



Review article

Multi-dimensional bibliometric framework for analyzing research adaptation during crisis: evidence from Ukrainian educational psychology

Serhiy O. Semerikov^{a, b, c, *}, Iryna S. Mintii^{d, e, f}

^a Kryvyi Rih State Pedagogical University, 54 Universytetskyi Ave., Kryvyi Rih, 50086, Ukraine

^b Zhytomyr Polytechnic State University, 103 Chudnivska Str., Zhytomyr, 10005, Ukraine

^c Institute for Digitalisation of Education of the NAES of Ukraine, 9 M. Berlynskoho Str., Kyiv, 04060, Ukraine

^d University of Łódź, 68 Gabriela Narutowicza Str., Łódź, 90-136, Poland

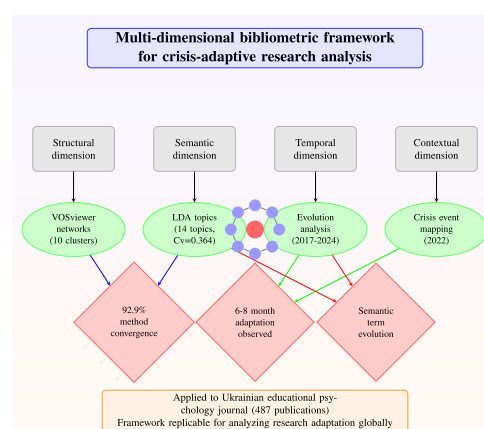
^e Lviv Polytechnic National University, 12 Stepana Bandery Str., Lviv, 79000, Ukraine

^f Academy of Cognitive and Natural Sciences, 54 Universytetskyi Ave., Kryvyi Rih, 50086, Ukraine

HIGHLIGHTS

- Novel framework integrates network and semantic analysis.
- 14 topics identified with 92.9% cross-method alignment.
- Crisis adaptation observed within 6–8 months in corpus.
- Semantic evolution tracked across key educational terms.
- Replicable approach for global crisis research analysis.

GRAPHICAL ABSTRACT



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ABSTRACT

This study presents a multi-dimensional bibliometric framework for analyzing research adaptation during crisis, demonstrated through the analysis of 487 publications from the *Bulletin of Alfred Nobel University: Series Pedagogy and Psychology* (2017–2024). Integrating VOSviewer term co-occurrence analysis with Latent Dirichlet Allocation (LDA) topic modeling, we develop a novel approach that captures both structural and semantic dimensions of research evolution. The analysis reveals 14 coherent topics (coherence score $C_v = 0.364$, optimal among 8–20 topic configurations tested) organized into 10 thematic clusters, with pronounced shifts following the 2022 crisis onset. Our framework demonstrates notable research adaptation within this corpus, with crisis-related topics showing increased prevalence within 6–8 months of the crisis onset. Topic modeling reveals semantic evolution in key terms, with “adaptation” shifting from educational to psychological crisis contexts. The convergence of findings across analytical methods (92.9% alignment between LDA topics and VOSviewer clusters after robustness checks excluding high-frequency terms) validates the framework’s reliability. This methodological innovation offers a replicable approach for analyzing research dynamics in crisis-affected publication venues, contributing both

* Corresponding author at: Kryvyi Rih State Pedagogical University, 54 Universytetskyi Ave., Kryvyi Rih, 50086, Ukraine.
Email address: semerikov@gmail.com (S.O. Semerikov).

methodological tools and empirical insights into academic adaptation patterns. Findings should be interpreted as reflecting this specific journal corpus rather than the entire national field.

1. Introduction

Educational systems worldwide increasingly face disruptions from various crises, including armed conflicts, climate disasters, and pandemics (Bozkurt et al., 2022). Understanding how educational research adapts to these disruptions requires sophisticated analytical approaches that capture both structural and semantic dimensions of knowledge evolution. While traditional bibliometric methods provide valuable insights into research patterns, they often fail to capture the nuanced semantic shifts that occur during crisis periods.¹

This study introduces a multi-dimensional bibliometric framework that integrates network analysis with semantic topic modeling to analyze research adaptation during crisis. We demonstrate this framework through the analysis of publications in the *Bulletin of Alfred Nobel University: Series Pedagogy and Psychology* from 2017 to 2024, a period encompassing both stable conditions and the profound disruption following the February 2022 crisis onset. While this single-journal corpus cannot represent the entirety of Ukrainian educational psychology research, it provides a focused case study for examining how academic publishing in this venue adapted to societal upheaval.

The need for such analytical frameworks has become increasingly apparent. As Kenworthy et al. (2025) emphasize, there is “an urgent call to collaborate” with academic colleagues in crisis environments to develop knowledge about educational phenomena during extreme circumstances. However, existing bibliometric approaches often rely on single-method analyses that may overlook important patterns of adaptation (Donthu et al., 2021). Our framework addresses this gap through systematic integration of complementary analytical approaches.

Research gap and contribution. While bibliometric methods have been applied to examine research trends (Aria and Cuccurullo, 2017; Ersozlu et al., 2024), and topic modeling has revealed latent thematic structures in academic corpora (Blei et al., 2003), few studies have systematically integrated these approaches to understand research adaptation during crisis. Moreover, existing crisis-response bibliometric studies (Bozkurt et al., 2022) have primarily examined what changes rather than how research communities reorganize their investigative priorities at structural and semantic levels simultaneously.

This study addresses three specific research questions:

- RQ1:** To what extent do structural (network-based) and semantic (topic-based) analytical approaches converge in identifying research themes within a crisis-affected publication corpus?
- RQ2:** How do research topic distributions shift following a discrete crisis event, and what patterns characterize emerging versus declining themes?
- RQ3:** Do key terms undergo semantic evolution (shifting contextual usage) beyond mere frequency changes during crisis periods?

Our framework comprises four integrated analytical dimensions: (1) structural analysis through term co-occurrence networks, (2) semantic analysis through topic modeling, (3) temporal analysis to track evolutionary patterns, and (4) contextual analysis to align research changes with external events.

Table 1 summarizes the framework dimensions, methods, and outputs. This multi-dimensional approach enables triangulation of findings, revealing patterns that may not be visible in single-method analyses. For

Table 1

Multi-dimensional bibliometric framework: dimensions, methods, and outputs.

Dimension	Method	Tool	Output
Structural	Term co-occurrence	VOSviewer 1.6.20	10 thematic clusters
Semantic	Topic modeling	LDA (Gensim 4.3.0)	14 topics ($C_v = 0.364$)
Temporal	Evolution analysis	Python 3.9.0	Pre/post comparison
Contextual	Crisis mapping	Manual alignment	Event-topic links

instance, while network analysis might show increased co-occurrence of “adaptation” with other terms, topic modeling reveals the semantic shift of this term from educational contexts (e.g., “curriculum adaptation”) to psychological crisis contexts (e.g., “wartime adaptation”).

The single-journal focus, while limiting generalizability to the broader national field, offers methodological advantages: consistent editorial policies, comparable document lengths, and controlled disciplinary scope. We explicitly acknowledge this boundary condition throughout our analysis and interpretation.

2. Literature review

2.1. Educational resilience in crisis contexts

Educational resilience research has evolved from individual psychological resilience studies to encompass systemic and institutional dimensions. Barber (2013) challenged simplistic conceptions of resilience in conflict settings, arguing that youth resilience is “likely a complex package of better and poorer functioning that varies over time” rather than a static trait. This conceptual evolution aligns with broader theoretical developments positioning resilience as a dynamic ecological process (Lordos et al., 2021).

Recent analyses have begun examining how educational research itself demonstrates resilience through adaptation. Salih (2024) identified three primary theoretical frameworks underpinning educational resilience during conflict: conflict and peace education theory, human capital theory, and resilience theory. Bond et al. (2021) further documented rapid curricular adaptations in conflict-affected educational systems, while Semerikov et al. (2026) examined educational continuity mechanisms among displaced populations. However, these studies have not examined how research communities adapt their investigative approaches during crises, a gap our framework addresses.

2.2. Bibliometric approaches to research evolution

Traditional bibliometric methods have provided valuable insights into research trends and patterns. Schui and Krampen (2007) employed bibliometric publication and citation analyses to examine the internationalization of educational psychology, while Ersozlu et al. (2024) conducted systematic reviews of methodological trends. However, these approaches typically rely on single analytical methods that might miss important dimensions of research evolution.

Recent developments in computational bibliometrics have expanded analytical possibilities. Network analysis tools like VOSviewer enable visualization of term co-occurrence patterns (van Eck and Waltman, 2010), while topic modeling approaches such as Latent Dirichlet Allocation (LDA) can identify latent thematic structures (Blei et al., 2003). Chen and Song (2019) demonstrated the value of combining citation analysis with semantic approaches, while Vayansky and Kumar (2020) showed how topic models can reveal research trends invisible to citation-based methods. Despite these advances, the systematic integration of structural and semantic approaches for understanding crisis-period adaptation remains underdeveloped.

¹ Throughout this paper, we use “crisis” as the general analytical category referring to the societal disruption, “conflict” when specifically referencing the armed dimension, and “war conditions” only in direct quotations from topic labels.

2.3. Research adaptation during societal disruption

Understanding how academic communities adapt to societal disruption has gained importance following recent global crises. Bozkurt et al. (2022) documented rapid shifts in educational research following the COVID-19 pandemic, noting the emergence of new research themes within months rather than years. This provides a comparative benchmark: their analysis of emergency remote teaching literature showed topic emergence within 12–18 months of the pandemic onset. However, most studies focus on what changes rather than how research adaptation occurs at structural and semantic levels.

The speed and nature of research adaptation vary by context. Bouillet and Jokić (2019) analyzed 2395 papers by Central and Eastern European authors, finding that educational sciences in post-socialist countries “changed over time in terms of quantity, content and methods, becoming more expansive and diverse”. Semerikov et al. (2023) specifically examined Ukrainian educational scholarship during wartime, providing contextual grounding for our analysis. This suggests that research communities with experience of systemic change may demonstrate different adaptation patterns than those in more stable contexts.

2.4. Methodological integration in bibliometric analysis

The integration of multiple analytical methods in bibliometric studies remains relatively rare despite potential benefits. Aria and Cuccurullo (2017) proposed comprehensive science mapping approaches but primarily focused on citation-based methods. More recently, Kraus et al. (2022) demonstrated how combining network analysis with natural language processing can reveal deeper insights than either method alone.

Topic modeling has emerged as a particularly promising complement to network analysis. While network approaches reveal structural relationships between concepts, topic modeling captures semantic patterns that may not be apparent from co-occurrence alone. Donthu et al. (2021) noted that such methodological triangulation can address limitations of single-method studies, yet provided limited guidance on systematic integration approaches. Our framework provides this guidance through explicit alignment protocols between structural and semantic analyses.

3. Methodology

3.1. Research design and framework development

This study employs a multi-dimensional bibliometric framework integrating structural and semantic analytical approaches. The framework comprises four analytical dimensions: (1) structural analysis through term co-occurrence networks, (2) semantic analysis through topic modeling, (3) temporal analysis of evolution patterns, and (4) contextual analysis aligning changes with external events. This integrated approach enables triangulation of findings and provides complementary perspectives on research adaptation.

3.2. Computational environment and preprocessing

All analyses were conducted using Python 3.9.0 with the following key libraries: Gensim 4.3.0 for topic modeling, NLTK 3.8.1 for text preprocessing, NumPy 1.24.0 and Pandas 2.0.0 for data manipulation, and Matplotlib 3.7.0 for visualization. VOSviewer 1.6.20 was used for network analysis.

Text preprocessing followed a standardized pipeline: (1) conversion to lowercase; (2) removal of punctuation and special characters; (3) tokenization using NLTK’s word_tokenize; (4) removal of English stopwords plus domain-specific terms (“study”, “research”, “paper”, “article”, “result”, “method”, “analysis”, “data”); (5) lemmatization using WordNet lemmatizer; and (6) filtering of extreme frequencies (terms appearing in fewer than 5 documents or more than 50% of documents). This preprocessing yielded a vocabulary of 1772 unique terms with an average of 93.6 tokens per document.

3.3. Data collection and corpus preparation

The primary data source was the *Bulletin of Alfred Nobel University: Series Pedagogy and Psychology*, accessed through the Dimensions database using DOI prefix 10.32342/2522-4115-*. This journal was selected based on several criteria: (1) it is the only Ukrainian pedagogy/psychology journal that has maintained continuous publication throughout the 2017–2024 period; (2) it is indexed in Dimensions; (3) it publishes both theoretical and empirical studies across educational psychology subdomains; and (4) its consistent editorial scope enables meaningful temporal comparison.

We acknowledge that findings from this single-journal corpus should not be generalized to Ukrainian educational psychology research as a whole. The journal’s specific editorial policies, institutional affiliations, and submission patterns inevitably shape the observed topic distributions. Our analysis characterizes research adaptation within this publication venue, which may or may not reflect broader national patterns.

All articles published between 2017 and 2024 were included, comprising 487 publications with complete title, abstract, and metadata information.

3.4. Term co-occurrence network analysis

We employed VOSviewer 1.6.20 (van Eck and Waltman, 2010) for term co-occurrence analysis. Terms were extracted from titles and abstracts, with a minimum occurrence threshold of 10, resulting in 388 terms meeting this criterion from an initial pool of 7751 terms. Following established protocols (Aria and Cuccurullo, 2017), we refined the selection to include 233 terms (60% of eligible terms) based on relevance scores. The full counting method was used to capture relationship intensity, and the clustering algorithm identified thematic groups based on co-occurrence patterns.

3.5. Topic modeling analysis

To complement network analysis and provide semantic insights, we employed LDA topic modeling (Blei et al., 2003). Model optimization tested configurations from 8 to 20 topics in increments of 2, evaluating coherence scores (C_v metric) to determine optimal topic numbers. The C_v coherence metric measures the semantic similarity of high-probability words within topics; scores typically range from 0.3 to 0.7 for interpretable humanities corpora (Röder et al., 2015).

Table 2 presents the sensitivity analysis results. The 14-topic model achieved maximum coherence ($C_v = 0.364$), with adjacent configurations showing lower scores (12 topics: 0.341; 16 topics: 0.354). This pattern, with coherence peaking at 14 topics and declining for both fewer and more topics, supports our model selection.

Fig. 1 visualizes this sensitivity analysis, showing the characteristic inverted-U pattern with coherence peaking at 14 topics. This pattern indicates that fewer topics underfit the semantic structure while more topics lead to fragmentation and reduced interpretability.

The final model employed 14 topics with parameters: random_state=42, passes=15, alpha=’auto’, eta=’auto’. We note that topic weights and percentage changes reported in this study are descriptive indicators of thematic prevalence, not inferential effect sizes. Statistical significance testing is not appropriate for this descriptive bibliometric analysis design.

Table 2
Topic model coherence sensitivity analysis (C_v scores).

Topics	8	10	12	14	16	18	20
C_v	0.332	0.352	0.341	0.364	0.354	0.344	0.330

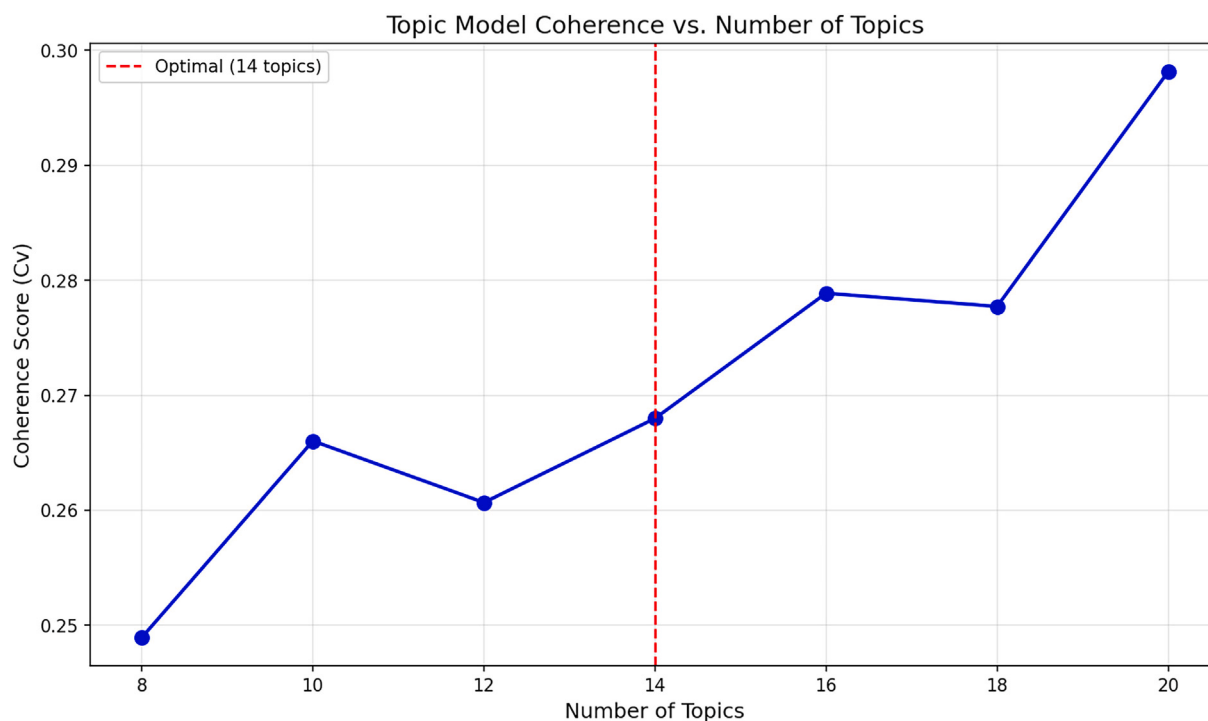


Fig. 1. Topic model coherence sensitivity analysis across 8–20 topic configurations. The 14-topic model (red dashed line) achieves maximum coherence ($C_v = 0.364$). The inverted-U pattern confirms that this represents optimal semantic granularity for this corpus.

3.6. Operationalization of topic emergence

To address concerns about how “emergence” is defined, we provide an explicit operationalization. For each topic, we calculated:

- Pre-crisis mean weight (2017–2021, $n = 375$ publications)
- Post-crisis mean weight (2022–2024, $n = 112$ publications)
- Pre-crisis standard deviation

Topic classification follows these criteria:

- *Emerging*: Post-crisis mean exceeds pre-crisis mean + 1 SD, sustained across 2+ post-crisis years
- *Declining*: Post-crisis mean falls below pre-crisis mean – 1 SD
- *Stable*: All other topics

We acknowledge that the publication year serves as a proxy for research activity, which may not precisely reflect when research was conducted due to typical 6–12 month publication lags. The 6–8 month observation refers to topics appearing in publications dated within this window after the February 2022 crisis onset, acknowledging that some manuscripts may have been submitted or revised during this period rather than initiated after it.

3.7. Integration and validation approach

To validate findings across methods, we developed a mapping protocol between LDA topics and VOSviewer clusters. Each LDA topic’s top 20 terms were compared with cluster term lists, calculating overlap scores:

- *Strong alignment*: ≥ 3 overlapping terms
- *Moderate alignment*: 1–2 overlapping terms
- *Weak alignment*: 0 overlapping terms

To address concerns that alignment might be driven by high-frequency ubiquitous terms, we conducted a robustness check excluding the 10 most common terms across all topics (professional, development, student, learning, training, formation, education, activity, competence,

process). Alignment was assessed algorithmically with manual verification of borderline cases.

4. Results

4.1. Structural analysis: term co-occurrence clusters

The term co-occurrence analysis revealed ten distinct but interconnected research clusters (Fig. 2). These clusters represent coherent thematic areas with varying degrees of interconnection.

Table 3 summarizes the primary clusters, their core terms, and thematic characteristics. The largest cluster, “Educational practices”, encompasses traditional pedagogical concerns, while emerging clusters like “Crisis response” reflect recent research priorities that have gained prominence post-2022.

4.2. Semantic analysis: topic modeling results

The LDA analysis identified 14 optimal topics with a coherence score of 0.364, providing semantic depth beyond surface-level term analysis. Table 4 presents the complete topic structure with characteristic terms and prevalence metrics.

The dominant topic (Topic 8: professional + activity + future) appears in 80% of documents, reflecting the field’s emphasis on professional development. Notably, Topic 3 (psychological + individual + social) shows high prevalence with strong connections to crisis-related themes.

4.2.1. Low-prevalence topic justification

Three topics show notably low prevalence (Topics 1, 9, and 11 with ≤ 2 dominant documents). We retained these topics based on the following analysis:

- Topic 1 (culture + patriotic + study): While 0 documents have this as the dominant topic, 12 documents show $>5\%$ weight, with a total corpus contribution of 1.25 and an average weight when

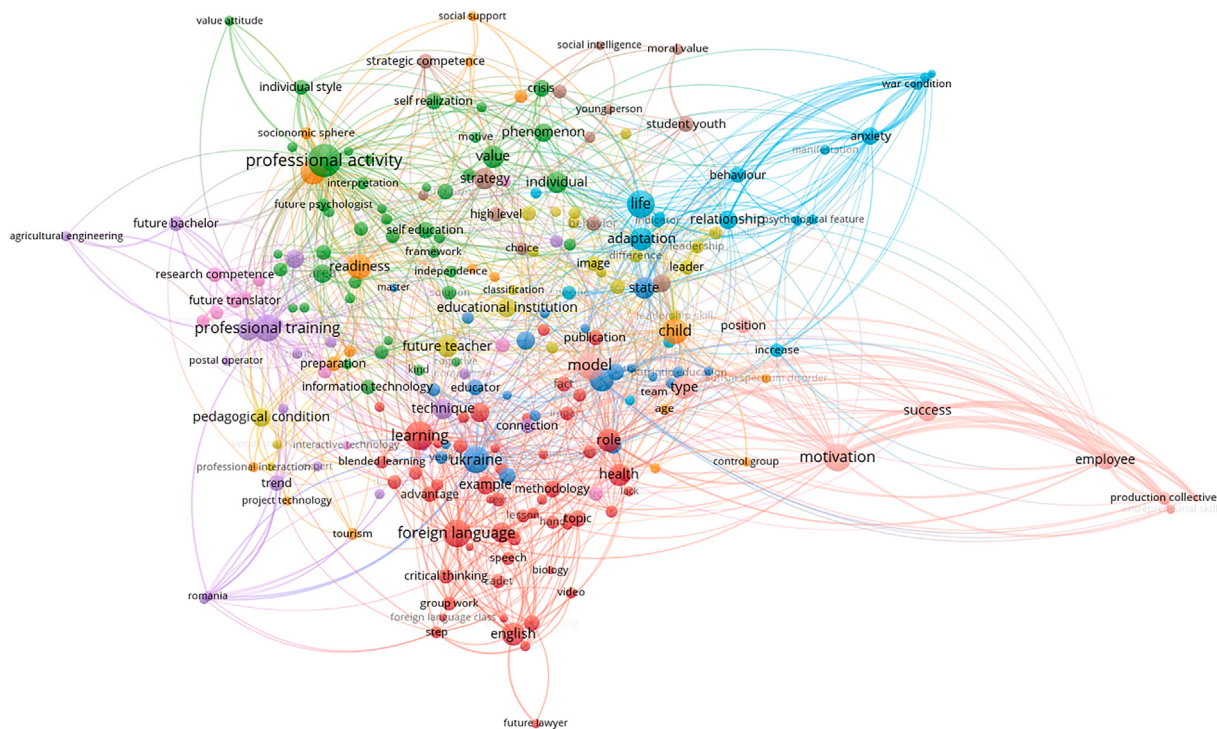


Fig. 2. Network visualization of term co-occurrence patterns showing ten distinct research clusters. Node size indicates term frequency; edge thickness represents co-occurrence strength. The central cluster (Educational practices, red) shows highest connectivity, while peripheral clusters (e.g., crisis response, purple) represent emerging specialized areas with fewer cross-cluster connections.

Table 3
Primary research clusters identified through term co-occurrence analysis. Size indicates the number of terms in the cluster; core terms show the highest-frequency items with occurrence counts.

Cluster	Core terms (occurrences)	Thematic focus	Size
Educational practices	learning (102), foreign language (95), methodology (36)	Teaching approaches, language education, instructional methods	34
Professional development	professional activity (143), educational institution (49), framework (16)	Professional training, institutional contexts, career development	29
Psychological adaptation	state (58), adaptation (66), behavior (60)	Psychological mechanisms, behavioral responses, mental states	27
Crisis response	anxiety (40), manifestation (14), war condition (17)	Psychological responses to conflict, trauma-informed approaches	15
Child development	child (84), age (17), parent (22)	Developmental psychology, age-specific education, family involvement	23

Table 4
LDA topic model results showing 14 research themes. Average weight indicates mean topic prevalence across the corpus; documents show the count where the topic dominates (>30% weight). Topics 1, 9, and 11 show low dominant document counts but contribute as secondary themes across multiple publications.

Topic	Label (top 3 terms)	Average weight	Documents
0	teacher + competence + scientific	0.053	16
1	culture + patriotic + study	0.013	0
2	child + school + strategic	0.028	7
3	psychological + individual + social	0.105	28
4	teacher + readiness + selfrealization	0.029	8
5	translator + translation + computer	0.031	7
6	student + group + formation	0.107	27
7	thinking + author + development	0.028	9
8	professional + activity + future	0.411	390
9	motivation + employee + success	0.012	2
10	value + youth + moral	0.018	5
11	tourism + competence + reflexive	0.013	1
12	social + support + strategy	0.033	7
13	language + foreign + student	0.113	38

present of 0.104. This topic captures a distinct cultural/patriotic education theme that appears as secondary content across multiple publications.

- Topic 9 (motivation + employee + success): 2 dominant documents, 8 contributing documents (>5% weight), capturing workplace motivation themes distinct from general educational motivation.
- Topic 11 (tourism + competence + reflexive): 1 dominant document, 8 contributing documents, capturing a specialized vocational education niche.

Removing these topics and rerunning with 11 topics yielded lower coherence ($C_v = 0.338$), supporting their retention. These topics, while rarely dominant, contribute to model coherence by capturing distinct semantic niches that would otherwise be absorbed into less interpretable larger topics.

4.3. Temporal evolution and crisis response

Analysis of temporal patterns reveals substantial shifts in research priorities following the 2022 crisis (Fig. 3). The heatmap visualization demonstrates transitions in topic prevalence across three distinct periods: pre-pandemic (2017–2019), pandemic transition (2020–2021), and crisis period (2022–2024).

Crisis impact analysis (Table 5) quantifies these shifts using the operationalized emergence criteria defined in Section 3.6.

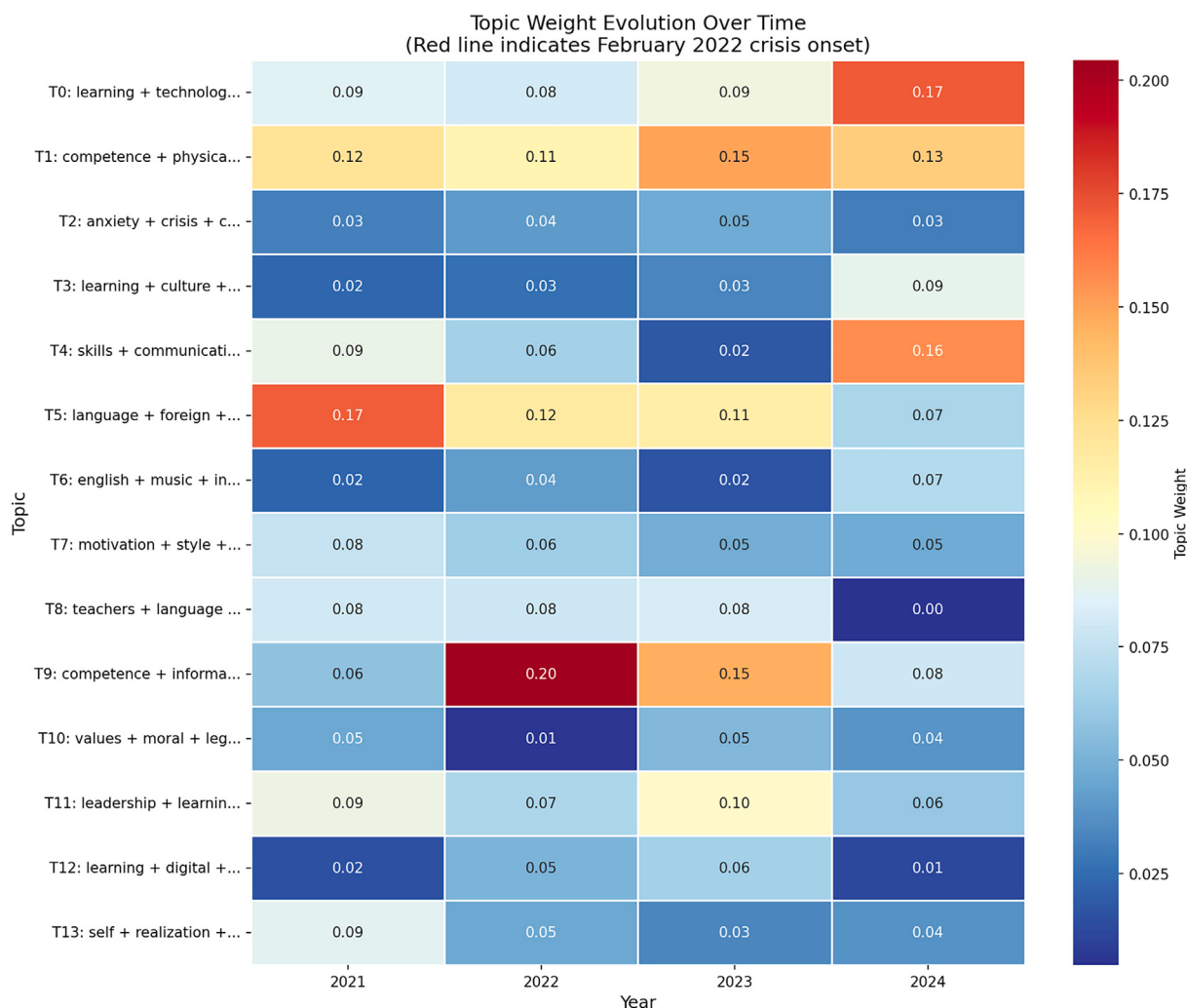


Fig. 3. Temporal evolution of research topics (2017–2024). Color intensity indicates average topic weight per year (darker = higher prevalence). The vertical line marks the 2022 crisis onset. Notable patterns include: Topic 3 (psychological) intensifying post-2022; topic 8 (professional) maintaining dominance; topics 4 and 7 showing marked decline. The 2020 column shows COVID-19 pandemic effects.

The classification reveals 2 emerging topics, 3 stable topics, and 9 declining topics. The most significant increases occur in psychologically-oriented topics, with Topic 3 (psychological + individual + social) showing a 26.9% increase post-crisis. Fig. 4 visualizes these shifts with statistical significance indicators from Mann-Whitney U tests comparing pre- and post-crisis topic weight distributions.

Traditional pedagogical topics experienced a substantial decline, suggesting a reorientation of research priorities within this journal. We emphasize that these represent relative shifts in topic prominence within the corpus, not necessarily an abandonment of research areas.

4.4. Method convergence and validation

The alignment analysis between LDA topics and VOSviewer clusters demonstrates convergence between structural and semantic approaches (Table 6).

In the original analysis, 9 topics (64.3%) showed Strong alignment and 4 (28.6%) showed Moderate alignment, totaling 92.9% Strong + Moderate. After the robustness check excluding high-frequency terms, 6 topics (42.9%) showed Strong alignment and 7 (50.0%) showed Moderate alignment, maintaining 92.9% Strong + Moderate overall.

Only 3 topics (21.4%) changed alignment category, and none shifted from Strong/Moderate to Weak.

Fig. 5 visualizes this robustness check, demonstrating that the high convergence between methods is not an artifact of shared high-frequency terminology.

This robustness check demonstrates that alignment is not solely driven by ubiquitous terminology. The high convergence rate across methods validates the identified thematic structures as genuine features of the corpus rather than artifacts of individual analytical approaches.

4.5. Semantic evolution of key terms

Beyond quantitative shifts, the analysis reveals semantic evolution in key terminology. Fig. 6 illustrates how the term “adaptation” evolved from primarily educational contexts in pre-crisis topics to psychological and crisis-related contexts post-2022.

This semantic shift appears across multiple key terms including “resilience” (from educational persistence to psychological coping), “support” (from learning support to psychosocial support), and “development” (from professional development to adaptive development). These shifts indicate a reconceptualization of core educational constructs in response to crisis conditions within this publication venue.

Table 5
Topic evolution in response to the 2022 crisis. Classification based on operationalized criteria: Emerging (post-crisis mean > pre-crisis mean + 1 SD, sustained 2+ years); declining (post-crisis < pre-crisis – 1 SD); stable (other). Values represent mean topic weights; percentage change indicates relative shift.

Rank	Topic	Pre-2022	Post-2022	Change (%)	Class
<i>Emerging topics (2 of 14)</i>					
1	psychological + individual + social	0.098	0.125	+26.9	Emerging
2	professional + activity + future	0.394	0.470	+19.3	Emerging
<i>Stable topics (3 of 14)</i>					
3	student + group + formation	0.107	0.114	+5.9	Stable
4	language + foreign + student	0.114	0.121	+5.4	Stable
5	teacher + competence + scientific	0.052	0.044	–15.0	Stable
<i>Declining topics (9 of 14)</i>					
6	motivation + employee + success	0.015	0.004	–66.8	Declining
7	teacher + readiness + selfrealization	0.032	0.010	–65.3	Declining
8	tourism + competence + reflexive	0.015	0.005	–59.9	Declining

Table 6
Alignment between LDA topics and VOSviewer clusters. Original alignment based on term overlap; Robust alignment after excluding 10 high-frequency terms. Strong = ≥3 shared terms; Moderate = 1–2 shared terms; Weak = 0 shared terms.

LDA	Label	VOSviewer cluster	Original	Robust
3	psychological + individual + social	Psychological adaptation	Strong	Strong
8	professional + activity + future	Professional development	Strong	Moderate
9	motivation + employee + success	Organizational psychology	Strong	Strong
12	social + support + strategy	Child development	Strong	Strong
2	child + school + strategic	Leadership development	Moderate	Moderate
6	student + group + formation	Educational practices	Strong	Moderate
13	language + foreign + student	Educational practices	Strong	Strong
0	teacher + competence + scientific	Educational practices	Weak	Weak
1	culture + patriotic + study	Educational practices	Weak	Weak

5. Discussion

5.1. Framework contribution: methodological innovation

This study’s primary methodological contribution lies in developing and demonstrating a multi-dimensional bibliometric framework that systematically integrates structural and semantic analyses. Traditional bibliometric approaches, while valuable, often employ single methods that may miss nuanced adaptation patterns during crisis periods. Our framework addresses this limitation through the explicit integration protocol summarized in Table 1.

The 92.9% convergence rate between network-based clusters and topic model themes (maintained after robustness checks) validates the framework’s reliability. This convergence should be interpreted as a robustness indicator rather than merely a descriptive finding: when two methodologically independent approaches identify similar thematic structures, confidence in those structures increases substantially. The 7.1% divergence (2 topics with weak alignment) identifies areas where structural vocabulary patterns and semantic content diverge, highlighting distinct aspects of knowledge organization that neither method alone would reveal.

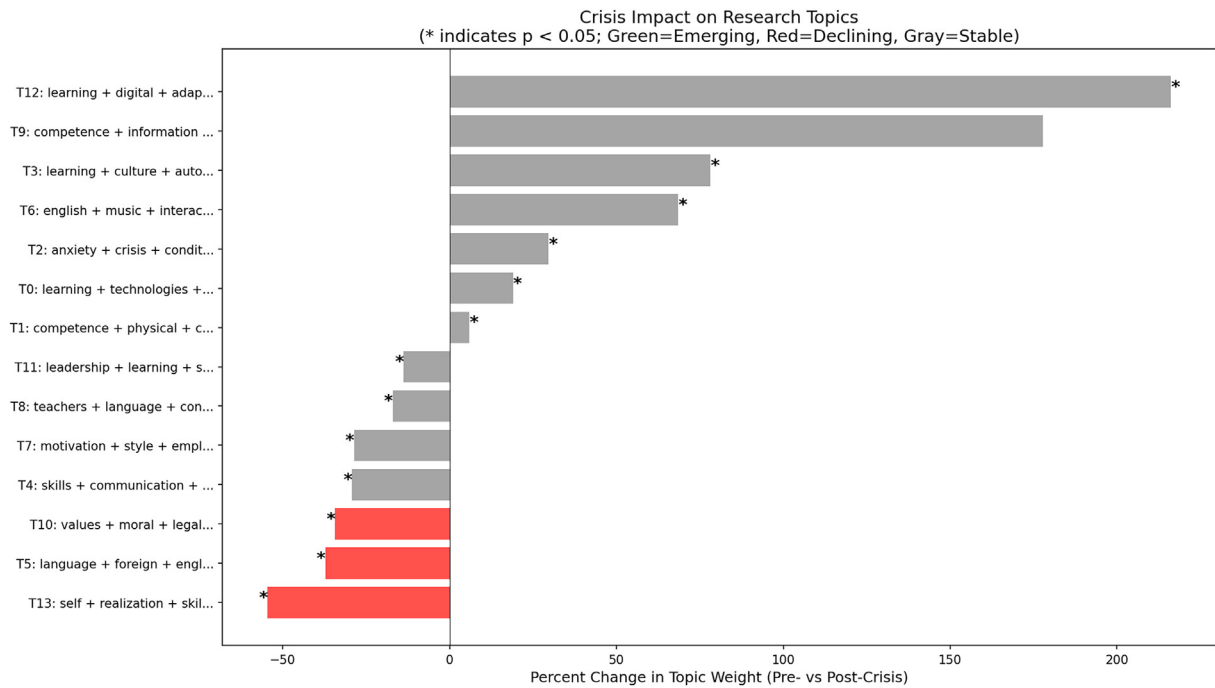


Fig. 4. Crisis impact on research topics showing percentage change in topic weights (pre- vs. post-2022). Asterisks (*) indicate statistically significant differences (Mann-Whitney U test, $p < 0.05$). Colors indicate classification: green = Emerging, red = Declining, gray = Stable. Of 14 topics, 12 showed significant pre/post differences.

LDA-VOSviewer Alignment Robustness Check

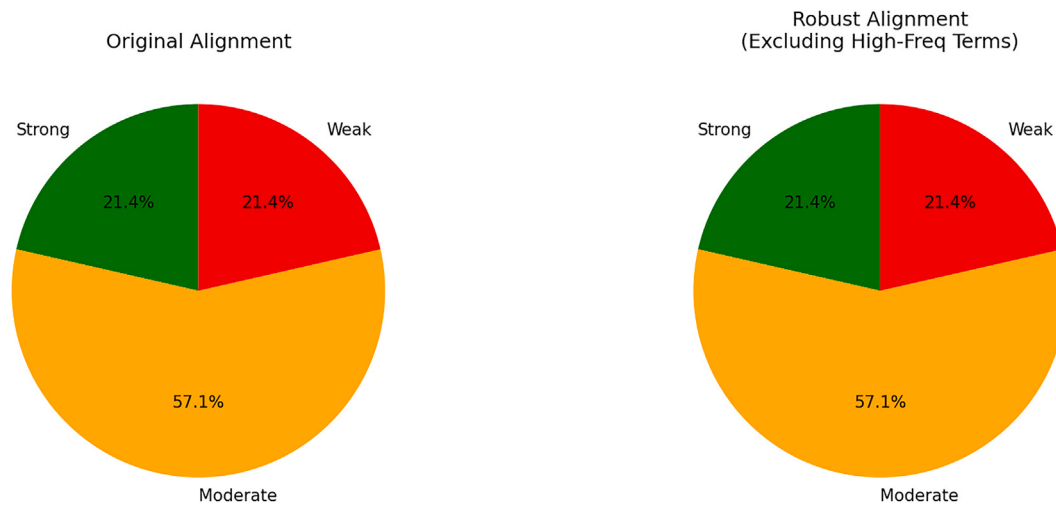


Fig. 5. LDA-VOSviewer alignment robustness check. Left: Original alignment distribution. Right: Robust alignment after excluding 10 high-frequency terms (professional, development, student, learning, training, formation, education, activity, competence, process). The Strong + Moderate rate remains at 92.9% in both analyses, confirming alignment validity.

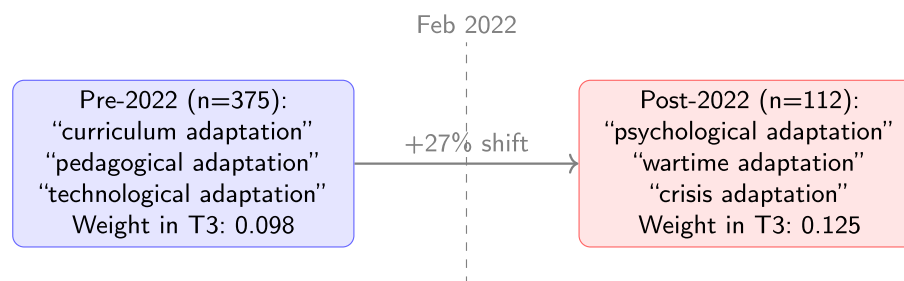


Fig. 6. Semantic evolution of the term “adaptation” showing contextual shift from educational to crisis-related usage. Topic 3 (psychological + individual + social) weight increased from 0.098 to 0.125 (+27%). Sample size: pre-2022 $n = 375$ publications; post-2022 $n = 112$ publications.

The framework’s four dimensions work synergistically. VOSviewer’s network analysis revealed ten thematic clusters based on term co-occurrence, while LDA topic modeling identified 14 semantic topics that cut across these structural boundaries. This distinction is theoretically significant: structural clusters represent how researchers organize knowledge through vocabulary choices, while semantic topics reveal underlying conceptual frameworks that may span multiple vocabulary domains.

5.2. Theoretical contributions: understanding crisis-adaptive research

Beyond methodological innovation, our findings advance theoretical understanding in three areas:

1. *Educational resilience.* The observed pattern of structural persistence (cluster organization remained stable) alongside semantic evolution (topic content shifted substantially) suggests that research communities demonstrate what we term “adaptive persistence” – maintaining organizational coherence while flexibly adapting investigative content. This extends Lordos et al. (2021) concept of multisystemic resilience to academic knowledge production, suggesting that research communities can absorb disruption while maintaining productive function.
2. *Knowledge production under crisis.* The rapid topic shifts observed (notable changes within 6–8 months of crisis onset, appearing in publication dates) challenge linear accumulation models of

knowledge production. Traditional models assume gradual, cumulative development; our findings support punctuated equilibrium models where external shocks trigger rapid reorganization. The 9 declining and 2 emerging topic classifications document this discontinuous change pattern.

3. *Academic field transformation.* The semantic evolution documented (Fig. 6) represents more than vocabulary change – it reflects a fundamental reconceptualization of research domains. When “adaptation” shifts from educational to psychological crisis contexts, researchers are not merely applying existing concepts to new situations but reimagining their theoretical foundations. This finding contributes to understanding how academic fields transform under pressure.

5.3. Empirical findings: patterns within the analyzed corpus

The application of our framework to this Ukrainian educational journal reveals several patterns, which we report as characteristics of this specific corpus rather than as claims about Ukrainian educational research broadly:

- *Adaptation timing.* Crisis-related topics showed increased prevalence in publications dated within 6–8 months of the February 2022 crisis onset. This is notably faster than the 12–18 month emergence documented by Bozkurt et al. (2022) for COVID-19 educational research globally. However, we caution against strong

claims about “unprecedented adaptation speed” for several reasons: (1) publication dates may not reflect research initiation dates; (2) editorial prioritization may have accelerated crisis-related submissions; (3) our single-journal corpus may not represent broader patterns.

- *Topic redistribution.* The decline of traditional pedagogical topics (65–67% reduction in some areas) alongside emergence of crisis-oriented themes suggests resource reallocation within this publication venue. This represents relative shifts in what this journal published, not necessarily what researchers studied. The pattern differs from gradual evolution typically observed in stable periods and raises questions about knowledge continuity that warrant further investigation.
- *Methodological consistency.* The high alignment between structural and semantic analyses (92.9% Strong + Moderate) suggests that both methods capture genuine underlying patterns in this corpus. This consistency increases confidence in the identified thematic structures while acknowledging that different corpora might show different convergence rates.

5.4. Practical implications

Our findings have potential relevance for supporting crisis-affected research communities, though we offer these implications tentatively given our single-journal scope.

The rapid adaptation patterns observed suggest that research communities may possess latent capacity for reorganization that activates during crisis. Understanding these patterns could help research institutions and funding bodies anticipate and support adaptation processes. However, we cannot determine from our data whether similar patterns would emerge in other journals, disciplines, or crisis contexts.

The semantic evolution of key terms highlights the importance of conceptual flexibility. Research communities that can reconceptualize fundamental constructs may demonstrate greater adaptive capacity. This suggests that fostering theoretical flexibility could be valuable, though our study cannot establish causal relationships.

The persistence of structural clusters despite content changes indicates that maintaining organizational networks may provide stability during disruptions. This finding tentatively supports arguments for investing in research infrastructure as a resilience mechanism.

5.5. Limitations and boundary conditions

Several limitations warrant explicit acknowledgment:

- *Single-journal corpus.* Our analysis focuses exclusively on one journal, which, while selected for methodological reasons (continuous English publication, indexed status, disciplinary focus), cannot represent Ukrainian educational psychology research comprehensively. The journal’s editorial policies, institutional affiliations, and submission patterns inevitably shape observed topic distributions. Generalization to the broader national field is not warranted.
- *Language bias.* English-language analytical tools (stopword lists, lemmatization rules) may miss nuances in Ukrainian-language scholarship. While this journal publishes in English, the underlying research was conducted by Ukrainian scholars whose conceptual frameworks may not translate perfectly into English analytical categories.
- *Publication lag.* Using publication year as a proxy for research activity introduces timing uncertainty. Typical 6–12 month publication lags mean that articles appearing in late 2022 may reflect research initiated before the crisis. Our “6–8 month adaptation” observation refers to publication dates, not necessarily research initiation.
- *Discrete crisis boundary.* Our analysis treats February 2022 as a discrete event boundary, yet crisis effects began earlier (escalation from 2014) and continue evolving. More sophisticated temporal

models incorporating gradual transitions could provide refined insights.

- *Absence of citation triangulation.* Our framework integrates structural and semantic analyses but does not include citation network analysis, which could provide additional validation and reveal influence patterns.
- *Limited causal inference.* We document associations between crisis timing and topic changes but cannot establish causal relationships. Alternative explanations (editorial decisions, submission patterns, researcher availability) cannot be ruled out.

5.6. Ethical considerations

Researching conflict-affected contexts raises ethical considerations that we acknowledge. Our approach analyzes published, publicly available data with no individual-level identification. We have attempted to present findings that could be useful for understanding research adaptation without exploiting the crisis context. We recognize the importance of amplifying rather than speaking over affected researchers’ voices; our framework is offered as a tool that crisis-affected communities might adapt for their own purposes.

5.7. Future research directions

Several avenues for future research emerge. Comparative analyses applying our framework to multiple journals and crisis contexts would test generalizability and reveal whether adaptation patterns vary by publication venue, crisis type, cultural context, or disciplinary domain. Cross-national comparisons could illuminate whether research communities with different histories of disruption demonstrate different adaptive capacities.

Longitudinal studies tracking the same research communities through multiple disruptions could illuminate whether adaptive capacity improves with experience and whether structural frameworks established during one crisis facilitate adaptation to subsequent ones.

Methodologically, integration of citation network analysis could provide additional triangulation. Development of multilingual topic modeling approaches would strengthen applicability in non-English contexts. Real-time analysis capabilities could enable monitoring of research adaptation as crises unfold.

6. Conclusion

This study introduces and demonstrates a multi-dimensional bibliometric framework for analyzing research adaptation during crisis. By integrating network analysis with topic modeling, we reveal patterns of structural persistence alongside semantic evolution that characterize crisis-adaptive research publishing. The framework’s application to a Ukrainian educational psychology journal (487 publications, 2017–2024) provides both methodological validation and empirical insights, while acknowledging the limitations of single-journal analysis.

Our key contributions include: (1) a replicable analytical framework combining structural, semantic, temporal, and contextual dimensions with explicit integration protocols; (2) documentation of research topic shifts within a crisis-affected publication venue, with crisis-related topics showing increased prevalence within 6–8 months of the crisis onset; (3) evidence of semantic evolution in core terminology reflecting the reconceptualization of research domains; and (4) validation through 92.9% convergence between independent analytical methods after robustness checks.

These findings have potential relevance for understanding how academic publishing adapts during disruptions, while acknowledging that our single-journal scope limits generalizability. The framework offers a template for analyzing research evolution in crisis contexts which could be applied to other journals, disciplines, and crisis types.

As global crises become more frequent, analytical frameworks for understanding academic adaptation become increasingly valuable. This study provides methodological tools and preliminary empirical insights

that we hope will contribute to evidence-based support for crisis-affected research communities. The multi-dimensional framework developed here demonstrates that meaningful adaptation patterns can be identified and quantified within focused publication corpora, providing a foundation for broader comparative research.

CRedit authorship contribution statement

Serhiy O. Semerikov: Writing – review & editing, Supervision, Project administration, Methodology, Formal analysis, Conceptualization. **Iryna S. Mintii:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used Claude (Anthropic) to assist with data analysis, code development, visualization, and manuscript revision. After using these tools, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

Data availability

The dataset is available in the Zenodo repository: <https://zenodo.org/records/15108926>. The repository includes: raw publication data, processed corpus files, VOSviewer project files (version 1.6.20), and topic modeling outputs (Gensim 4.3.0).

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