyholders by maintaining a sufficient gap between assets and liabilities to meet obligations, even under adverse conditions. Recent international practices emphasize risk-based capital models, with capital requirements tied to asset and liability risks, as adopted in markets like the EU, UK, Australia, and the US.

Uzbekistan is actively reforming its insurance sector under the "New Uzbekistan – Development Strategy 2022–2026", enhancing solvency control, introducing new actuarial methods, and expanding capital requirements. However, challenges remain, including the need to localize international approaches, address limited historical data, and strengthen methodological and technological capacities.

This article examines capital and reserve management mechanisms in Uzbekistan's

insurance sector, analyzes international best practices, and proposes recommendations for adapting global standards to local conditions.

The relevance of the study is supported by Uzbekistan's regulatory documents governing insurance activities, including the Law of the Republic of Uzbekistan "On Insurance Activities" (amended in 2023), the Presidential Decree "On Measures for the Development of the Insurance Market" (No. PQ-4669), as well as regulations issued by the Ministry of Finance and the Central Bank of the Republic of Uzbekistan. The implementation of effective capital and reserve management mechanisms in accordance with international standards will enhance the financial stability of the national insurance sector and strengthen investor and consumer confidence in insurance services.

Literature Review

Scientific research dedicated to the financial stability of insurance organizations provides an extensive analysis of key aspects related to determining and ensuring the financial resilience of insurance companies. Studies emphasize the role of capital regulation in protecting policyholder interests and maintaining the stability of the insurance market. One of the main directions of academic analysis is the examination of approaches to evaluating insurance companies and managing capital in a volatile macroeconomic environment.

According to international studies, such as those by Cummins (1988) and Buzic (1994), the financial stability of insurance companies depends largely on the level of capital and its ability to cover unexpected losses. Sherris (2003) introduced the concept of Dynamic Financial Analysis (DFA) as a method for assessing insurers' capital requirements, allowing for risk-based approaches to asset and liability management.

A major focus of modern literature is the study of Solvency II standards. According to the Insurance Core Principles Working Party (IAA, 2004), contemporary regulatory models incorporate two methods for calculating capital: the standard formula and advanced internal models. This issue is particularly relevant for developing countries, where it is necessary to adapt international requirements to local conditions.

In Uzbekistan, the issue of the financial stability of insurance companies is actively addressed in regulatory documents, including the Law of the Republic of Uzbekistan "On Insurance Activities" and Presidential Decree No. PQ-4669. However, scientific research on adapting international models of capital and reserve management remains at an early stage.

This article aims to examine existing approaches to capital regulation, identify gaps in the national regulatory framework, and develop practical recommendations for improving the management of insurance company capital and reserves in Uzbekistan, taking into account international standards.

Research Methodology

This study is based on a combination of quantitative and qualitative analysis methods, allowing for a comprehensive examination of capital and reserve management mechanisms in insurance companies in Uzbekistan. The research employs the following methodological approaches.

This involves studying the current legislation and regulatory documents of the Republic of Uzbekistan, as well as international insurance regulation standards, including Solvency II and the recommendations of the International Actuarial Association (IAA).

This approach reviews best practices in capital and reserve management from the EU, UK, and Australia to identify key factors affecting financial stability. Statistical methods and econometric models assess the impact of various factors on the capitalization of Uzbek insurers, highlighting the main determinants of solvency. Scenario modeling considers regulatory changes, macroeconomic trends, and new capital management practices. Data from insurers, regulators, and experts evaluate the practical applicability of recommendations. A comprehensive methodology supports both the analysis of current mechanisms and the development of improvement strategies tailored to Uzbekistan's conditions.

Research Analysis

The study examined the capital and reserve management models of foreign insurance companies based on international best practices. These models account for key risks

affecting insurers' solvency, including investment risk, insurance risk, credit risk, and operational risk.

Dynamic Financial Analysis (DFA) methods were applied to assess the variability of insurance claims, catastrophic risks, and the impact of macroeconomic factors on insurers' investment portfolios. Additionally, stress-testing was employed to model different insurance market development scenarios and their influence on company capitalization.

Special attention was given to the interdependence between different business lines of insurance companies. In this regard, modern stochastic models such as copulas were used to more accurately model the probability distribution of extreme risks, which is particularly important for Uzbekistan's insurance market, given its relatively small size and high risk concentration in certain segments

The study identified key challenges in capital management within Uzbekistan's insurance sector, including limited access to actuarial data, insufficient diversification of investment portfolios, and the need to improve regulatory requirements for reserve formation. The developed recommendations focus on optimizing capital requirements and adapting international standards to national conditions, aiming to enhance the stability of the country's insurance sector.

Similar trends in capital allocation were observed in Uzbekistan's insurance market, though some significant differences remain. Notably, compulsory insurance of civil liability for vehicle owners (CICLVO) continues to dominate, but due to relatively low premium volumes and limited actuarial data, capital requirements for this segment may differ.

Property insurance, including residential and commercial real estate, construction, and infrastructure projects, requires greater attention to risk assessment in Uzbekistan, given market growth. This may lead to an increase in the share of capital allocated to this segment.

Adapting international capital allocation models to national conditions requires consideration of the unique characteristics of the economic environment, regulatory standards, and the availability of actuarial data.

Table 1. *Capital Allocation Across Business Lines in the Baseline Scenario*

Business Line	Capital (thousand USD)	Share of Total Capital (%)
Domestic Motor Insurance	28,291	9.1%
Home Insurance	60,965	19.7%
Fire and Industrial Risk Insurance	11,550	3.7%
Civil Liability Insurance	7,266	2.3%
Compulsory Motor Third-Party Liability (CMTPLI)	201,323	65.1%

This table presents the allocation of the Minimum Capital Requirement (MCR) across various business lines of an insurance company under the baseline scenario. The largest share of capital, 65.1%, is allocated to the compulsory motor third-party liability insurance (CMTPLI), reflecting the high proportion of risks associated with long-term liabilities and payment uncertainties.

Home insurance accounts for the second-largest share (19.7%) due to the high volatility of loss costs and significant potential claims. Meanwhile, despite its widespread coverage, domestic motor insurance demonstrates lower capital requirements (9.1%), which is linked to the relatively short claims settlement period.

The level of Minimum Capital Requirement (MCR) for insurance companies is significantly influenced by assumptions regarding the volatility of insurance liabilities. In particular, differences in methods for calculating the coefficient of variation (CV) have a considerable impact on the volume of required capital. Companies with lower risk profiles are less likely to use internal models for MCR calculation, whereas insurers facing higher volatility tend to apply such models to optimize capital requirements.

In Uzbekistan, the use of internal models for capital calculation is not yet widespread. This is partly because the current regulatory approach often leads to lower capital requirements compared to what could be achieved through internal modeling. However, such an approach may expose insurers to the risk of underestimating liabilities, potentially resulting in undervalued insurance premiums and reduced financial stability of the sector in the future.

One of the key regulatory challenges is the calibration of capital requirements. International practices, such as Solvency II, employ a risk-based approach that considers each insurer's specific characteristics, liability portfolio, and risk environment. In contrast, Uzbekistan's current standards do not yet provide for a differentiated approach to MCR calculation, which limits system flexibility and increases the risk of underestimating capital needs.

Existing regulations do not always ensure adequate solvency across all insurers, regardless of business size or portfolio structure. International practices increasingly require higher capital for liabilities with greater volatility to better prepare for adverse scenarios. In Uzbekistan, the revision of capital requirements may become necessary, particularly amid integration with international standards.

It is also crucial to account for diversification effects. Larger insurers benefit from lower capital burdens through diversified portfolios, while smaller, specialized companies may be underestimated under current regulations, highlighting the need for adjustments based on business scale and diversification.

Investment risk regulation remains essential, as current standards often fail to fully capture the effects of investment decisions or encourage well-diversified portfolios. Addressing these gaps is critical for ensuring the long-term financial stability of insurers in Uzbekistan.

Adopting a risk-based approach, aligning capital standards with international practices, and considering diversification would enhance the resilience of Uzbekistan's insurance sector, reducing the risks of capital shortfalls and financial instability.

Conclusion and Recommendations

Based on the analysis, several important conclusions can be drawn regarding the improvement of capital and reserve management mechanisms for insurance companies in Uzbekistan.

First, the current regulatory framework requires modernization towards a risk-based approach similar to Solvency II, allowing for better consideration of the individual characteristics of insurance portfolios and improving the accuracy of capital requirement assessments.

Second, the use of internal models for calculating the Minimum Capital Requirement (MCR) remains limited among Uzbek insurance companies. This is largely because standardized methods often impose lower capital requirements than internal models would. Introducing a more flexible methodology that reflects the true variability of insurance liabilities could enhance market stability.

Third, the regulatory capital requirements should be revised to account for the degree of diversification among Uzbek insurers. Under the current system, smaller insurers with narrow specialization may be underestimated, increasing their financial risks. Adjustments that consider business scale would ensure a fairer distribution of capital requirements.

Fourth, the regulation of investment risks remains a critical aspect of maintaining the financial stability of insurance companies. Incentivizing the formation of diversified investment portfolios and revising capital requirements for high-risk assets would help mitigate systemic risks.

Thus, the proposed measures for improving capital and reserve management mechanisms in Uzbekistan's insurance sector would strengthen the sector's financial resilience, enhance public trust in insurance companies, and ensure their long-term solvency.

References

Cummins, J. D., & Phillips, R. D. (2005). Financial Risk Management in Insurance. Journal of Risk and Insurance, – 72(4). – P. 541–569.

Butsic, R. P. (1994). Solvency Measurement for Property-Liability Risk-Based Capital Applications. Journal of Risk and Insurance, – 61(4). – P. 656–690.

Sherris, M. (2003). Solvency, Capital Allocation and Fair Rate of Return in Insurance. Journal of Risk and Insurance, – 70(3). – P. 527–550.

IAA Insurer Solvency Assessment Working Party. (2004). A Global Framework for Insurer Solvency Assessment. International Actuarial Association.

European Parliament and Council. (2009). Directive 2009/138/EC (Solvency II). Official Journal of the European Union.

Basel Committee on Banking Supervision. (2001). The Regulatory Treatment of Operational Risk. Bank for International Settlements.

Presidential Decree of the Republic of Uzbekistan No. PQ-4669 "On Measures for the Development of the Insurance Market."

Regulatory acts of the Ministry of Finance of the Republic of Uzbekistan governing capital and reserve requirements for insurance companies.

Ergasheva F. Sh. Analysis of Risk-Based Capital Models and Their Applicability to the Insurance Market of Uzbekistan. – Tashkent: Banking and Finance Academy of the Republic of Uzbekistan, 2024. – 28 p. (In Russian)

Yuldashev A. K. Building Consumer Trust through Personalization: A Case Study of Uzbekistan's Digital Insurance Market. – Tashkent: KIMYO International University in Tashkent, 2024. – 24 p. (In Russian)

WAYS TO ENSURING ECONOMIC STABILITY BASED ON INCREASING THE EFFICIENCY OF USING STATE BUDGET EXPENDITURES

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Abstract

The efficiency of public spending is a critical component of sustainable economic development and macroeconomic stability. This paper explores strategies for ensuring economic stability through the rational and efficient use of state budget expenditures, focusing on the case of Uzbekistan. The study includes a statistical analysis of Uzbekistan's budget execution trends between 2015 and 2023, a comparative assessment of global practices in public finance management, and recommendations for enhancing expenditure efficiency. The results demonstrate that increasing transparency, applying performance-based budgeting, and strengthening fiscal discipline can significantly improve economic outcomes.

Keywords: *economic stability, budget efficiency, fiscal discipline, public finance, expenditure management, Uzbekistan*

Introduction

One of the key challenges faced by many developing economies is how to allocate limited public resources efficiently in order to achieve maximum social and economic returns. The effectiveness of state budget expenditures not only affects the quality of public services but also serves as a stabilizing force in the face of economic shocks.

Uzbekistan, undergoing structural economic reforms, has increased its public investments and social sector funding significantly over the past decade. However, there remain substantial inefficiencies in expenditure planning and execution. In this context, improving the efficiency of state budget spending is imperative to ensuring economic resilience and sustainable growth.

This article aims to investigate the role of efficient budget expenditure in achieving economic stability, analyze existing problems in the budget system of Uzbekistan, and propose measures grounded in international experience.

Methodology

The research methodology incorporates the following approaches:

Descriptive analysis of the structure and dynamics of Uzbekistan's budget expenditures from 2015 to 2023.

Comparative analysis of best practices in OECD countries and select emerging economies in terms of budget efficiency.

Efficiency indicators such as budget deficit to GDP ratio, social return on investment (SROI), and sectoral output relative to government expenditure.

Expert opinion polling of 12 professionals in budget policy and public administration in Uzbekistan to identify key bottlenecks and opportunities.

The study relies on official statistics from the Ministry of Economy and Finance of the Republic of Uzbekistan, the State Statistics Committee, IMF and World Bank reports, and relevant academic literature.

Literature Review

The concept of efficient public expenditure dates back to classical economic theories. Musgrave (1959) introduced the idea of the three fundamental roles of government: allocation, distribution, and stabilization. Efficient budget expenditure falls under the allocation function, ensuring optimal resource distribution to maximize social welfare.

Keynesian economics further emphasized the role of government spending in stabilizing economies during recessions (Keynes, 1936). However, inefficient spending can lead to fiscal deficits without achieving desired economic outcomes, necessitating better expenditure control mechanisms.

Several studies have examined the link between efficient budget spending and economic growth:

Gupta and Verhoeven (2001) analyzed public spending efficiency in African countries, finding that better allocation in education and healthcare correlates with higher GDP growth.

Haque and Kneller (2015) studied OECD countries and concluded that performance-based budgeting (PBB) improves fiscal discipline by linking expenditures to measurable outcomes.

A study by the IMF (2018) found that medium-term expenditure frameworks (MTEFs) help governments plan budgets more effectively, reducing wasteful spending.

PBB shifts focus from input-based budgeting (how much is spent) to output/outcome-based budgeting (what results are achieved).

New Zealand's reforms (1989–1994) introduced PBB, leading to greater accountability in public spending (Schick, 1998).

South Korea's National Fiscal Management Plan (2004) integrated PBB, improving efficiency in social welfare programs (Kim & Park, 2016).

Technological advancements have transformed budget monitoring:

Estonia's e-governance model uses blockchain for real-time expenditure tracking, reducing corruption (Kalvet, 2012).

Brazil's "Transparency Portal" increased fiscal accountability by publishing real-time budget data (Ferraz & Finan, 2011).

Independent audits prevent misallocation of funds:

The role of Supreme Audit Institutions (SAIs)—such as the U.S. GAO and the UK's NAO – has been crucial in detecting inefficiencies (Blume & Voigt, 2011).

Botswana's Directorate on Corruption and Economic Crime (DCEC) reduced leakages in public procurement (Hope, 2020).

Some sectors yield higher economic returns when funded efficiently:

Infrastructure: The World Bank (2017) found that efficient infrastructure spending in China contributed to rapid industrialization.

Education & Healthcare: Rwanda's targeted health investments led to a 70% reduction in child mortality (WHO, 2019).

While many studies focus on developed economies, fewer examine low-income countries where budget inefficiencies are more severe. Additionally, most research on digitalization emphasizes AI-driven solutions, whereas this study focuses on simpler, non-AI reforms for broader applicability.

Analysis and Results

The study of Uzbekistan's budgetary trends from 2015 to 2023 reveals a gradual yet consistent increase in state budget expenditures relative to GDP. Specifically, government spending rose from 29.5% of GDP in 2015 to 32.4% in 2023. This upward trend reflects the government's proactive fiscal approach, particularly aimed at stimulating economic development and supporting social welfare sectors. Notably, spending on education increased from 21% to 24% of total expenditures, while healthcare expen-

ditures grew from 9.5% to 11% during the same period. Capital expenditures, representing government investments in infrastructure and long-term assets, experienced a more pronounced growth, rising from 19% to 26.1% of the total budget over the eight-year period.

Despite the growing volume of budget allocations, empirical evidence and audit reports suggest that the efficiency of public spending remains moderate. On average, 8–10% of allocated funds were either not fully utilized or misallocated, indicating systemic inefficiencies within the planning and execution mechanisms. In many instances, delays in project implementation and cost overruns were reported, particularly in infrastructure development. Moreover, several budget lines were found to be duplicated across ministries and regional authorities, reflecting a lack of coordination and strategic alignment in fiscal policy implementation.

Table 1. *Indicators of Fiscal Efficiency (State Statistics Committee of Uzbekistan, 2024)*

Indicator	2015	2018	2020	2023
Budget expenditures (% of GDP)	29.5	30.8	31.1	32.4
Budget deficit (% of GDP)	−0.5	−1.9	−3.5	−2.8
Capital expenditures (% of budget)	19.0	21.2	24.0	26.1
Efficiency score (1–5 expert rating)	2.8	3.0	3.2	3.5

The situation at the regional level demonstrates additional challenges. Local governments often experience limitations in institutional capacity, resulting in poor implementation of budgetary programs. Furthermore, the absence of real-time monitoring and digital financial control systems contributes to inefficiencies and resource mismanagement. In some regions, unspent funds accumulated despite pressing needs for socio-economic infrastructure, thereby highlighting the misalignment between budget planning and actual local development priorities.

The effectiveness of state expenditures was assessed through a set of efficiency indicators, combining financial ratios and expert evaluations. While the overall efficiency score improved marginally – from 2.8 in 2015 to 3.5 in 2023 on a five-point scale – it remains insufficient to fully justify the scale of expenditure growth. The widening fiscal deficit, peaking at −3.5% of GDP in 2020 before declining to −2.8% in 2023, further reflects pressures on budget sustainability and the need for tighter expenditure control.

An international benchmarking exercise reveals that countries such as Estonia, Chile, and South Korea have successfully enhanced budget efficiency through institutional reforms and digital innovations. Estonia's implementation of digital public finance systems enabled real-time monitoring and reduced administrative overhead, resulting in cost savings and increased transparency. Chile has established an independent agency to evaluate the effectiveness of public spending, thereby strengthening accountability. South Korea's shift to performance-based budgeting has linked each budget allocation to measurable outcomes, leading to improved service delivery and fiscal discipline (International Monetary Fund, 2022).

Several countries offer models that Uzbekistan can learn from:

Estonia: Digital budgeting systems reduced administrative costs by 14% between 2016–2022 and improved transparency.

Chile: Established an independent agency for evaluating the efficiency of public spending, improving accountability.

South Korea: Uses performance-based budgeting where each expenditure is linked to outcome indicators, leading to improved fiscal outcomes.

These experiences provide valuable lessons for Uzbekistan. While increasing budget allocations is essential for socio-economic development, the key to achieving macroeconomic stability lies in the efficient use of these resources. The analysis indicates that inefficiencies in Uzbekistan's budget management stem primarily from gaps in strategic planning, weak financial discipline, insufficient oversight, and low levels of digitalization. Current budget planning often lacks evidence-based assessments and

performance metrics, leading to suboptimal resource allocation. Furthermore, financial control mechanisms and audit institutions are yet to reach the level of independence and capacity necessary to prevent misuse or inefficiency.

Systemic Challenges in Budget Management

Planning gaps: Budget allocations are not always based on evidence or strategic need assessments.

Weak financial discipline: Delays in fund disbursement and lack of accountability reduce the efficiency of implementation.

Limited oversight: Internal and external audit mechanisms lack the authority or capacity to enforce corrective actions.

Technological lag: Budget tracking remains largely manual, making it difficult to identify and prevent misuse of funds in real time.

The findings demonstrate that while Uzbekistan has made progress in expanding the volume and scope of public spending, the ef-ficiency of these expenditures remains a key challenge. Addressing this issue through institutional reforms, digital tools, and evidence-based budget planning is essential not only for optimizing the use of public resources but also for ensuring long-term economic stability.

Conclusion

Ensuring economic stability in a transitioning economy like Uzbekistan requires a fundamental shift in the management of public finances. The effectiveness of budget expenditures plays a crucial role in supporting long-term development, reducing inequality, and enhancing institutional credibility. By adopting evidence-based budgeting practices, increasing transparency, and introducing performance metrics, Uzbekistan can substantially improve its fiscal outcomes. These reforms, supported by digital technologies and capacity building, will help lay the foundation for sustained macroeconomic stability and inclusive growth.

References

Blume, L., & Voigt, S. (2011). Does organizational design of supreme audit institutions matter? A cross-country assessment. European Journal of Political Economy, – 27(2). – P. 215–229. URL: https://doi.org/10.1016/j.ejpoleco.2010.08.003

Ferraz, C., & Finan, F. (2011). Electoral accountability and corruption: Evidence from the audits of local governments. American Economic Review, – 101(4). – P. 1274–1311. URL: https://doi.org/10.1257/aer.101.4.1274

Gupta, S., & Verhoeven, M. (2001). The efficiency of government expenditure: Experiences from Africa. Journal of Policy Modeling, – 23(4). – P. 433–467. URL: https://doi.org/10.1016/S0161-8938(00)00036-3

Haque, M. E., & Kneller, R. (2015). Why does public investment fail to raise economic growth? The role of corruption. Manchester School, – 83(6). – P. 623–651. URL: https://doi.org/10.1111/manc.12087

Kalvet, T. (2012). Innovation: A factor explaining e-government success in Estonia. Electronic Government, – 11(1/2). – P. 142–157. URL: https://doi.org/10.1504/EG.2012.049608

Keynes, J. M. (1936). The general theory of employment, interest, and money. Palgrave Macmillan.

IMF. (2018). Medium-term budget frameworks in advanced economies. International Monetary Fund. URL: https://www.imf.org/en/Publications/Policy-Papers/Issues/2018/03/20/pp021518medium-term-budget-frameworks-in-advanced-economies

World Bank. (2017). Beyond the gap: How countries can afford the infrastructure they need while protecting the planet. World Bank Group. https://openknowledge.worldbank.org/handle/10986/31291

WHO. (2019). Success factors for women's and children's health: Rwanda. World Health Organization. URL: https://www.who.int/pmnch/knowledge/publications/rwanda_country_report.pdf

Kim, J., & Park, C. (2016). Fiscal rules and fiscal sustainability: Evidence from Korea's National Fiscal Management Plan. Asian Economic Policy Review, – 11(1). – P. 90–106. URL: https://doi.org/10.1111/aepr.12125

Hope, K. R. (2020). Corruption and governance in Botswana: A best-case example? Journal of Contemporary African Studies, – 38(3). – P. 448–465. URL: https://doi.org/10.1080/02 589001.2020.1769525

Dener, C., Watkins, J. A., & Dorotinsky, W. L. (2021). Financial management information systems: 25 years of World Bank experience. World Bank. URL: https://openknowledge. worldbank.org/handle/10986/35691

Estonian e-Governance Academy. (2022). Estonia's digital governance model. URL: https://ega.ee/solutions/digital-governance

Vokhidova, M. K., & Abdullaeva, A. R. (2024). Directions of Trade Relations of Uzbekistan with the Countries of Central Asia. In Ecological Footprint of the Modern Economy and the Ways to Reduce It: The Role of Leading Technologies and Responsible Innovations (pp. 465–468). Cham: Springer Nature Switzerland.

State Statistics Committee of Uzbekistan. (2024). Macroeconomic Indicators.

International Monetary Fund (2022). Fiscal Monitor: Public Investment for the Recovery. Washington, D. C.

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WAYS TO ENSURING ECONOMIC STABILITY BASED ON INCREASING

BUILDING CONSUMER TRUST THROUGH PERSONALIZATION: A CASE STUDY OF UZBEKISTAN'S DIGITAL INSURANCE MARKET

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Abstract

This study investigates the relationship between perceived personalization and consumer trust in Uzbekistan's insurance market amid digital transformation. A survey of 400 respondents confirmed a significant correlation between personalization and trust, with prior insurance experience enhancing openness to digital products. The findings highlight the importance of trust-building strategies, simplified digital interfaces, and localized user experiences to boost adoption, offering insights into consumer behavior in emerging insurance markets.

Keywords: *digital insurance, personalization, consumer behavior, trust, Uzbekistan, digital transformation*

Introduction

Amid rapid technological progress and financial market transformation, retail insurance is shifting towards consumer-centric models. Digitalization, online platforms, and AI integration have redefined insurance products and consumer behavior. In emerging economies like Uzbekistan, these trends coincide with broader financial modernization and rising digital literacy.

Despite some progress, Uzbekistan's insurance market faces persistent challenges: low insurance penetration, limited public trust, and insufficient service personalization. According to the 2024 report by the Agency for the Development of the Insurance Market under the Ministry of Economy and Finance, the sector's GDP share remains below 1%, lagging behind regional and global benchmarks, underscoring the need for systemic reforms.

Personalized services, leveraging digital channels, behavioral analytics, and predictive models, are crucial for enhancing customer satisfaction and building long-term trust. However, the impact of personalization on consumer behavior in Uzbekistan's insurance sector remains underexplored.

This study examines the link between personalization in insurance services and consumer trust during Uzbekistan's digital transformation. It analyzes consumer behavior, preferences, and perceptions of digital service channels, offering practical recommendations for insurers to strengthen market presence and public confidence.

Literature Review

The development of retail insurance in the digital era has been widely studied over the past two decades, with a focus on consumer behavior shifts, the impact of digital technologies on decision-making, and the role of personalization in fostering trust.

Personalization remains a key theme. Weinmann et al. (2023) highlight how big data and machine learning allow insurers to tailor products to individual risk profiles, boosting loyalty and reducing churn. Lin and Zhang (2022) emphasize that personalized insurance enhances perceived service value and consumer security, particularly among digitally engaged users.

Trust is equally critical as interactions increasingly occur online. Pavlou's (2003) model identifies perceived security, transparency, and provider reputation as key trust drivers, while later studies (Kim & Park, 2020) show trust mediates between digital interfaces and consumers' transactional intentions.

The digital transformation of insurance, as outlined by The Geneva Association (2023), is not only a technological shift but also an institutional reconfiguration of the insurance model itself. In emerging economies, factors such as technology accessibility, regulatory frameworks, and the level of digital literacy are especially influential. In the case of Uzbekistan, these aspects become even more relevant due to historically low levels of trust in financial institutions and the relatively recent shift towards digital service delivery.

While research in the Central Asian region remains limited, several studies (Sattorova, 2021; Rahmatov, 2023) indicate that Uzbek consumers demonstrate significant interest in digital insurance products – particularly in the areas of auto insurance and microinsurance – provided that user interfaces are simple and information is transparently communicated. However, there is a notable lack of localized studies specifically examining the influence of personalization on trust, which underscores the relevance of this study.

Research Methodology

This study empirically investigates the relationship between personalization in insurance services and consumer trust amid Uzbekistan's digital insurance transformation. A quantitative, descriptive-analytical approach was employed, using a standardized online survey and multivariate regression analysis to measure consumer behavior, attitudes toward digital services, and trust perceptions.

The target population includes individuals residing in Uzbekistan who have either prior experience with or potential interest in using insurance services in a digital format.

The sample size consisted of n = 400 respondents, selected using stratified random sampling, considering the following criteria:

- Age: 18 to 60 years;
- Geography: Tashkent, Samarkand, Bukhara, Fergana, and other regions;
- Digital activity: possession of a smartphone and experience with online purchases.

The questionnaire was developed based on an adapted Technology Acceptance Model (TAM) and included the following key blocks:

- Perceived personalization of insurance offerings (4 items);
- Trust in insurance companies (5 items);
- Behavioral intention to use digital insurance products (3 items).

All items were measured using a 5-point Likert scale, where 1 = "Strongly disagree" and 5 = "Strongly agree."

Data collection was conducted during September–March 2024–2025 via online platforms (Google Forms and a Telegram bot), with the support of partner insurance companies and digital university channels. Participation was voluntary and anonymous.

Data were processed and analyzed using SPSS v.27. The following statistical methods were employed:

- Descriptive statistics (means, standard deviations);
- Pearson's correlation coefficient to examine relationships between variables;
- Multiple linear regression analysis to assess the impact of personalization on trust and behavioral intentions.

The level of statistical significance was set at $p < 0.05$.

Results and discussion

The purpose of this section is to present and interpret the results of the empirical

study conducted among insurance consumers in the Republic of Uzbekistan. The data analysis reveals key patterns in the perception of personalization, levels of trust, and behavioral intentions toward the use of digital insurance products. All calculations were performed using SPSS v.27, employing descriptive statistics, correlation, and regression analysis methods.

A total of 400 respondents participated in the survey. The average age was 31.4 years (SD = 9.2). The sample included:

- 52.3% male and 47.7% female participants;
- 68% urban and 32% rural residents;
- 89% had internet access via smartphones;
- 61% had prior experience with insurance products, while 39% did not.

The perception level of personalization in insurance services ranged from moderate to high. The average score on the Likert scale was 3.71 (SD = 0.78). The highest-rated items related to the customization of offers to individual needs (M = 3.94), while the lowest ratings were given to the transparency of personalized product terms (M = 3.45).

Trust in insurance companies was found to be moderately low, with a mean score of 3.24 (SD = 0.85). The greatest concerns were related to «hidden conditions» and the complexity of the claims process. However, respondents with prior positive insurance experiences reported significantly higher levels of trust (M = 3.67) compared to those without such experience (M = 2.89).

The behavioral intention to use digital insurance products received an average score of 3.58 (SD = 0.73). This indicates a general openness to using digital channels, provided that trust levels increase and the user interface is simplified.

The correlation analysis revealed a statistically significant positive relationship between the perception of personalization and trust ($r = 0.46$, $p < 0.001$), as well as between trust and behavioral intention to use digital insurance ($r = 0.53$, $p < 0.001$). These results confirm interdependence between the key variables of the model.

To test the hypothesis regarding the impact of personalization on trust, a multiple linear regression analysis was conducted. The model was found to be statistically significant:

- $F_{(2, 397)} = 34.82$, $p < 0.001$
- $R^2 = 0.29$, indicating that 29% of the variation in trust levels can be explained by perceived personalization and prior insurance experience.

The strongest predictor was personalization ($\beta = 0.41$, $p < 0.001$). Previous insurance experience also had a significant, though weaker, effect ($\beta = 0.28$, $p = 0.003$).

Table 1. *Summary of Key Descriptive Statistics*

Variable	Mean (M)	Std. Deviation (SD)	Min	Max
Perceived Personalization	3.71	0.78	1	5
Trust in Insurance Companies	3.24	0.85	1	5
Behavioral Intention to Use Digital Insurance	3.58	0.73	1	5

Source: Author's survey data, 2025 (n = 400)

Table 1 shows that perceived personalization had the highest mean score, followed by behavioral intention and trust. Although consumers acknowledge personalization efforts, moderate trust levels may partly explain their hesitation to fully embrace digital solutions.

The findings confirm that perceived personalization significantly contributes to building consumer trust in insurance providers. The regression analysis identified personalization as the most influential predictor ($\beta = 0.41$, $p < 0.001$), supporting prior studies by Weinmann et al. (2023) and Lin & Zhang (2022), who emphasized the value of customized services in fostering stronger consumer relationships. In the context of Uzbekistan, where traditional skepticism toward financial institutions still persists, the ability to tailor products to individual needs appears to act as a trust-building mechanism, particularly among younger, tech-savvy demographics.

The results also highlight the role of prior insurance experience in shaping both trust and openness to digital channels. Respondents with previous positive insurance interactions demonstrated significantly higher levels of trust (M = 3.67 vs. 2.89), indicating that experience is a critical mediator between personalization and trust. This aligns with findings by Kim & Park (2020), which suggest that digital trust is cumulative and strongly influenced by past experiences.

Moderate behavioral intention (M = 3.58) suggests latent demand for digital insurance in Uzbekistan. However, barriers such as concerns over transparency, product clarity, and ease of use persist. Despite wide access to smartphones, these friction points may hinder full adoption of digital services.

These findings are consistent with global literature (Pavlou, 2003; The Geneva Association, 2023), underscoring the importance of user-friendly interfaces, transparent policy terms, and digital literacy efforts in improving trust.

Conclusion and recommendations

This study explored the relationship between perceived personalization, consumer trust, and the intention to use digital insurance platforms in Uzbekistan. Findings confirm that personalization strengthens trust, driving digital adoption. Despite growing digital access, trust in insurers remains moderate due to transparency concerns and past negative experiences. Positive interactions with insurance products, however, significantly boost trust and digital engagement.

The study highlights that personalization acts as a trust-building mechanism, not just a marketing tool. Tailored services increase consumer trust, but sustaining it requires continuous focus on user-centric design, transparency, and service reliability.

Based on the findings of this research, the following recommendations are proposed for insurance providers, regulators, and policy-makers in Uzbekistan:

- Insurance companies should leverage customer data and machine learning models to offer truly individualized products. This includes dynamic pricing, customized coverage options, and tailored communication;
- Clear policy language, straightforward claims procedures, and visible security protocols on digital platforms are essential. Special attention should be paid to explaining the terms of personalized offers to reduce the perception of hidden conditions;
- Companies should develop intuitive mobile and web interfaces and invest in customer education campaigns, particularly targeting older and rural populations. Chatbots and guided tutorials can serve as helpful tools in this effort;
- Testimonials, user stories, and feedback mechanisms can be used strategically to highlight successful digital insurance experiences, thereby reinforcing trust and encouraging broader adoption;
- While digital transformation is crucial, insurers should also maintain offline touchpoints – especially in regions with limited digital access. Human-assisted digital onboarding could ease the transition for first-time users;
- Regulatory authorities should support innovation by encouraging experimentation (e.g., regulatory sandboxes), while ensuring that personalization practices adhere to ethical standards and protect consumer data.

References

Weinmann, M., Schneider, C., & vom Brocke, J. (2023). Artificial Intelligence in Personalized Insurance: Opportunities and Challenges. Journal of Risk and Insurance, – 90(1). – P. 112–133.

Lin, Y., & Zhang, L. (2022). Personalization and Consumer Trust in Digital Financial Services. Insurance: Mathematics and Economics, – 105. – P. 72–85.

Kim, H.-W., & Park, Y. J. (2020). The Role of Trust in the Acceptance of Digital Insurance Platforms. Electronic Markets, – 30. – P. 561–573.

The Geneva Association. (2023). Digital Transformation in Insurance: Implications for Consumers and Providers. Geneva: The Geneva Association Reports.

Sattorova, M. (2021). Digitalization of Insurance in Uzbekistan: Current Trends and Barriers. Central Asian Journal of Business and Economics, – 12(2). – P. 53–66.

Rahmatov, B. A. (2023). Consumer Attitudes toward Insurance Products in Uzbekistan: A Behavioral Perspective. Uzbekistan Journal of Applied Economics, – 4(1). – P. 88–102.

Nomozova K. I. Improvement of Capital Requirements in Insurance Companies of Uzbekistan // Improvement of Capital Requirements in Insurance Companies of Uzbekistan. – Tashkent: Banking and Finance Academy of the Republic of Uzbekistan, 2024. – 26 p. (In Russian)

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MANAGEMENT OF PERSONNEL AT RISK

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Abstract

One of the new directions in human resource management is working in organizations in crisis. Any modern enterprise can find itself in a crisis situation, caused by, for example, a change in senior management, a breakdown in the information structure, a breakdown in the production mechanism, a sharp change in market demand.

If we think of a crisis as a state of an organization in which it will no longer exist in the future unless it undergoes some internal change, then probably all organizations experience a similar state in the transition from one stage of their life cycle to another. This is normal. From a human standpoint, a crisis is characterized by the emergence of at least two problems. First, there's a mismatch between the professional tools that people have in an organization and what they need in a new situation. On the other hand, it is the inadequacy of internal organizational norms and rules (of one's own corporate or organizational culture) to new conditions. So we can assume that the crisis is determined externally by professional activity, and internally by the need to change organizational culture.

It's important to work with the staff to overcome the crisis that has arisen. The activities of the HR department at this stage should include: diagnosing the human resources potential of the enterprise, developing a reorganization strategy and supporting human resources programs for reorganization, reducing staff, increasing labour productivity, resolving conflicts, especially those that are particularly difficult during this period.

Keywords: *behaviour, stress, aggressive insults, strategy, tactics*

Introduction

Dismissal – is the final stage of Musaki's professional career. This is undoubtedly stressful for people, because work is a significant part of the lives of the working population. Job loss is subjectively severe as it relates to:

– the loss of a source of material resources; Loss of a place to realize talents and abilities; Loss of social environment, loss of connection, Dismissal vectors (reasons): Self Termination;. The company's dissatisfaction; Layoffs; Retirement;

I. Peltzman distinguishes four phases of the human condition during termination (more consistent with vectors 2.3).

Stage 1 – is a state of confusion and shock. It can be very distressing, especially if the job loss was unexpected (a sudden layoffs, a disagreement with a supervisor, etc.). It's important to note that confusion and fear are

also associated with other discomforts, such as illness, accidents, and so on. The most potent pathogen is not so much the loss of a job as the constant fear that it will happen. As they say, waiting to die is worse than dying. So anticipating this event and preparing for it in some way makes it a little bit easier.

Stage 2 – Subjective adjustment of the situation by psychological adaptation to it. This phase usually lasts for three to four months after the job is lost. Already in the first weeks after the psychological shock has passed, many people experience a relief, almost a joy – no need to go to the office at 9 a.m. every day, heavy work obligations disappear, a lot of free time appears, and in general, a feeling of psychological comfort and satisfaction (especially if you have savings and can survive for a while). Forced rest is usually beneficial. Many report improvements in their health and mood. After a full recovery, the person begins to actively seek employment.

Psychologists have found that looking for a job right after you're fired doesn't increase your chances of finding one. And those who manage to cope with the negative effects of being fired, such as depression and a loss of self-esteem, and only then start looking for a new job, are less nervous about interviews, are more confident in themselves, and make a good impression on potential employers.

These people tend to be more satisfied with their new jobs than those who started looking for work as soon as they were fired.

Stage 3 is exacerbation. This happens six to seven months after you lose your job. By this time, the financial and social situation of a person usually deteriorates. There is a lack of active behaviour, a reduction in social circles, a disruption of life behaviours, interests, goals. Our ability to cope with adversity is diminishing. Depression is exacerbated when people are unemployed for long periods of time, when they cannot afford even a small wage for temporary, seasonal, or other jobs. Especially devastating is the constant failure to find a job – or, more accurately, the appearance of some hope of finding one (When a person learns about some chance) and then that hope disappears. Repeated failures can lead to apathy and the abandonment of the job search.

Stage 4 – Accepting your own powerlessness. This severe psychological condition is present even when the unemployed person is not experiencing material hardship, for example, a person receives unemployment benefits. Apathy is increasing month by month. One loses hope of ever finding a job, stops trying to make things better, and gets used to being unemployed. He loses control of himself, he starts drinking, and as a result, he ends up on the bottom of social ladder.
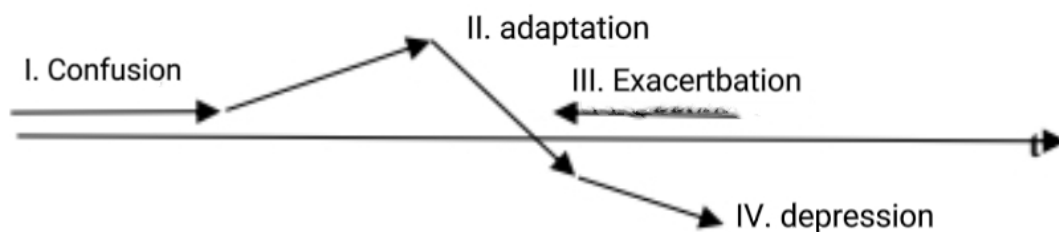
The Four Stages of the Human Condition after Dismissal from the job

Coping strategies for coping with dismissal-related stress.

Studies have shown that different people, depending on their personality traits, have different ways of coping. People can build models of their situations.

- A non constructive emotional model of the dismissal situation. For these types of people, firing from the job has become an uncomfortable situation, a stress, an insult. Then they use the

interpretation of the reasons for the dismissal and don't try to find a job. They don't go through the constructive coping strategies that are designed to deal with the current situation successfully;

- A constructively emotional model of dismissal. People in this category recall experiences of stress and abuse. However, for a number of reasons, they are able to overcome adversity and implement constructive coping strategies that are geared towards finding a job;

- A pattern of "constructive attitudes" toward the release situation. In this case, jib termination is a difficult life situation. People in this category don't experience acute discomfort, and they go from dismissal to constructive coping behaviour in no time.

Recommendations for employees who leave the company voluntarily:

- Reflect on the prospects for the future;
- Talk to your supervisor about your decision;
- When talking to your supervisor, do not explain your decision by saying that you are the fed up with everything. It's better to focus on the circumstances that make people leave the company;
- It is not wise to rush off to a better place and forget everything, including your obligations, even if you feel that you are already in a new place. The business ethic requires that there is no unfinished business after you're gone;
- After talking to your supervisor, brief all your colleagues. It's a bit stressful for them, too (the more you're valued in the company, the harder it is for your colleagues to cope with the stress);
- One of the traditions of most companies (at this time) is to have a cup of coffee or a small dinner on the last day of the old job. It's another way to stay on good terms with everyone.

When an employee is laid off, the company's recommendations for action are:

- In a survey of chief executives and managers of human resources departments in multinational companies, 60 percent said that announcing a layoff was the most stressful time of their lives;
- The loss of a valuable employee cannot be without impact on the company's efficiency. The damage can be huge if an organization doesn't have a corporate knowledge management system in place;

- It is necessary to speak with an employee who has had certain obligations;
- Do not schedule an appointment just before weekends or a holidays, when the person may feel completely abandoned, not knowing what to say to their friends or family;
- The conversation should not be conducted directly at the dismissed person's place of work or in a room where many people are working, so that the person does not have to pass through the lines of sympathetic employees;
- The conversation should not last more than 20 minutes, because the worker who is already disturbed by the unpleasant news, does not have the ability to listen for a long time, especially when the supervisor tries to embellish the essence of the release in every way;
- It is important that the one taking the lead prepare in advance for difficult conversations, be aware of his own feelings, and speak as frankly as possible;
- Think about the different types of compensation and social security that must be provided when the worker is dismissed, so that the final interview procedure does not cause stress for the person who is told 'you are dismissed'.

In addition to the conversation, arrangements can be made to greet the dismissed employee, to give him/her a souvenir, a good letter of recommendation, to maintain good personal contacts with the person so that in case of mutual interest the dismissed person can communicate with the organization.

Conclusion

Currently, companies that think about staff development and loyalty during a stable situation, may have the hope of supporting their staff during a crisis situation and expect that the staff will help the company in any way possible to overcome the crisis.

References

Kitsmarishvili K. *Personnel Managment* Press"Samartliani Sakartvelo". – Tbilisi, 2021. (In Georgian).

Paichadze N. Chokheli E. Pharesashvili N *Management of Human Resources* Press "Merlani" – Tbilisi, 2011. (In Georgian).

Bazarov T., Eremin B. L. *Personnel Management: Textbook for Universities* Press "Aspect". – Moscow, 2001. (In Russian).

Bazarov T. *Psychological Facets of a Changing Organization* Press "Aspect". – Moscow, 2007. (In Russian).

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BUSINESS SOCIAL RESPONSIBILITY AND ITS ENVIRONMENTAL ASPECTS

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Abstract

At the current stage of development of socio-economic relations, the social responsibility of business is quite relevant not only for individual countries, but also at the global level. The ultimate goal of the activities of modern business entities is not only to make and maximize profit. Business entities are trying to actively engage in various social activities, increase their social responsibility to stakeholders and society, and raise their awareness among consumers and society. The article emphasizes that social responsibility of modern business covers various aspects, but among them environmental aspects are quite popular and widespread in international practice. Our research provides evidence of why the importance and popularity of active recreation is growing in connection with the concept of sustainable development as part of the global agenda.

Keywords: *Business social responsibility, environmental aspects, environmental responsibility*

Introduction

In addition, corporate social responsibility implies the participation of an economic entity in solving social, environmental and economic issues not related to its core business. The degree of participation largely depends on the size of the company itself, its mission and goals, as well as the social "history" of the company. Companies that are most successful in meeting their social responsibility select causes that are consistent with their core values and their employees' interests and skill sets (Scarborough & Cornwall, 2018, p. 92).

In today's global business world, companies (corporations) strive to gain competitive advantages, improve the quality of their activities in the field of social and cultural events, and increase the „social value" of their products.

Research Methods

Firstly, the study assesses the social responsibility of business and its environmental aspects, identifies the concept of social responsibility of business and its features, which are widespread in foreign countries

and are widespread in developing countries, including Georgia.

The study used materials published in international and domestic scientific journals, including articles by Georgian and foreign scientists on issues of social responsibility of business and measures to protect the environment, the results of studies by international rating organizations, as well as Statistical data. The study is based on the processing of secondary analytical materials from open sources. The methods of deduction and induction, analysis and synthesis were used in the study.

Results Analysis

As is known, social responsibility of business includes:

1. **Economic responsibility** – Business leaders should make significant efforts to strengthen economic responsibility by making financial decisions, such as: full payment of taxes, full and fair payment of dividends and ensuring stable development of the company. In addition, economic responsibility implies the practice of making financial decisions based on the implementation of good deeds for the benefit of society.

2. **Social responsibility** – implies the development of corporate culture, respect for the freedom and equal rights of employees, the fight against discrimination against employees, the production of safe products in order to care for the health of consumers. In addition, business and society are correlated with each other.

3. **Environmental responsibility** – refers to a company's commitment to sustainable development and environmental protection.

Environmental responsibility implies the rational use of natural resources for the purpose of their protection and conservation, the use of advanced technologies to reduce harmful substances and waste, the restoration of damaged natural objects and compensation for damage already caused, as well as other measures to protect the environment.

Environmental aspect includes natural resource use, environmental management, and pollution prevention of air, water, land and waste (Bahaduran & Waqqas, 2013, pp. 92–97). Every year, more and more companies are adopting sustainable development practices and are committed to considering the consequences of their environmental impact at every stage of their business.

4. **Moral and ethical responsibility** – implies compliance with generally accepted moral and ethical standards, the fight against corruption, the encouragement of fair competition, the rejection of dumping prices and false information advertising, etc. Establishing ethical standards is only the first step in an ethics-enhancing program; implementing and maintaining those standards is the real challenge facing management (Scarborough & Cornwall, 2018, p. 90). Business ethics includes standards of conduct and moral values that guide business people in making decisions and solving problems.

Responsibility to society and future generations – includes the obligation of companies to preserve and improve the natural and economic environment, as well as to protect spiritual and material culture for future generations.

From the above dimension, companies improve their image, social trust and customer loyalty when they build strong community relationships by contributing to sustainable environmental practices (Alam & Islam, 2021, pp. 1–16).

Today, the implementation of environmental protection measures, financing of green projects is one of the dominant issues for both developed and developing countries. In addition to the governments of various countries, international organizations such as the United Nations and its structural agencies, international financial and credit organizations, specialized organizations, etc. are actively involved in regulating environmental issues.

The European Union document on corporate social responsibility reflects a new approach, which no longer refers to corporate social responsibility as a voluntary action. However, there are different approaches to this depending on the countries. National policies and strategies for corporate social responsibility depend largely on the political and institutional context of the respective country. Depending on the country, individual instruments of corporate social responsibility policy vary across EU Member States, even in terms of application. At the current stage of development of socio-economic re-

lations, many states, including the countries of the European Union, play an important role in supporting and encouraging business entities to conduct business in a socially responsible manner. The European Union and the European Commission have prepared a number of documents on this issue.

The environmental aspects of corporate social responsibility involve gaining a company's competitive advantage and increasing business social responsibility, reducing harmful impacts on the environment, and continuously improving the company's operations. Companies not only manage the interest of employees and shareholders but are also responsible for the social and environmental dimensions in their operations (Marrewijk, 2003, pp. 95–105).

The concept of environmental management of a company is part of the overall management of the company and includes the organizational structure, responsibilities and duties, methods and procedures, direction and resources for the development and implementation of environmental policies. CSR and sustainable development – both include three areas – economic, social and environmental. However, sustainability is often used as a synonym for corporate responsibility in the context of companies. As CSR issues become increasingly integrated into modern business practices, there is a trend towards referring to it as "responsible competitiveness" or "corporate sustainability" (Hohnen & Potts, 2007, p. 4).

In addition, the implementation and management of environmental protection measures is an integral part of the global agenda – sustainable development. By implementing a social standard, a company publicly declares its commitment to environmental protection, minimizes harmful impacts on the environment, ensures the creation of a safe environment for future generations and promotes sustainable development (Nozadze, Giorgidze, & Kapanadze, 2025, p. 2).

It is important to note that the social responsibility of business and its environmental policy are related to new financing methods and the introduction of new, innovative financing and lending instruments. Accordingly, green and blue bonds, green credits and green insurance are actively used to finance these activities. Among them, one of the most common innovative financial instruments for financing is green bonds. The capital raised through the issuance and sale of green bonds is used to finance environmental projects, and the use of this cash capital for other purposes is prohibited. "In effect, companies should set up their environmental values and behaviors in line with the green innovative expectations of society (Fosu, Fosu, Akyina, & Asiedu, 2023).

In the process of issuing and circulating green bonds, companies take into account the Green Bond Principles, developed by the International Capital Markets Association. The GBP recommend a clear process and disclosure for issuers, which investors, banks, underwriters, arrangers, placement agents and others may use to understand the characteristics of any given Green Bond (The International Capital Market Association (ICMA, 2021). The GBP emphasizes the transparency and accuracy of information that green bond issuers must provide to stakeholders.

At the present stage of socio-economic development, the concept of corporate social responsibility has become widely ingrained in the practice of both developed and developing countries. In 2007, the Georgian representative office of the UN Global Compact program "Global Compact – Georgia" was established in Georgia. Currently, more than 40 local organizations are members of the organization. Its goal is to popularize the topic of corporate social responsibility in Georgia and introduce the practice of drawing up international social reports. In addition to the above, Georgian business entities, with the assistance of international organizations, widely take into account aspects of sustainable development and environmental protection in their activities. In Georgia, with the help of international organizations and a number of leading countries, the concept of sustainable and green financing has been formed and is developing (Kutateladze, Nozadze, Chelidze, & Beridze, 2025, p. 60).

It is important to note that these documents are advisory in nature, however, if a green bond issuer wants to certify it, it is required to undergo an audit by the CBI–Climate Bond Initiative to ensure that the bonds it issues meet predetermined sustainability criteria (Nozadze & Samchkuashvili, 2025, p. 7).

We believe that social projects implemented through the joint efforts of the Georgian

government, international organizations and business entities will be an important factor in the socio-economic development of Georgia. Social responsibility practices not only increase a company's awareness and popularity, but also, most importantly, help organizations operate more sustainably.

Conclusions

– The concept of corporate social responsibility is inseparable from the concept of sustainable development. Corporate responsibility is usually understood as the contribution of business to achieving sustainable development goals.

– This has already become a common and widespread form of doing business. An active marketing tool that allows you to gain a market advantage in the face of increased competition, since the product acquires additional social value.

Environmental problems are a global problem. Modern environmental management considers the environmental elements of management at the strategic, operational and institutional levels. Its goal is to gain social legitimacy and competitive advantage, minimize negative environmental impacts and continuously improve company operations.

References

Alam, S. M., & Islam, K. M. (2021). Examining the role of environmental corporate social responsibility in building green corporate image and green competitive advantage. International Journal of Corporate Social Responsibility 6:8, DOI:10.1186/s40991-021-00062-w, 1–16.

Bahaduran, W., & Waqqas, O. (2013). Corporate Social Responsibility for a Sustainable Business. Journal of Sustainable Society, – Vol. 2. – No. 4. DOI: 10.11634/216825851302389, 92–97.

Fosu, E., Fosu, F., Akyina, N., & Asiedu, D. (2023). Do environmental CSR practices promote corporate social performance? The mediating role of green innovation and corporate image. Cleaner and Responsible Consumption. – Vol. 12 (1). DOI:10.1016/j.clrc.2023.100155.

Hohnen, P., & Potts, J. (2007). Corporate Social Responsibility An Implementation Guide for Business. Winnipeg, Manitoba: ©International Institute for Sustainable Development, ISBN 978-1-895536-97-3.

Kutateladze, R., Nozadze, M., Chelidze, M., & Beridze, T. (2025). Green Financing and Its Instruments Foreign and Georgian Experience. he European Journal of Humanities and Social Sciences No1, DOI:10.29013/EJHSS-25-1-58-61., 60.

Marrewijk, M. V. (2003). Concepts and Definitions of CSR and Corporate Sustainability: Between Agency and Communion. Journal of Business Ethics – 44(2–3). DOI:10.1023/A:1023331212247, 95–105.

Nozadze, M., & Samchkuashvili, N. (2025). Modern Finance Markets and ''Green'' Aspects of Their Functioning. Journal of Social Research & Behavioral Sciences, – Vol. 34 (08). ISSUE 01., 7. DOI: 10.36962/PIRETC34012025-04

Nozadze, M., Giorgidze, B., & Kapanadze, M. (2025). Business Social Responsibility and "Green Innovations" –Cause-And-Effect Relationship. International Journal of Innovative Technologies in Social Science – 1(45). Doi: 10.31435/ijitss.1(45).2025.3261, 2.

Scarborough, N. M., & Cornwall, J. R. (2018). Essentials of Entrepreneurship and Small Business Management, 9th Edition. Pearson Education.

The International Capital Market Association (ICMA. (2021). Green Bond Principles (Voluntary Process Guidelines for Issuing Green Bonds). Paris: The International Capital Market Association (ICMA).

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Section 3. Legal stydies

CHARACTERISTICS OF HIGHER EDUCATION INSTITUTIONS IN VIETNAM RELATED TO FIRE PREVENTION AND FIGHTING

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Abstract

The article presents the results of research on the characteristics of higher education institutions in Vietnam related to fire prevention and fighting; on that basis, it points out the development forecast as well as identifies some issues that need attention in fire prevention and fighting.

Keywords: *Fire prevention and fighting; higher education institutions; Vietnam*

1. Problem

According to the authors of IGI Global, a higher education institution includes universities, polytechnics, agricultural colleges, specializing in various fields such as engineering, agriculture, medicine, pedagogy, arts and economics and many other fields or a higher education institution includes traditional universities and professional-oriented schools, called universities of applied sciences or polytechnics (Tony Holloway, 2006). According to Article 4 of the Law on Higher Education (amended), a higher education institution is an educational institution belonging to the national education system, performing the function of training at higher education levels, scientific and technological activities, and serving the community. Also according to the provisions of Article 7 of the Law on Higher Education (amended),

higher education institutions in the national education system of Vietnam include: Universities, Colleges and higher education institutions with other names in accordance with the provisions of law. The concept of higher education institutions stated in the Law on Higher Education (amended) is relatively similar to international concepts of higher education institutions. Higher education institutions are organizations established and carry out higher education activities in accordance with the provisions of law. The general goals of higher education in Vietnam are: (1) to train human resources, help improve people's knowledge and nurture talents for the country; to conduct scientific and technological research to create knowledge and new products, to serve the requirements of socio-economic development, ensure national defense, security and

international integration; (2) to train people with political and ethical qualities; to have knowledge, professional practice skills, research and development capacity for scientific and technological applications commensurate with the level of training; to have good health; to have creativity and professional responsibility, to adapt to the working environment; to have a sense of serving the people. Thus, higher education institutions have the task of providing high-quality and highly-qualified human resources for the economy, increasing the value of each individual by equipping them with knowledge, skills and a spirit of autonomy and responsibility, thereby helping each individual to do their job better, increase labor productivity and create more income for themselves, more material wealth for society. Thus, higher education institutions can be understood as: all educational institutions in the national education system, carrying out activities in training, scientific research and technology to meet the learning needs for higher education levels of domestic and foreign learners, meeting the scientific and technological needs of the community. Higher education institutions can be organized in the forms of universities, colleges, academies, etc. depending on the development strategy and practical conditions of the facility, however, with each form of organization, it is necessary to ensure compliance with the provisions of the law. Therefore, it is very necessary to study the characteristics of higher education institutions in Vietnam related to fire prevention and fighting, on that basis, identify the issues raised in state management.

2. Research results
2.1. Research results on characteristics related to fire prevention and fighting

(1) Characteristics of construction architecture, traffic, water sources, combustibles, heat sources, technical systems, fire prevention and fighting systems, on-site fire fighting forces and means

Regarding construction architecture, most higher education institutions are built on campuses with many buildings and areas with different functions: learning areas and scientific research facilities; sports areas; student dormitories including housing and living facilities; housing areas for lecturers and staff; technical works including pumping stations, transformer stations, repair shops, warehouses and car and bicycle parking lots. Most of the buildings on campuses were built long before the Fire and Rescue Law was enacted, so they are often not fully equipped with fire prevention and fighting systems. During the operation process, due to increased demand, the facilities built more buildings with different functions, which led to the failure to ensure fire prevention and fire protection distance between buildings, and the width of roads for fire trucks to access. During the operation, many schools arbitrarily partitioned and divided classrooms with structures that did not have fire prevention capabilities, leading to failure to ensure fire prevention regulations.

Many schools have buildings that do not have automatic fire alarm systems or have them but they are not connected between buildings. The indoor fire-fighting water supply system is available, but the water pressure is not guaranteed because the pump system has not been invested with enough capacity and flow.

The fire prevention and fighting force of higher education facilities is mainly security guards. However, many educational facilities are large-scale, with many subdivisions and areas, so the number of security guards is not guaranteed. Especially for educational institutions that are universities with many member schools, the decentralization of management and allocation of fire prevention and fighting forces at the facility are still overlapping and unreasonable.

On-site fire fighting systems are basically fully equipped by the facilities, of the right type, but training on their use for students, lecturers, etc. is still limited.

In addition, some small-scale higher education institutions often rent office buildings as headquarters, teaching and research places, so the nature of construction architecture, traffic, water sources, combustibles, heat sources, technical systems, fire prevention and fighting systems, on-site fire fighting forces and means are completely dependent on the building and the building management unit.

(2) Characteristics of the operation of higher education institutions

With higher education institutions, the main activities are teaching and research,

both of which have the potential to lead to high fire and explosion hazards. With teaching activities, classrooms are often crowded places, and with the development of information technology and the need to apply digital transformation in teaching, classrooms are equipped with many electrical devices such as computers, projectors, sound systems, lighting and many flammable materials: tables, chairs, books, etc. In addition, classes all start and end at the same time, so during the operation, there will be peak hours with large crowds. If an incident occurs, it will be difficult to escape.

With experimental activities, higher education institutions, especially technical higher education institutions, often have many specialized laboratories with many complex equipment and machinery. This laboratory also has many potential fire and explosion risks.

In addition to the two main activities above, there are also dormitories at universities. This is a crowded area with many potential fire and explosion risks. Most dormitories do not allow cooking in the rooms, but due to high demand, students often use electricity to cook and boil water in the room. This is very dangerous and can easily lead to fire and explosion due to electricity if not strictly managed.

In addition, on university campuses, there are many types of service businesses such as canteens, restaurants, eateries, and library archives. These are also places that contain a lot of flammable substances. If there are no effective management measures, this can lead to high fire risks.

In the process of organizing their activities, universities, especially those with undergraduate training, often organize events, conferences, and performances indoors and outdoors. These events often attract large crowds, have large, complex sound and lighting systems, and also pose a high risk of fire and explosion.

(3) Characteristics of fire prevention and fighting systems

In higher education institutions, depending on the function and nature of the buildings, fire prevention and fighting systems are installed according to the provisions of law. Buildings in higher education institutions are installed with automatic fire alarm systems that are responsible for proactively reporting fires when fires occur according to the provisions of section 6.1.3. TCVN 3890:2009 (now section 5.2 TCVN 3890:2023) and section 12.1. TCVN 6160:1996; automatic fire fighting systems according to the provisions of Appendix C TCVN 3890:2009 (now Appendix A TCVN 3890:2023).

Higher education institutions have a number of buildings in group 4 of table A.1 Appendix A TCVN 3890:2023 regulating the equipment of automatic fire alarm systems, local fire alarm equipment and automatic fire extinguishing systems. Accordingly, automatic fire extinguishing systems must be equipped for the entire building if the area of rooms subject to automatic fire extinguishing systems is equal to or greater than 40% of the total floor area. The automatic fire alarm system or equipment equipped for the building must be connected to the database management system on fire prevention and fighting and incident reporting of the Fire Police and Rescue Department according to regulations. When determining the requirements for automatic fire extinguishing systems, automatic fire alarm systems must first determine the requirements for the entire building, then for each item, area and room as well as equipment within the scope of the project; rooms with fire hazard class D; side corridors; stairs; pressurized fire buffer zones, areas without fire hazard. In addition, comply with other regulations in TCVN 5738 Automatic fire alarm system – Technical requirements; TCVN 5760 Fire extinguishing system – General requirements for design, installation and use; TCVN 7161 Automatic fire extinguishing system with water, foam – Design and installation requirements...

Technical systems include electrical systems, ventilation systems, smoke exhaust systems, information cables, optical cables; stairwells for pedestrians, elevator shafts; waste pipes; plastic wastewater pipes, etc. installed synchronously, with fireproof covers, separation between floors, technical pipes between floors. In addition, at higher education institutions, there are also anti-smoke systems, traffic systems, water sources... which also need to comply with relevant fire prevention and fighting regulations and standards such as QC 06:2022/BXD (amended 1:2023); TC3890:2023.

Communication system (speakers, security cameras, LAN, internet, television, telephone, security surveillance). The communication system is directly connected to the duty room, technical room, with a server system to store information, also known as the low voltage system. Here, the duty officer will recognize the fire alarm signal, as well as other signals, observe through the camera system (closed-circuit-television security system – CCTV) to identify where the fire occurs, the direction of development and broadcast the announcement loudspeaker (public address system – PA).

(4) Characteristics of fire and explosion hazards at higher education institutions

At higher education institutions, as mentioned above, there exists a large amount of flammable substances, in many different types. There are flammable substances, some are easy to burn, some are difficult to burn... but when a fire occurs, the fire spreads very quickly. These are the flammable substance systems in libraries, cafeterias, cabinets, paper, information equipment systems such as computers...; these are wooden furniture, decorative objects, plastic, foam, leather goods... in offices, meeting halls... In addition, at higher education institutions, basements are also arranged as parking lots for motorbikes and cars, where a large amount of flammable substances such as gasoline and oil are stored.

Along with flammable substances is a heat source, because in educational institutions, the possibility of forming a heat source causing fire is also very diverse; mainly in the kitchen, this is the largest source of fire and explosion hazard. In addition, laboratory areas, electrical cabinets, garages, electrical outlet areas, etc. always have the potential for heat sources. Due to the characteristics of educational facilities with many types of flammable substances, some places containing large amounts of chemicals in laboratories are very flammable, and the possibility of fire spreading also occurs quickly, if not handled promptly. From the process of forming a dangerous environment for fire and explosion, the fire spreads from one room to another, from one area to another, from one floor to another... is very large. Along with that, the smoke system appears due to many flammable sub-stances spreading with the fire, making escape work more difficult. Therefore, along with not allowing the formation of a dangerous environment, having measures to prevent smoke accumulation in higher education facilities is very important. With the characteristics of fire spreading, smoke gathering... so when designing, accepting, propagating, training... it is necessary to pay special attention to the issue of escape as well as ensuring safety during the escape process by lighting system, by escape stairs, by refuge floors.

2.2. Forecast of related situations and issues arising in fire prevention and fighting

(1) Forecast

– In the coming years, Vietnam's economy will continue to grow at a high speed, the population will grow on a large scale, the people's education level and living standards will be increasingly improved and enhanced, the people's demand for teaching and learning will increase. Therefore, the system of higher education institutions in the whole country will develop further in the coming time to meet the needs of the people.

– According to the planning for the development of higher education institutions up to now, higher education institutions in Vietnam will continue to develop. From that, it can be affirmed that higher education institutions will increase in number and scale, at the same time leading to the diversity and richness of types of higher education institutions. From the perspective of research on fire safety, it shows that the increase in the types of higher education institutions, the construction structure of higher education institutions, the number of works and the functions of the works in higher education institutions will increase the amount of flammable substances in higher education institutions, including flammable substances such as: books, newspapers, chemicals, tables, chairs, blankets, sheets, pillows, mattresses; gasoline, oil; paper, cabinets, computer systems; ... these are the main flammable substances of higher education institutions not only in Vietnam but also in other countries in the world. Therefore, the investment in construction and development of higher education institutions will be increasingly diverse, at the same time the number of accompanying flammable substances will be more diverse

and lead to a higher risk of fire and explosion for higher education institutions. Thus, from the above analysis, it has been shown that, in terms of flammable substances in higher education institutions, not only are they increasing but they are also diverse and abundant, with many flammable items existing.

(2) Some issues arising in the state management of fire prevention and fighting need to be further studied

Proactively advise, propose the promulgation and implementation of legal regulations on fire prevention and fighting for higher education institutions;

Continue to study ways to organize propaganda, dissemination and education of knowledge and laws on fire prevention, fighting and rescue; guide the development of a mass movement to participate in fire prevention, fighting, rescue and rescue;

Research the work of design appraisal and inspection of fire prevention and fighting acceptance for works in higher education institutions;

Strengthen the inspection and strict and thorough handling of violations of regulations on fire prevention and fighting for higher education institutions;

Continue to study the process of organizing, consolidating, maintaining the activities of the grassroots fire prevention and fighting force and improving the quality of professional training for the grassroots fire prevention and fighting force for higher education institutions;

Study the development and practice of fire prevention and fighting plans and fire fighting organization for higher education institutions;

Study the coordination relationship in state management of fire prevention and fighting for higher education institutions...

3. Conclusion

The article presented the research results, including pointing out the characteristics of higher education institutions in Vietnam related to fire prevention and fighting; made predictions and pointed out issues that need further research to improve the effectiveness of state management of fire prevention and fighting for higher education institutions in Vietnam, contributing to ensuring security, safety, and ensuring sustainable development of the education and training sector in Vietnam today.

References

Nguyen Ngoc Anh. (2019). "Overview of the legal system in the field of Fire Prevention, Fire Fighting and Rescue and Directions for Supplementation and Improvement", Proceedings of the scientific conference on Law on Fire Prevention, Fire Fighting and Rescue in Practice and Application, Fire Prevention University, Hanoi.

Dao Huu Dan, Vu Van Binh, Hoang Ngoc Hai. (2021). Theoretical and practical issues on state management of fire prevention and fighting and search and rescue in the current period, Monograph for PhD training, CAND Publishing House, Hanoi.

Hoang Ngoc Hai, Dao Huu Dan. (2020). Monograph on State management of fire prevention and fighting and search and rescue, CAND Publishing House, Hanoi.

National Assembly. (2024). Law on fire prevention and fighting and search and rescue, 2024, Hanoi.

Section 4. Pedagogy

FORMATION OF LANGUAGE COMPETENCE OF STUDENTS AT THE PRESENT STAGE

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Abstract

The formation of language competence of students at the present stage is the most important task of the educational process, since language proficiency determines the success of communication, knowledge acquisition and social adaptation. The article discusses the main approaches to the development of language competence, including communicative, cognitive and activity-based methods. Special attention is paid to the integration of digital technologies, interdisciplinary learning and individualization of educational strategies. The modern challenges associated with the changing language environment are analyzed, and effective methods of improving the level of language competence of students are proposed. The findings emphasize the need for an integrated approach to learning, focused on the development of all aspects of language activity.

Keywords: *language competence, educational strategies, language activity, language environment, effective methods, modern challenges, communicative methods, cognitive methods, activity-based methods*

Introduction

In the modern world, language competence is an integral part of the educational process and a key factor in the successful socialization of an individual. The ability to effectively use language in various communicative situations determines the level of a person's professional and personal realization. With the rapid development of technology and globalization, approaches to the formation of language competence are changing, which requires the adaptation of educational strategies. This article examines modern methods and approaches to the development of language competence of students, as well as the challenges faced by teachers and students.

In the course of the globalization process, which is developing everywhere today, international cooperation between various countries, peoples and, undoubtedly, their cultures is expanding and strengthening, provided that foreign culture is taken into account in terms of the totality of human activities related to all spheres of life. In this regard, solving the

problems of intercultural communication is impossible without the context of interaction and cultural influence. Due to the mastery of a foreign language, a person becomes involved in the process of communication with other people who are representatives of their cultures. Therefore, foreign language learners need to possess not only a multicomponent set of language abilities and skills, but also a willingness to carry out speech activity, which includes the presence of foreign language communicative competence in the totality of all its components, namely linguistic, speech, sociocultural, compensatory and educational-cognitive. It should also be emphasized that language competence serves as the basis for the formation of all components of communicative competence, and an insufficient level of its formation leads to difficulties both in direct communication (listening, speaking) and in indirect communication (writing, reading).

Language competence includes the knowledge, skills and abilities necessary for the adequate use of language in oral and written form. According to the definition proposed by the Council of Europe, linguistic competence consists of several components:

- Linguistic competence – mastery of phonetic, grammatical and lexical norms of a language. Sociolinguistic competence is the ability to use language in accordance with the social context;
- Discursive competence – the ability to build coherent and logically organized statements;
- Strategic competence – the use of various strategies to overcome language difficulties.

These components form the basis of successful language communication and require an integrated approach to learning.

Methods. The main methods of forming students' language competence, which are highlighted by T. I. Skripnikova, are the following:

– the communicative method, which implies natural immersion in the language environment in order to solve a speech problem;

– the structural method, which consists in presenting structural models;

– the deductive method, based on the principle of consciousness and ideally suited for independent work of students-an inductive method based on a form of inference such as induction, i.e. the transition from single factors to general ones;

– an inductive-deductive method suitable for explaining concepts and phenomena that are absent in the native language.

Modern approaches to the formation of language competence

1. A communicative approach One of the most effective methods of language competence formation is a communicative approach based on the practice of real communication. This method involves the use of interactive tasks, dialogues, role-playing games and discussions, which allows students to apply language in natural situations.

2. Cognitive activity approach. Modern research highlights the importance of cognitive processes in language learning. The cognitive activity approach focuses on the development of thinking, the analysis of linguistic structures and the awareness of linguistic patterns. This method helps students not only memorize language rules, but also understand their logic and apply them in practice.

3. Integration of digital technologies at the present stage, digital technologies are becoming an important tool in language teaching. The use of online platforms, mobile applications, virtual simulators and artificial intelligence significantly expands the possibilities of self-study of the language. Electronic educational resources allow you to personalize learning by providing access to authentic materials, interactive tasks, and adaptive tests.

4. Interdisciplinary approach. Important direction in the development of language competence is the integration of language learning with other subjects. For example, the CLIL (Content and Language Integrated Learning) method involves the study of subject subjects in a foreign language, which contributes to the expansion of vocabulary and the development of academic writing and speech skills.

Results

Modern challenges in the formation of language competence Despite the variety of methods, the process of language competence formation faces a number of challenges:

1. Changing the language environment – the development of digital communications leads to a simplification of language norms, a reduction in formal communication and a decrease in the level of written language proficiency.

2. The difference in training levels – the difference in the language experience of students requires flexible educational strategies and an individual approach.

3. The problem of motivation – insufficient motivation to learn a language, especially in conditions of high student workload, requires the introduction of interactive and playful teaching methods.

4. The need to develop critical thinking – the ability to analyze texts, formulate arguments and conduct discussions is becoming an important component of language competence, but requires special training.

The teacher must keep in mind the methodological conditions that ensure the assimilation of the concept.

1. Ensuring the active mental activity of students. It is known that the effectiveness of knowledge acquisition is determined by teaching methods. The reproductive method does not give the desired results, it focuses on memorization. Search methods are more effective.

2. Purposeful work on the development of children's linguistic attitudes towards words and sentences.

3. Ensuring awareness of essential and non-essential features of the concept. Highlighting non-essential features prevents mistakes of false generalization, which is expressed in the fact that students mistake an insignificant feature for an essential one and take it as a guideline for defining a concept. For example, when introducing nouns, only words denoting the names of objects were used, some children did not mark nouns denoting natural phenomena, events, etc.

4. The inclusion of a new concept in the system of previously studied ones.

5. Disclosure of the essence of the connection of language categories in the process of studying a new category.

6. Visual study of the concept. The specificity of visual aids is due to the fact that the object of study are words, phrases, sentences, etc. Therefore, along with tables, diagrams, objects and their images, the linguistic material itself acts as a means of visualization.

Conclusion

The formation of students' language competence at the present stage requires an integrated approach, including communicative, cognitive, digital and interdisciplinary methods. The development of technology and the changing communication environment pose new challenges to education that require the adaptation of learning strategies. In the context of globalization and digital transformation, language competence is becoming an essential skill that ensures successful academic, professional and social activities. Therefore, improving the methods of language teaching and taking into account modern challenges are priority areas for the development of educational systems.

References:

Bear I. L. German. Basic course. Concept, program. – M.: New School, 1995. (In Russian)

I. I. I. Language competence as a component of general cultural competencies in the light of new Federal State Educational Standards // Foreign languages in science and education: Problems and prospects: Sat. scientific. tr. Based on materials I is the international. Scientific and practical. Conf. – Nizhny Novgorod, 2016. (In Russian)

Kayl Yu. A. competence in language education // Experimental and theoretical studies in the 21st century: Problems and development prospects: Materials of the XIII All -Russian. Scientific and practical. Conf.: In 3 hours – Rostov n/d, 2018. (In Russian)

Leontovich O. A. Russia and the USA: Introduction to intercultural communication. – Volgograd.: Change, 2003. (In Russian)

Skripnikova T. I. Methods of forming a language competence in a foreign language [Electronic resource]: a textbook // Far Eastern Federal University, a school of pedagogy. – Electron. Dan. – Vladivostok.: Far Eastern Federal University, 2017. (In Russian)

Surygin A. I. Fundamentals of the theory of learning in a non -native language. – St. Petersburg: Zlatoust, 2000. Khomsky, N. Language and thinking. – M.: Moscow State University, 1972. (In Russian)

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FORMATION OF LANGUAGE COMPETENCE OF STUDENTS AT THE PRESENT STAGE

SIGNIFICANCE OF DISCURSIVE COMPETENCE IN ENHANCING ORAL COMMUNICATION SKILLS

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Abstract

Discursive competence plays a crucial role in enhancing oral communication skills by enabling individuals to effectively structure discourse, maintain coherence, and engage in meaningful interactions. It encompasses the ability to use appropriate linguistic and pragmatic strategies to manage conversations, express ideas clearly, and respond to social and cultural contexts. Mastering discursive competence allows speakers to navigate various communicative situations, adapt to different discourse genres, and maintain fluency and cohesion in speech. This paper explores the significance of discursive competence in developing oral proficiency, highlighting its impact on effective communication, language learning, and intercultural interactions. Through a comprehensive analysis, the study underscores the necessity of integrating discursive competence into language education to foster confident and articulate speakers.

Keywords: *discursive competence, structure of discursive competence, criteria and factors for the formation of discursive competence, monitoring, interactive teaching methods, oral speech, communicating in oral speech*

Introduction

In today's world, successful communication is becoming one of the key factors of social and professional fulfillment. A special place among communication skills is occupied by discursive competence, which allows a person not only to competently construct statements, but also to effectively participate in a dialogue, observing the logical and semantic integrity of speech. This article examines the importance of discursive competence in improving oral communication, as well as its impact on successful interaction in various communicative situations. The concept of discursive competence Discursive competence is one of the components of communicative competence and includes the ability to build a coherent, logically organized and meaningful statement, as well as adequately perceive the speech of the interlocutor. This skill covers the use of various linguistic means, knowledge of the norms of dialogue and monologue, the ability to observe the structure of the text, as well as the ability to adapt speech to the context of communication.

Based on an analysis of the literature on discursive competence in the pedagogical process, we came to the conclusion that

discursive competence is almost not considered in recent studies. In order to define the term "discursive competence", consider the meaning of the concepts "discursive" and "competence". Discursive is defined as (Celce-Murcia, Marianne. 2007).

– "Discussing a controversial issue to clarify different points of view; debate" (Shuman, E. V.);

– "Public discussion of any controversial issues, scientific problems, aimed at finding the optimal mutually acceptable solution" (Milrud R. P., 2007);

– "Public discussion, during which, by comparing different points of view, a consensus is sought for perhaps the correct solution to the controversial question" (Cholak V. V., 2014) and others.

Thus, the definition of discursive as a communicative activity can be divided into two groups:

1) dispute, discussion of any issue, that is, the discussion is viewed as a process;

2) a way to solve an issue or problem through discussion, respectively, the discussion is considered as the form of activity to achieve the goal is to solve the problem. And, we will use the second definition in our work (Hymes, D., 1971).

The structure of the discussion speech includes the statements of the participants in the discussion and the moderator. Discussion speech is characterized by lexical, phraseological, morphological and syntactic norms. The following requirements are imposed on a discussion speech: correctness, accuracy, clarity, consistency, simplicity, wealth, purity, euphony, communicative expediency and relevance (Skibitsky E. G., Kholina L. I., 2016).

The opinion of many authors allows to effectively develop different competencies. For example, A. A. Leontyev believes that discussion and argumentative skills are necessary for the development of both communicative and intellectual self-sufficiency, personality (Cholak V. V., 2014). L. V. Murzenko talks about the development of communication skills with the help of discussion used in intercultural projects, as well as those discussions make it possible to get to know the studied person better, language and take a detached view of your culture (Hymes, D., 1971). We have analyzed the works devoted to discursive competence, and we can conclude that many authors agree that discursive competence is part of a broader communicative competence. For example, V. K. Ivanov argues that "the discussion contributes to the development and strengthening of speech communication skills and phenomena (communicative competence)", as well as that "discussion speech is one of the significant components of the communicative and professional competence of students" (Skibitsky E. G., Kholina L. I., 2016).

The role of discursive competence in the development of oral speech:

1. Improving the coherence and consistency of statements Developed discursive competence allows the speaker not only to formulate individual phrases correctly, but also to link them into a meaningful and structured utterance. This is especially important in situations that require a detailed explanation, argumentation, or narrative.

2. Improving the effectiveness of interaction A person with high discursive competence is able to take into account the communicative intentions of the interlocutor, anticipate possible questions and adjust his speech in the process of communication. This helps to communicate information more accurately and clearly, and also reduces the likelihood of misunderstandings.

3. Developing the ability to argue an important aspect of discursive competence is the ability to logically build arguments, consistently express thoughts and use linguistic means to strengthen one's position. These skills are especially important in the professional field, scientific discussions and public speaking.

4. Adaptation to different communication situations the owner of a developed discursive competence is able to choose appropriate language tools depending on the communicative situation. For example, in formal conversations he will adhere to strict norms of speech etiquette, and in informal communication he will use more free and colloquial forms of expression.

Methods

Ways to develop discursive competence

The development of discursive competence is possible through comprehensive exercises and targeted training. Among the most effective methods are:

- Analysis of speech samples – the study and analysis of texts of various genres helps to understand the principles of organization of coherent utterance;
- The practice of oral speech – participation in discussions, role-playing games and public speaking helps to improve the skills of constructing statements;
- Development of retelling skills – presenting what you read or heard in your own words allows you to improve the structuring of speech;
- Cohesion training – purposeful work on the means of communication between sentences and parts of the text.

Results

Discursive competence plays a key role in the development of oral communication, as it allows a person to build coherent, logically organized and meaningful statements. It promotes effective interaction, reasoned presentation of thoughts and adaptation to various communicative situations. The development of this type of competence should become an important part of the educational process, since the mastery of discourse determines the level of success of a person in the social, professional and personal spheres.

The methodological basis of the comprehensive approach is made up of the following guiding principles: consistency, complexity, unity of theory and practice, comprehensiveness, concreteness, practical usefulness, development and integrity. When developing the methodological, theoretical, normative and methodological provisions of an integrated approach, as well as the multidimensionality of the process of forming students' discussion competence, the general scientific principles of subject-competence, integrative-developing, individually differentiated and context-modular approaches were used, which mutually enrich and complement each other and take into account the specifics (social order, conditions, pedagog-

ical support, didactic support and monitoring) of the formation of the discursive competence of students.

In the formation of discursive competence, students need to take into account the factors that can affect the results of educational work. Based on the analysis of scientific literature and our own observations, we were able to identify the following factors affecting on the formation of discursive competence among students for developing oral speech:

– the level of preparation of students in the studied areas of knowledge;

– learning objectives and educational the trajectory must be built based on group level analysis;

– learning objectives should, on the one hand, contribute to the development of knowledge, on the other sides, do not be overly complex in order to do not reduce the motivation of students.

Conclusion

Discursive competence plays an important role in the development of oral communication skills, as it allows a person not only to formulate individual phrases correctly, but also to create coherent, logically organized and meaningful statements. It ensures effective communication, promotes accurate information transmission and helps to adapt to various communication situations. The development of discursive competence is especially important in modern society, where oral communication is a key factor for success in professional, educational and social spheres. Learning the skills of building coherent speech, using strategies of interaction and argumentation, as well as the practice of oral communication help to form confident and competent interlocutors. Thus, the improvement of discursive competence should be considered as an important aspect of language education, since it contributes not only to the development of speech, but also to the general intellectual and communicative growth of personality.

References

Celce-Murcia, Marianne. 2007. "Rethinking the Role of Communicative Competence in Language Teaching." In Intercultural Language Use and Language Learning, ed. by Eva Alcón Soler, and Maria Pilar Safont Jordà, – P. 41–57. Dordrecht: Springer

Cholak V. V. Interactive learning // Problems of modern science and education. 2014. – 3 (21). – P. 102–105.

Hymes, D. "Competence and Performance in Linguistic Theory". In R. Huxley and E. Ingram (eds.) Language Acquisition: Models and Methods. – London: Academic Press. 1971.

Milrud R. P. English Teaching Methodology. – M.: Drofa, 2007. – 182 p.

Shuman, E. V. Opportunities and prospects of intercultural communication in German at school [Electronic resource] / E. V. Schumann // International scientific and practical (electronic) journal INTER-CULTUR @ L-NET.

Skibitsky E. G., Kholina L. I. Development creative potential of undergraduates in education educational process of the university // Continuous education of professional education: theory and practice: collection of articles based on materials of the VII International scientific and practical conference of teachers, givers, graduate students, undergraduates and undergraduate / under total. ed. Dr. ped. sciences, professors. E. G. Skibitsky. – Novosibirsk: SAFBD, 2016. – 387 p.

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ORGANIZING EDUCATION WITH ARTIFICIAL INTELLIGENCE IN THE 21ST CENTURY: NEW APPROACHES AND OPPORTUNITIES

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Abstract

Artificial intelligence (AI) technologies are being successfully applied in various fields, including education, virtual healthcare assistants, and online store management. This article analyzes the integration of AI tools into educational systems, evaluating innovative approaches and their potential to enhance the educational process. The COVID-19 pandemic accelerated the entry and development of artificial intelligence in education. After the pandemic forced students and teachers to switch to online or hybrid learning, it became evident that these technologies could provide new opportunities in education. The use of artificial intelligence in online classes has created the possibility for independent learning of educational programs and for students to freely address emerging challenges. Additionally, AI allows for the creation of individualized learning plans, enhances student engagement in the learning process, and simplifies complex assignments. The effectiveness of AI tools is significant not only in optimizing the process between teachers and students but also in developing the education system as a whole. In this article, we will explore how applying modern trends can advance this field.

Keywords: *artificial intelligence, machine learning, higher education, intelligent tutoringsystem, natural language processing, student engagement, administrative tasks, virtual assistants*

Introduction

Artificial Intelligence (AI) is transforming nearly every sector, and education is no exception (Yeruva, 2023). AI has the potential to revolutionize teaching and learning by making it more personalized, engaging, and efficient (Alneyadi, Wardat, Alshannag, & Abu-Al-Aish, 2023). In this review, we will examine the role of AI in education and how it impacts the learning process.The use of AI in education refers to the application of artificial intelligence technologies, such as machine learning and natural language processing, to enhance the teaching and learning process (Alneyadi et al., 2023). This involves leveraging algorithms that analyze data, identify patterns, and make predictions, enabling educators to personalize learning experiences for each student (Khan et al., 2022).

The benefits of implementing AI in education are notably significant. Personalized learning is one of the most prominent advan-

tages of AI in education, as it allows students to learn at their own pace and in ways that suit their individual learning styles, ultimately improving their academic outcomes (Shrivastava et al., 2023). Intelligent tutoring systems, chatbots, and automated assessment tools can enhance efficiency, save educators' time, and provide more accurate and consistent feedback.

At the same time, there are several challenges associated with the use of AI in education. Issues such as privacy and security concerns, lack of trust, costs, and potential biases need to be addressed (Jarrah, Wardat, & Gningue, 2022). Additionally, ethical considerations, such as ensuring equity, transparency, and fairness in AI-based educational systems, must be taken into account (AlArabi, Tairab, Wardat, Belbase, & Alabidi, 2022; Tariq et al., 2022). Despite these challenges, the potential of AI in education remains immense (M Al-Bahrani, Gombos, & Cree, 2018). AI enables better analysis of educational data, providing educators with the tools to make data-driven decisions. Moreover, AI can enhance student engagement by delivering interactive and engaging learning experiences (Yang et al., 2022; Wardat, Belbase, & Tairab, 2022). With the help of AI, education can become more inclusive and equitable, enabling learners from diverse backgrounds to access high-quality educational opportunities.

In the subsequent sections of this article, we will delve into various applications of AI in education, including personalized learning, intelligent tutoring systems, chatbots, and automated assessment processes. Furthermore, we will examine the advantages and challenges associated with the implementation of AI in education, as well as the ethical considerations that warrant attention. Finally, we will analyze the future prospects of AI in education and the opportunities it offers for fostering innovation and growth.

Method research

In this study, a descriptive and qualitative data collection and analysis method was chosen as the research approach. The data utilized in this research is qualitative in nature and categorized into two types: primary data and supplementary data. The sources of data were gathered through a library research approach, which involved credible online and offline platforms such as scholarly articles, literature, and news reports. These sources were systematically organized by linking and discussing the information.

The methods employed for data collection in this study included observation, interviews, and exploration. The collected data was thoroughly analyzed, and generalized conclusions were drawn based on the findings.

Result and discussion
Personalized Learning

The involvement of artificial intelligence (AI) in education has paved the way for the implementation of personalized learning, fundamentally transforming the ways in which students acquire knowledge (Rana, 2022). Personalized learning refers to an educational approach that is tailored to each student's strengths and weaknesses, individual needs, and interests (Samad, Hamza, Muazzam, Ahmer, et al., 2022). This approach leverages technology to adapt the learning process to each student's level and pace of comprehension (Zarei et al., 2022).

In personalized learning, AI plays a crucial role. Using machine learning algorithms, AI analyzes students' interests, behaviors, and academic performance, and processes data to identify patterns and trends (Samad, 2022). Based on this data, AI can then provide learning methods that align with the specific needs of each student (Samudrala et al., 2022). For example, AI can present learning materials, identify areas that require further development, and adjust or simplify the complexity level of tasks accordingly.

One of the key advantages of personalized learning is that it provides each student with the necessary support and guidance to maximize their potential. This approach helps struggling students acquire knowledge, while offering advanced learners the opportunity to further improve at their own level (Gningue, Peach, Jarrah, & Wardat, 2022). By offering a personalized learning experience, students are more engaged, which can lead to higher academic performance and improved retention rates (Al-Abboodi, Fan, Mahmood, & Al-Bahrani, 2021). AI-based learning platforms can provide personalized learning experiences in several ways (Ibra-

him, Al-Awkally, Samad, Zaib, & Hamza, 2022). For instance, AI can analyze students' past performance to identify difficulties and offer targeted solutions to address them (Alarabi & Wardat, 2021). Additionally, AI can adapt to students' learning pace, slowing down or speeding up the instruction as necessary (Mohammed Al-Bahrani, Alhakeem, & Cree, 2020). Furthermore, AI offers personalized feedback based on students' achievements, providing suggestions for improvement, which leads to a more individualized and effective learning experience. AI-based personalized learning has been successfully implemented in various educational settings, such as K-12 schools, higher education, and corporate training (Mohammed, Samad, & Omar, 2022). For example, Carnegie Learning's AI-powered math software has been shown to improve student performance in mathematics by up to 30%. Similarly, Duolingo's AI-based language learning platform provides a personalized learning experience tailored to each student's knowledge level, interests, and learning style (Al-Bahrani, Majdi, Abed, & Cree, 2022).

Despite the significant potential of AI-based personalized learning, several challenges need to be addressed. The first issue is the need for accurate and reliable data to effectively utilize AI algorithms (Wu et al., 2022). The quality of the data can negatively impact the precision and effectiveness of the personalized learning process, so ensuring the data is current and accurate is essential. The second challenge is the need for training and professional development for educators to successfully implement personalized learning using AI technologies (Zahmatkesh et al., 2022). Teachers also need to learn how to apply AI tools and interpret the data generated by the algorithms. AI-based personalized learning has the potential to enhance the learning process and help students reach their full potential. Personalized learning provides tailored support for each student, leading to improved academic outcomes, stronger retention, and increased engagement. Additionally, AI monitors students' progress, offering personalized feedback and suggestions, which further individualizes the learning experience and enhances its effectiveness (Jarrah, Almassri, Johnson, &

Wardat, 2022). While addressing the existing challenges is necessary, the opportunities and benefits of AI-based personalized learning in education are substantial and promising (Balamurugan et al., 2022) (Anjan Kumar, Singh, & Al-Bahrani, 2022).

Chatbots are software tools designed to facilitate human interaction, enabling communication with users through text-based or voice interfaces (Sreenivasu et al., 2023). In recent years, chatbots have been increasingly utilized in the field of education, providing personalized assistance to students, automating administrative processes, and creating new opportunities for learning engagement (Yeruva, Choudhari, et al., 2022).

One of the key advantages of employing chatbots in education is their ability to deliver tailored support to students. Acting as virtual mentors, chatbots provide instant feedback, answer questions, and serve as guiding tools to manage students' learning processes (Sridhar et al., 2022). Furthermore, chatbots recommend personalized learning resources, identify areas requiring improvement, and monitor students' progress, ensuring a more individualized and effective educational experience.

Another significant benefit of utilizing chatbots in education is their capability to automate administrative tasks (Mohammed Al-Bahrani, Bouaissi, & Cree, 2022). Chatbots can handle routine tasks such as creating schedules, generating timetables, inputting grades, and responding to frequently asked questions. This functionality helps save educators' time, enabling them to focus on higher-value responsibilities, such as organizing instructional activities and mentoring students (Gningue et al., 2022). Automation through chatbots also minimizes administrative errors and inconsistencies, ensuring that tasks are completed efficiently and accurately.

Moreover, chatbots have the potential to enhance student engagement in educational settings by introducing innovative tools and methods (Patil, Raut, Pande, Yeruva, & Morwani, 2022).

By providing a conversational interface, chatbots can make learning more interactive and engaging, promoting active learning andincreasing student motivation. Chatbots transform the educational process into an interactive and engaging experience by providing

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conversational interfaces, thereby enhancing active learning and boosting student motivation. Additionally, chatbots can be utilized to gamify the learning process, offering rewards and incentives for completing tasks and achieving educational goals (Stoica & Wardat, 2022).

However, there are certain challenges associated with the use of chatbots in education that must be addressed (Abbas, Al-Abady, Raja, Al-Bonsrulah, & Al-Bahrani, 2022). One major challenge is the necessity of designing chatbots with a student-centered approach, considering learners' needs, interests, and learning styles (Al-Abboodi, Fan, Mhmood, & Al-Bahrani, 2022). Furthermore, chatbots must be designed to ensure accessibility, enabling all students to utilize and benefit from the technology. Another critical issue is ensuring the accuracy and reliability of chatbots, as they must provide correct information and avoid errors or biases.

Currently, numerous educational institutions and organizations have implemented chatbot technologies in their learning systems (Reddy Yeruva et al., 2023). For instance, Georgia State University launched a chatbot named "Pounce," which offers personalized services to students by answering questions and providing guidance on academic and administrative matters. Similarly, the University of Adelaide in Australia developed a chatbot called "MyUni," which supports students with administrative tasks such as enrollment, timetables, and course information (Mohammed Al-Bahrani, 2019; Yeruva, Durga, et al., 2022). Additionally, the language-learning chatbots on the Duolingo platform enhance students' educational experiences by providing conversational language practice and personalized feedback (Gningue et al., 2022).

Utilizing Artificial Intelligence in Grading and Assessment Processes

Artificial intelligence facilitates the automation of grading and assessment processes, providing students with rapid feedback while saving educators significant time and resources (AlAli, Wardat, & Al-Qahtani, 2023). AI systems evaluate students' work and deliver feedback based on pre-established criteria, ensuring learners receive immediate and constructive insights on their performance (M Al-Bahrani et al., 2018; Li et al., 2022). A notable example of AI-powered automated grading is the implementation of automated essay grading systems (Stoica & Wardat, 2021). These systems leverage natural language processing and machine learning algorithms to analyze student essays, delivering instant evaluations and scores.

The Benefits of Artificial Intelligence in Education: Personalized Learning, Enhanced Efficiency, Increased Student Engagement, and Advanced Data Analysis

The integration of AI into education offers a range of significant benefits, including the following:

Personalized Learning

AI enables the provision of tailored educational experiences for individual students, adapting to their unique needs, abilities, and learning preferences. This personalized approach enhances learning outcomes and fosters greater engagement among learners.

Enhanced Efficiency

By automating repetitive tasks such as grading, data analysis, and administrative functions, AI reduces the workload of educators and students. This efficiency allows stakeholders to focus on more meaningful and impactful activities within the educational process.

Improved Student Engagement

Artificial intelligence plays a significant role in enhancing student engagement by creating interactive and captivating learning environments. For instance, chatbots and virtual assistants can make the learning process more enjoyable and interactive, while adaptive learning technologies present materials at a student's comprehension level, thereby increasing their involvement.

Enhanced Data Analysis

AI is capable of analyzing large volumes of data, offering deep insights into student performance. This allows educators to better understand their students and adapt their teaching methods to meet individual learning needs. Consequently, this can lead to improved educational outcomes and better overall student performance.

Challenges of Using AI in Education
Privacy and Security Concerns

The collection and analysis of substantial amounts of personal data from students could present risks if this information falls into the wrong hands. Educational institutions must take appropriate measures to safeguard students' privacy and protect against data breaches.

Trust Issues

Some students may hesitate to accept grades or feedback generated by AI systems, preferring human evaluation. It is essential to build trust with students and make them feel comfortable with the technology.

Cost Considerations

Implementing and maintaining AI systems can be costly, posing a challenge for educational institutions that are already dealing with budget constraints. Institutions must carefully evaluate the financial implications and benefits of incorporating AI into their classrooms.

Potential Bias

AI systems can be biased, especially if they are trained on inaccurate or prejudiced data. Ensuring that AI algorithms are fair and unbiased is a key challenge in their effective use in education.

Ethical Considerations
in AI in Education

The implementation of AI in education presents several ethical challenges that must be carefully addressed to ensure the fair and equitable use of technology. One of the most significant concerns is **ensuring accessibility**. AI-based educational systems must be designed with inclusivity in mind, ensuring that all students, including those with disabilities, can access and effectively use the technology. This commitment to accessibility ensures that no student is excluded from the educational opportunities AI offers.

Transparency is another crucial ethical consideration. AI systems must operate with transparency, providing clear explanations about how decisions are made and why certain outcomes occur. This transparency is essential to build trust between students and AI systems, enabling students to feel confident in the fairness and reliability of the technology they interact with.

Moreover, **fairness** is a central ethical principle in AI education. AI-driven educational platforms must ensure that all students are treated equally, without bias based on factors such as race, gender, or socio-economic status. It is vital that AI systems are developed and deployed in a manner that does not perpetuate existing inequalities, but instead fosters a fair and supportive learning environment for every student.

The Future of AI in Education

The future of AI in education is poised to bring about significant transformation. AI has the potential to make education more personalized, efficient, and effective by adapting to the individual needs of students. In the near future, we can expect more advanced AI systems capable of understanding and responding to human emotions, offering more nuanced feedback, and even creating tailored lesson plans for each student, thereby enhancing the learning experience.

Conclusion

While the integration of AI into education brings with it many potential benefits, such as personalized learning and improved efficiency, it also presents several challenges that need to be carefully considered. Educational institutions must thoroughly evaluate the costs and benefits of implementing AI systems in classrooms and take the necessary steps to protect students' privacy, mitigate potential biases, and ensure the ethical deployment of AI technologies. By addressing these concerns, we can create a more personalized, efficient, and equitable educational environment that benefits all students.

References

Abbas, Ehsan F., Al-abady, Abdulnasser, Raja, Vijayanandh, AL-bonsrulah, Hussein A. Z., &Al-Bahrani, Mohammed. (2022). Effect of air gap depth on Trombe wall system us-ingcomputational fluid dynamics. International Journal of Low-Carbon Technologies, 17,941–949.Al-2.Abboodi, Hamid, Fan, Huiqing, Mahmood, Ibtihal A., & Al-Bahrani, Mohammed. (2021).Experimental Investigation and Numerical Simulation for Corrosion Rate ofAmorphous/Nano-Crystalline Coating Influenced by Temperatures. Nanomateri-als, – 11(12). – 3298 p.

Al-Abboodi, Hamid, Fan, Huiqing, Mhmood, Ibtihal A., & Al-Bahrani, Mohammed. (2022). The dry sliding wear rate of a Fe-based amorphous coating prepared on mild steel byHVOF thermal spraying. Journal of Materials Research and Technology, – 18. – P. 1682–1691.

Al-Bahrani, M, Gombos, Z. J., & Cree, A. (2018). The mechanical properties of functionalised-MWCNT infused epoxy resin: A theoretical and experimental study. Int. J. Mech.Mecha-tronics Eng, – 18. – P. 76–86.

Al-Bahrani, Mohammed. (2019). The Manufacture and Testing of Self-Sensing CNTsNano-composites for Damage Detecting Applications. University of Plymouth.

Al-Bahrani, Mohammed, Alhakeem, Mohammed Ridh H., & Cree, Alistair. (2020). Damagesens-ing and mechanical properties of a laminate composite material containing MWCNTsduring low-velocity impact. Journal of Petroleum Research and Studies, – 10(4). – P. 147–164.

Al-Bahrani, Mohammed, Bouaissi, Aissa, & Cree, Alistair. (2022). The fabrication and test-ingof a self-sensing MWCNT nanocomposite sensor for oil leak detection. International-Journal of Low-Carbon Technologies, – 17. – P. 622–629.

Al-Bahrani, Mohammed, Majdi, Hasan Shakir, Abed, Azher M., & Cree, Alistair. (2022). Anin-novated method to monitor the health condition of the thermoelectric cooling systemus-ing nanocomposite-based CNTs. International Journal of Energy Research, – 46(6). – P. 7519–7528.

AlAli, Rommel, Wardat, Yousef, & Al-Qahtani, Mohammed. (2023). SWOM strategy andinflu-ence of its using on developing mathematical thinking skills and on metacognitivethink-ing among gifted tenth-grade students. EURASIA Journal of Mathematics, Scienceand Technology Education, – 19(3). – em2238.

Alarabi, K., & Wardat, Y. (2021). UAE-based teachers' hindsight judgments on physicsedu-cation during the COVID-19 pandemic. Psychology and Education Journal, – 58(3). – P. 2497–2511.

AlArabi, Khaleel, Tairab, Hassan, Wardat, Yousef, Belbase, Shashidhar, & Alabidi, Suzan. (2022). Enhancing The Learning of Newton's Second Law Ofmotion Using Computer Sim-ulations. Journal of Baltic Science Education, – 21(6).

Alneyadi, Saif, Wardat, Yousef, Alshannag, Qasim, & Abu-Al-Aish, Ahmad. (2023). Theeffect of using smart e-learning app on the academic achievement of eighth-gradestudents. EUR-ASIA Journal of Mathematics, Science and Technology Education, – 19(4). – em2248

Balamurugan, Rohini Janaki, AL-bonsrulah, Hussein A. Z., Raja, Vijayanandh, Kumar, Lokeshkumar, Kannan, Sri Diviyalakshmi, Madasamy, Senthil Kumar, Rasheed, Raffik, Rajendran, Parvathy, & Al-Bahrani, Mohammed. (2022). Design and multiperspectivity-based performance investigations of H-Darrieus vertical axis wind turbine throughcom-putational fluid dynamics adopted with moving reference frame approaches.International Journal of Low-Carbon Technologies, – 17. – P. 784–806.

Gningue, S. M., Peach, R., Jarrah, A. M., & Wardat, Y. (2022). The Relationship betweenTeacher Leadership and School Climate: Findings from a Teacher-Leadership Project.Educ. Sci. 2022, – 12, – 749 p. Note: MDPI stays neutral with regard to jurisdictional claimsin published.

Ibrahim, Hamza Khalifa, Al-Awkally, Noor Alhooda Milood, Samad, Abdul, Zaib, Waqar, &Hamza, Muhammad. (2022). Covid-19 Pandemic and Its Impact on Psychological Dis-tress, Malignancy and Chronic Diseases: A Scoping Review. Eduvest-Journal OfUniversal Studies, – 2(5). – P. 1017–1021.

ORGANIZING EDUCATION WITH ARTIFICIAL INTELLIGENCE IN THE 21ST CENTURY

Jarrah, Adeeb M., Almassri, Haneen, Johnson, Jason D., & Wardat, Yousef. (2022). Assessingthe impact of digital games-based learning on students' performance in learning fractionsusing (ABACUS) software application. EURASIA Journal of Mathematics, Science andTechnology Education, – 18(10). – em2159.

Jarrah, Adeeb M., Wardat, Yousef, & Gningue, Serigne. (2022). Misconception on additionand subtraction of fractions in seventh-grade middle school students. Eurasia Journal ofMathematics, Science and Technology Education, – 18(6). – em2115.

Khan, Muhammad Farooq, Ahmed, Haron, Almashhadani, Haidar Abdulkareem, Al-Bahrani, Mohammed, Khan, Asif Ullah, Ali, Sharafat, Gul, Nida, Hassan, Tajamul, Ismail, Ahmed,& Zahid, Muhammad. (2022). Sustainable adsorptive removal of high concentrationorganic contaminants from water using biodegradable Gum-Acacia integrated magnetitenanoparticles hydrogel adsorbent. Inorganic Chemistry Communications, – 145. – 110057 p.

Kumar, Anjan, Singh, Sangeeta, & Al-Bahrani, Mohammed. (2022). Enhancement in powerconversion efficiency and stability of perovskite solar cell by reducing trap states usingtrichloroacetic acid additive in anti-solvent. Surfaces and Interfaces, – 34. – 102341 p.

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Section 5. Philology and linguistic

LINGUISTICS AND LOGIC: PROS AND CONS

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Abstract

The article is devoted to the study of the interconnection between linguistics and logic. To analyze linguistic material we propose the use of taxonomic methods within a holistic systemic logical approach, structural and combinatorial analysis, object recognition, comparative analysis, modeling in the form of graph-schematic representations of linguistic constructions and more. Principles of a new interpretation of the problem of parallel semantic and structural study of linguistic expressions are proposed. Based on the logical-functional conjunctive, disjunctive and implicative properties of linguistic objects, we present a new, to some extent, universal functional-linguistic model of natural language.

Keywords: *linguistics, logic, function, relation, clustering, recognition, modeling*

Introduction

Natural language is a multifaceted multifunctional system in which the formal and semantic-content connections of its elements are intertwined within a hierarchical structure. The meaning of a word is closely tied to the constantly changing reality and is characterized by particular flexibility. At the same time, language conveys the totality of knowledge, thought, will and emotions. Within the system of language there are certain logical relationships between signs, where each sign is determined by all the others, and such relationships are the object of study for structuralists. Modern linguistics has increasingly focused on the internal systemic relationships and connections within language itself. A necessary intermediate step for identifying these relationships is the description, analysis, and synthesis of formal-content interconnections and the properties of linguistic constructions and units of varying complexity. At this stage, the relationship between linguistics and various related fields in the humanities and natural sciences begins to play a crucial role as linguistic rules and categories are closely interconnected with logical thinking. Semantic completeness – the potential ability to express arbitrary information in any natural language – is achieved through the indispensable presence of certain signifying tools that express conjunctive, disjunctive, conditional relationships and negation.

Traditional and current questions in linguistics are deepened, expanded and enriched by ideas, opportunities and methods applied in other scientific disciplines, which become new tools for linguistics itself. As a result of such interactions linguistics primarily "retains" and "integrates" only those concepts and research methods whose application proves rational and appropriate. The autonomy of linguistics as an integral science provides the foundation for extracting necessary elements and pragmatic simple and complex models from a wide range of related sciences. Within linguistics new definitions and concepts borrowed from other sciences acquire specific characteristics. The study of the application of definitions and principles from the exact sciences to linguistics has revealed certain limitations of this apparatus in representing and describing many linguistic phenomena. Consequently, the need arises to reconsider the relationship between linguistic and applied methods and to incorporate additional logical tools. Linguistics and logic are distinctly defined in terms of their objects and capabilities; however, they converge and become adjacent, as the analysis of natural language utterances is a consequence of the cognitive process. In linguistic research the use of logical concepts requires their clear definition and unambiguous interpretation. However, it has been found that this apparatus is insufficient for representing and describing all the subtleties of linguistic phenomena. An in-depth, holistic and fundamental analytical study of certain linguistic constructions with complex structures is a linguistic task. This task involves identifying and extracting the general properties and internal needs of language as a system of relationships without the formal-mechanical use of the logical-mathematical apparatus. So, Saussure noted: "Linguistics is closely connected with several other sciences, which at times borrow its data, while at other times provide their own to it. The boundaries separating it from these sciences are not always entirely clear" (Sossure, 1997).

Research methods

The application of methods from natural sciences cannot transform linguistics into a purely deductive or inductive science, as empirical linguistic material is widely used in linguistic research. In some cases it may become necessary to adapt the existing logical apparatus to linguistic tasks, create new models, develop new analytical expressions for specific linguistic patterns. Modifying this apparatus and methods for linguistics is a challenging task, as it requires describing elements of live language using rather abstract terms and tools. Appropriate adaptation is only possible, if these elements are semantically equivalently characterized by the proposed formal-content language. Otherwise, logical-formal methods cannot fully reflect the depth and diversity of language. In structural-semantic research of linguistic objects the use of a special language – a metalanguage – is often necessary. This metalanguage does not complicate the understanding and explanation of the object language, but serves as a system of concepts for its description and study. Not all terms in traditional grammar meet the requirements of new approaches to studying certain linguistic phenomena, and therefore they must be replaced with a new system of terms. It is known, that the metalanguage of linguistics is a special semiological system used, when speaking about language itself as the object language. The elements of the metalanguage rely on the words of the object language to explain the meanings of the corresponding concepts being studied in relation to the surrounding reality. A distinguishing feature of the metalanguage is its ability to describe the properties and relationships of elements within a specific sublanguage domain. The meanings and senses of sublanguage words used in scientific research often require expansion and additional processing. In logical-linguistic research metalanguage concepts such as *statement, true, false, relation, function, class, cluster, recognition, image* and among others are used (Anderson, 2001; Clustering and Classification, 1999; Xu, Wunsch, 2009).

One of the significant factors of referential semantics is the correlation of a statement with reality, conveyed through the metalanguage terms *true* and *false*. In natural language statements the meanings of true and false are contextually determined and can be concrete, absolute, relative or hypothetical. The words *truth* or *fact*, which convey reliable information, are interconnected with their antonyms *falsehood* or *lie*. It should be

noted, that in artistic literature these words often carry specific contextual meanings.

The word *relation*, used in natural language, is also a metalanguage term and aligns with the logical concept of *relation*. Logical relations include *binary relations*, among others. In many linguistic statements relationships between subjects and objects can be represented using the logical-mathematical concept of a binary or bilateral relation. Applying this concept to natural language clarifies many issues related to examining the multifaceted and multidirectional interconnections of related sides, objects, phenomena, processes in nature, society and thought from the perspective of logical-semantic syntax. It is worth noting that these relations in linguistic statements can be explicit or implicit and are determined by context. In addition to binary relations, *multidimensional relations* can also be applied in linguistic research. In most cases, the order of elements in relations plays a significant role.

In many cases the semantics of simple and complex sentences can be represented by equivalent logical functions *of negation, conjunction, disjunction, exclusive disjunction, implication,* reverse implication and others, which are also elements of the metalanguage. These functions involve variables and the functions themselves, both of which can take on true or false values. Logical functions, as statements, can serve as formal and substantive tools for representing and analyzing linguistic expressions (Hakobyan, 2017). Logic demonstrates that all logical statements can be constructed using the functions of conjunction, disjunction and negation, as they form a complete system. Through substitution or superposition, all possible logical connections can be expressed.

In linguistic constructions, alongside logical functions and relations, logical methods developed in pattern recognition theory are widely used. These methods are applied in various fundamental theoretical and applied studies. In particular, cluster analysis is one of the key research methods and represents one of the oldest and most complex scientific endeavors. The theoretical results obtained in this area have broad practical applications for systematic material organization in various fields of science and technology. Tasks

and methods of clustering and recognition are also relevant in studying natural language, where a detailed, comprehensive analysis of a large volume of initial linguistic data is required. In linguistics objects or patterns may include constructions and units of different linguistic levels, such as words, phrases, simple or complex sentences, that meet specific formal or substantive properties. The initial linguistic data are processed and presented in the necessary formal-content format. The classification of linguistic units involves two research approaches: from form to meaning and from meaning to form. For example, in hierarchical clustering of complex sentences grammatical units with their formal structure and substantive meaning are the foundation, reflecting the application of these two traditional research approaches.

The task of clustering involves creating clusters in which elements within the same cluster are more similar and closer to each other in certain parameters, than to elements in other clusters. The initial stage of any clustering process involves grouping elements based on formal-content features. Clusters may consist of groups or classes. Groups are characterized by common quantitative-formal features, while classes are defined by qualitative-substantive characteristics of the included patterns.

Numerous clustering algorithms have been developed, and one is chosen for each specific case. It is important to note, that the final result provides an accurate and adequate picture only if the initial properties of the object were reliably, logically and linguistically correctly selected by the researcher. The number of clusters may be known in advance, simplifying the process. However, when the number of clusters is unknown, the process becomes more complex and requires the development of additional specific methods.

The task of recognition is based on functional-logical and structural-geometric research approaches and involves determining the affiliation of a certain pattern to one of the predefined clusters to which the given linguistic object belongs. The recognition system algorithm may rely on the principle of feature commonality, when formed clusters are characterized by shared properties inherent to all their members.

The functional-logical approach assumes representing the semantics of a linguistic object through a specific functional connection, which allows sentences characterized by the same logical function to be grouped within each cluster. Recognizing a specific linguistic pattern requires thorough, deep formal-content analysis to identify properties and characteristics that help associate it with one or more predefined clusters containing patterns with similar features.

The structural-geometric or graphical approach represents the structure of the studied objects geometrically, in the form of directed or undirected graphs, as well as hypergraphs, which are widely used to describe structural connections in various fields of natural and human sciences (Berge, 1973). Components of these models are specific linguistic patterns with inherent interconnections. It is worth noting that in such an algorithmic process of defining components and their interconnections, the professional judgment of the linguist-researcher plays a critical role, as only they can provide exhaustive information describing and characterizing the linguistic units under consideration.

Research results

A comprehensive study of an individual natural language involves examining both its formal and semantic characteristics and can be conducted based on two diametrically opposed principles: from structural-formal to content-semantic and vice versa – from content-semantic to structural-formal. In a multi-aspect study from formal to semantic linguistic objects are initially systematized according to their internal structure, after which the semantics of the already created classes or groups are examined. This approach is practically applied in language engineering, which helps solve tasks such as creating electronic dictionaries, translation systems, review programs, automatic proofreading, search engines, plagiarism detection software and more. The downside of such constructed models is their very rapid "obsolescence." Empirical data from recent decades show, that this approach requires constant modernization and ongoing refinements due to the emergence of new interests and demands, as well as the semantics of for-

malization. Language research following the principle of moving from semantic to formal is based on the systematization of semantics with subsequent formal modeling. This type of research is more complex and requires specialized development. A significant stage in both principles is the systematic generalization of obtained results for studying and comparatively analyzing the general linguistic properties of languages.

A comprehensive and holistic representation of the general linguistic properties of natural languages assumes the creation of a unified general linguistic model. Many linguists have conducted such studies. However, it is becoming clear, that the task is extremely difficult: developing a unified general linguistic model is extraordinarily challenging and perhaps even impossible. In constructing the framework of a potential universal theory of language, G. Dzhaukian proposed a four-level classification of linguistic structures: lexical, taxematic, predicative and textual levels, with their intra-level and inter-level relationships. Within each of these levels, he identified two sublevels: in the lexical level – root or lexematic; in the taxematic level – tagmatic and syntagmatic; in the predicative level – protasematic and symprotasematic; and in the textual level – textematic and syntextematic (Dzhaukyan, 1999).

We have presented a new, in some sense, universal functional-linguistic model of natural language, which is based on the logical-functional conjunctive, disjunctive and implicative properties of linguistic objects corresponding, as previously noted, to conjunctive, disjunctive compound and conditional complex sentences (Hakobyan, 2025).

For a more detailed structural analysis and synthesis of the studied linguistic objects with regard to the logical functions under consideration it became necessary to conduct a level-based hierarchical clustering. Key structural taxons of linguistic functional units were identified, and a graph-schematic model was developed to represent and study their structural connections. We analyzed words, phrases, simple and complex sentences, parts of text in which the logical-functional relationships characteristic of the linguistic units under study were identified. In analyzing these objects, the issue of iden-

tifying the tools and methods for revealing the corresponding functional relationships was addressed. As a result, the following five linguistic levels were organized and distinguished: *tagmatic, syntagmatic, protasematic, symprotasematic* and *textematic.* Each of these five levels can, in fact, be conjunctive, disjunctive or implicative, resulting in 15 functional clusters. For each of these clusters the linguistic level units comprising them are defined, a certain portion of which are functional units. These units must explicitly or implicitly be associated with the corresponding logical function of conjunction, disjunction or implication. Intra-level and inter-level structural connections of the units carrying the primary functional-semantic load were studied.

Conclusions

Thus, the taxonomic studies of linguistic constructions with regard to logical functions conducted by us represent only a small part of the theoretical and practical questions and tasks within the inexhaustible field of exploring the interconnection between linguistics and logic. The taxonomy of linguistic constructions of varying complexity based on specific selected parameters will enable the development of additional precise and universal research methods, opening new opportunities for solving linguistic tasks.

However, it should be remembered, that logical-formal methods for studying structural interconnections in complex sentences can have both positive and negative aspects. Excessive enthusiasm for structural schematization may lead to contradictory conclusions from the perspective of linguistic theory. Therefore, it is important in each specific case to determine the appropriate depth of formalization. Structural formalization must be justified from a linguistic standpoint.

References

Anderson, J. (2001). Discrete Mathematics with Combinatorics. New Jersey: Prentice Hall.

Benveniste, E. (1974). Problèmes de linguistique générale. Paris: Gallimard.

Berge, C. (1973). Graphs and Hypergraphs. Amsterdam: North-Holland Pub. Co.; New York: American Elsevier Pub. Co.

Chomsky, N. (2006). Language and Mind. New-York: Cambridge University Press.

Clustering and Classification (1999) Singapore, New Jersey, London, Hong Kong: World Scientific.

Dzhaukyan, G. (1999). Universal Theory of Language. Prolegomena to Substantial Linguistics. – M., Institute of Linguistics RAS. (In Russ.)

Hakobyan, A. (2017). Functional Specificity of the Conjunction IF. European Journal of Literature and Linguistics, № 3. Vienna: East West. DOI: https://dx.doi.org/10.20534/EJLL-17-3-3-6 (In Russ.)

Hakobyan, A. (2025). Taxonomy of Language Constructions (and, or, if). Monograph. Yerevan: YSU. DOI: https://doi.org/10.46991/YSUPH/9785808427044 (In Russ.)

Sossure, F. (1997). Cours de linguistique generale. Paris: Tullio de Mauro.

Tesnière, L. (1959). Élements de syntaxe structurale. Paris: Librairie c. Klinksieck.

Xu, R., Wunsch, D. (2009). Clustering. New Jersey: A John Wiley & Sons, Inc.

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