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Review Article

Understanding Research Novelty and Research Gaps: A Systematic Conceptual Review and Technology-Driven Strategies for Identification

Faridah Mohd Said[1*], Etik Pratiwi[1,2]

[1]School of Nursing and Applied Health Science, Lincoln University College, Wisma Lincoln, No 12-18, Jalan SS 6/12, 47301, Petaling Jaya, Selangor Darul Ehsan, Malaysia

[2]Départementof Nursing, Sekolah Tinggi Ilmu Kesehatan Notokusumo Yogyakarta,Jl. Bener No 26 Tegalrejo, Yogyakarta, 55243 Indonesia

Corresponding Author's Email: faridah.msaid@lincoln.edu.my

Abstract

Research novelty and gap identification are critical drivers of scientific progress, enabling scholars to move beyond incremental contributions toward transformative discoveries. Novelty refers to original concepts, perspectives, or methodologies, while research gaps denote unresolved or underexplored areas within existing knowledge. This review followed the SPIDER framework (Sample, Phenomenon of Interest, Design, Evaluation, Research Type) to structure the search strategy. The guiding question was: "What are the conceptualizations, typologies, and identifying methodologies for 'research novelty' and 'research gaps' across various designs, and how have these been qualitatively explored?". Comprehensive searches were performed across Google Scholar, PubMed/NCBI, Scopus, DOAJ, and ERIC. From 1,250 screened records, 10 seminal studies (2022–2025) were included based on relevance and quality. The protocol was registered with PROSPERO CRD420251178180. Findings reveal that interdisciplinary collaboration and AI-powered approaches—deep learning models and human–GenAI frameworks—are revolutionizing how novelty is measured and gaps are mapped. These advanced methods outperform citation-based metrics by autonomously detecting latent patterns in large scholarly datasets, offering precision and scalability. By integrating technology-driven strategies with conceptual rigor, this study provides actionable insights for researcher, and policymakers to strategically position research for maximum impact. Furthermore, performative collaboration, characterized by a lack of genuine integration, proves less effective than shared protocols for accurately predicting novelty. Future research should focus on developing hybrid models that combine semantic metrics with reinforcement learning approaches. To advance these goals, researchers should leverage AI for ideation, funders must prioritize interdisciplinary AI-assisted proposals, and developers are tasked with building transparent, auditable systems.

Keywords: *Artificial Intelligence; Deep Learning; Interdisciplinary Research; Research Gaps; Research Novelty*

Introduction

Advancing scientific knowledge depends on two critical elements: novelty in research and the identification of research gaps (Okeke, 2025). However, researchers frequently encounter two interrelated challenges: articulating the novelty of their work and identifying meaningful research gaps

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within the literature (Baako *et al*., 2022). Novelty refers to the introduction of original concepts, methods, or perspectives that extend beyond established paradigms, while research gaps represent areas of incomplete understanding or unresolved questions within existing literature. Together, these elements ensure that scholarly work contributes meaningfully rather than incrementally (Tennant *et al*., 2017). Their significance extends beyond academia novel research drives technological innovation, informs evidence-based policy, and strengthens institutional and national competitiveness (Salter & Martin, 2001). In an era of rapid knowledge expansion and digital transformation, systematically identifying novelty and gaps has become increasingly complex, requiring robust conceptual frameworks and advanced analytical tools (Shin *et al*., 2022). This review addresses these challenges by synthesizing recent methodological developments and exploring technology-driven strategies for precision and scalability in novelty detection (Cohen *et al*., 2002).

Novelty Claim of This Review

The novelty of this review lies in its integrative and forward-looking synthesis of interdisciplinary and AI-driven approaches to identifying research gaps and research novelty (Huang *et al*., 2026). Unlike prior conceptual discussions that rely predominantly on citation-based indicators or narrative judgment, this review consolidates emerging evidence demonstrating how deep learning models, topic modeling, novelty-driven reinforcement learning, and collaboration between humans and GenAI frameworks can systematically detect latent intellectual spaces across disciplines (Wang *et al*., 2024). By bridging methodological scholarship with technological innovation, this article advances a scalable, data-informed framework that redefines how novelty is conceptualized and operationalized, thereby offering a substantive contribution to research methodology literature. Research novelty, as a formal evaluation criterion, prompted a shift in top priorities toward emerging, underexplored areas—such as the convergence of gaming and gambling, technological innovations, and treatment process barriers—rather than the replication of established knowledge or the testing of new interventions (Czakó *et al*., 2025).

Practical Significance

The ability to identify novelty and research gaps carries profound implications for both academic and societal progress.

First, **funding and resource allocation** are strongly influenced by originality; novel research often attracts competitive grants and institutional investment, positioning scholars, and institutions at the forefront of discovery (Cohen *et al*., 2002).

Second, **policy development** benefits from systematic gap identification, as addressing knowledge deficits informs strategic decisions in critical domains such as healthcare, education, and technology (Salter & Martin, 2001)

Third, **career advancement** is closely tied to originality; demonstrating novelty enhances scholarly reputation, visibility, and opportunities for collaboration (Okeke, 2025).

Fourth, **innovation and industry impact** accelerate when research introduces novel findings, enabling faster product development and solutions to societal challenges (Salter & Martin, 2001)

Finally, **global competitiveness** hinges on prioritizing novelty-driven research, as nations that invest in originality strengthen their knowledge economies and innovation ecosystems (Cohen *et al*., 2002).

Objectives

This study aims to:

1. Clarify conceptual distinctions between novelty in research and research gaps.

2. Survey typologies and methodologies for identifying these elements across disciplines.

3. Articulate the relationship between gaps and originality to guide researchers in positioning their contributions strategically.

Methodology

Study Design and Protocol

This study is literature review was conducted using the SPIDER framework (Sample, Phenomenon of Interest, Design, Evaluation, Research type) to structure the search strategy and eligibility criteria (Yang *et al*., 2026).

Identify the Research Question

Researchers prepared research questions using the SPIDER scheme (Sample, Phenomenon of Interest, Design, Evaluation, and Research Type). This format is attached in Table 1. The guiding research question in this systematic review is "What are the conceptualizations, typologies, and identifying methodologies for 'research novelty' and 'research gaps' as presented in the scholarly methodological literature of various designs, and how have these been qualitatively explored?".

Table 1: Spider Format

SPIDER	Mesh	Database
Sample	researcher*, scholar*, publication*, "academic paper", AND "scientific study"	Pubmed, Scopus, DOAJ, Google Scholar, Enrich
Phenomenon of Interest	research novelty", AND "Research gap", "innovation in research", "originality", "Research contribution", "Exploring the unknown	
Design	"Conceptual paper", "systematic review", "bibliometric analysis", "meta-research"	
Evaluation	"Novelty assessment", "gap identification", "originality criteria", "innovation framework"	
Research Type	qualitative OR conceptual OR "Mixed method" OR "meta research"	

Figure 1 illustrates the conceptual framework of this review, demonstrating how multidisciplinary literature is systematically analyzed using artificial intelligence and deep learning techniques to identify research gaps and articulate research novelty. Interdisciplinary collaboration and human–AI interaction serve as enabling mechanisms that transform fragmented knowledge into high-impact scholarly contributions.

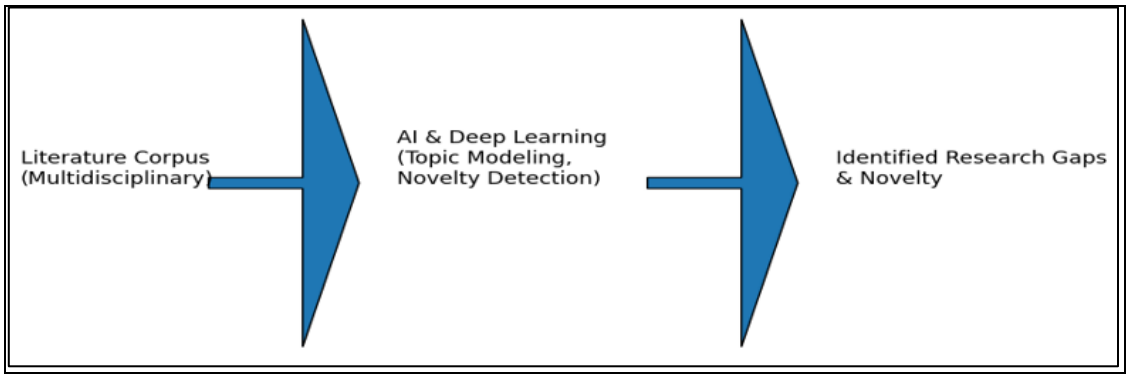

Figure 1: AI-Driven Conceptual Framework for Identifying Research Gaps and Research Novelty

Searching Literature

Comprehensive searches were performed across Google Scholar, PubMed/NCBI, Scopus, DOAJ, and ERIC, targeting conceptual and methodological literature on novelty and gap identification. From 1,250

screened records, 10 seminal studies published between 2022 and 2025 were included based on relevance and quality as shown in Figure 2. The review protocol was registered with PROSPERO (CRD420251178180) to ensure transparency and rigor (Okeke, 2025).

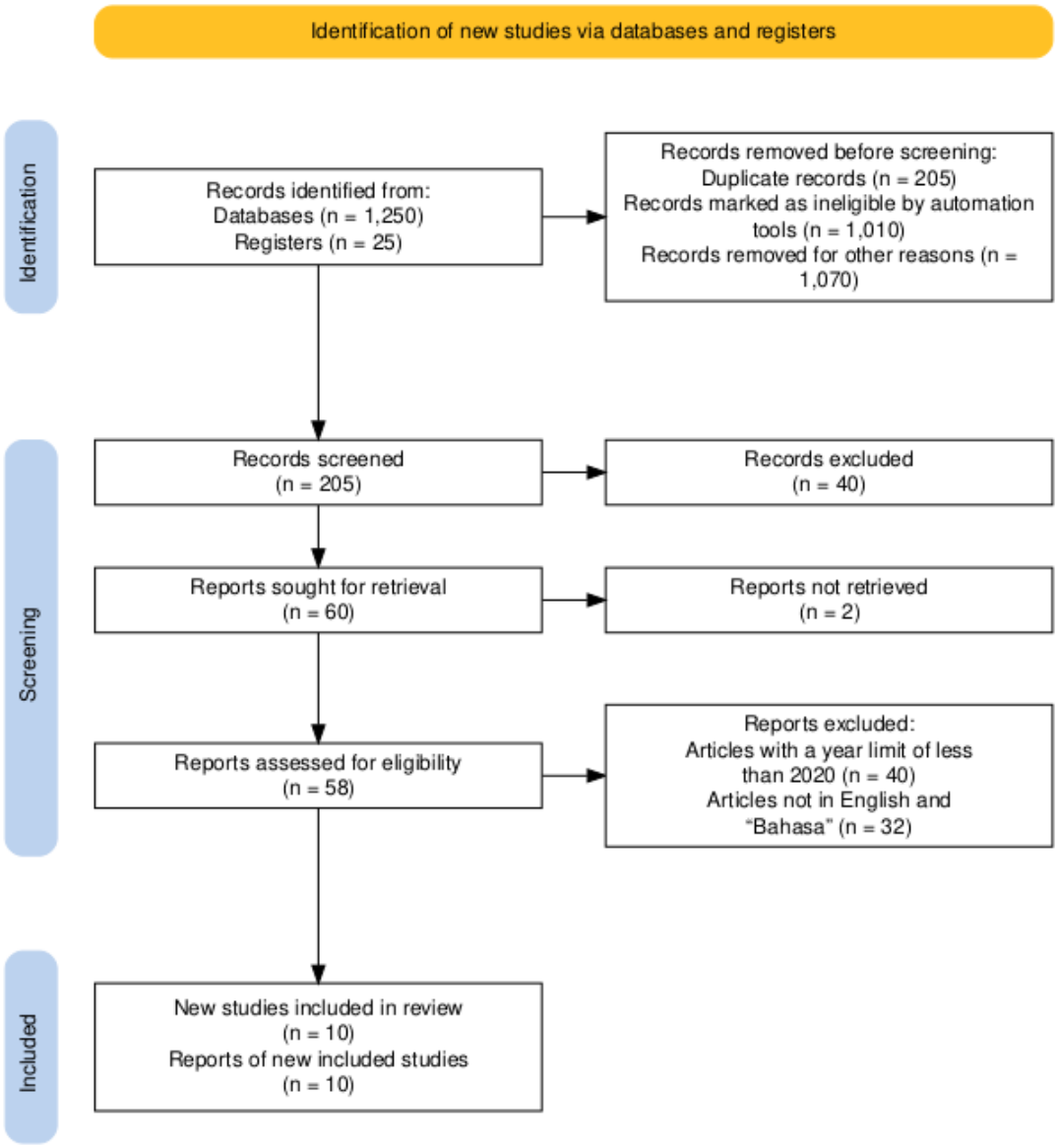

Figure 2: PRISMA Flow Diagram Illustrating the Identification, Screening, Eligibility, and Inclusion Stages

Data extraction

In data extraction of the article review format, the author entered it into an electronic spreadsheet, so that the data extraction process could be managed well. The data extraction process consists of: (1) author and title, (2) researcher's country of origin, (3) objectives, (4) methods, (5) results, (6) implications.

Results

The reviewed literature reveals distinct, country-specific findings regarding the role of novelty across scientific, cognitive, and technological domains (Cochrane Central Editorial Service *et al.*, 1996) Table 2 presents the data extracted from the research summaries, including the author, title, author's country of origin, objectives, methods, results, and implications. In Ireland, studies demonstrated a significant negative relationship between novelty and both scientific collaboration and funding, indicating that

funded papers exhibited lower novelty than unfunded ones. Dutch research identified novelty as a "cognitive highlighter" that enhances memory consolidation within specific time windows; additionally, Dutch scholarship provided a comprehensive review of Building Information Modelling (BIM) and sustainability. Chinese contributions encompassed the development of a quantitative framework (ITMCM) for measuring scientific novelty and the ERLNEIL-MDP algorithm, which established new benchmarks for medical data processing. Furthermore, Chinese research provided evidence that human– Gen AI collaboration specifically boosts creative novelty during the initial idea-generation phase. From other national contexts, a novel hybrid approach in Bangladesh achieved high accuracy in sentiment analysis. Malaysian research demonstrated that unsupervised deep learning effectively detects novelties in time-series data. Mexican scholarship concluded that AI in medical education has transitioned from a novelty to a pedagogical necessity. Finally, Nigerian research offered strategies to identify uncharted study areas by clarifying the distinction between research novelty and existing research gaps.

Table 2: Article Review Format

No	Author and Title	Researcher's Country Origin	Objectives	Methods	Result	Implications
1	Shin *et al*. (2022); Scientific collaboration, research funding, and novelty in scientific knowledge	Ireland	This study examines, first, the impact of scientific collaboration on novelty of research, investigate both the effect and moderating effect of research funding on novelty.	Using Web of Science publication data from European regions for the period between 2008 and 2017	There is a negative and significant relationship between scientific collaboration and novelty. Furthermore, funded papers show lower novelty than the unfunded, but funding does have a significant moderate effect on the relationship between collaboration and novelty.	By examining macro-meso-micro levels of collaborations in Europe and by linking them to the value of novelty in scholarly activities. Also, it could reveal the role of funding in research novelty which has been mostly unanswered.
2	Lorents *et al*. (2023); Novelty-induced memory boosts in humans: The when and how	Netherlands	Identified several factors that have been shown to influence whether novelty promotes memory or not, including the timing between novel experience and the learning events, the involvement with the novel material, and population characteristics (such as clinical diagnosis or age).	An electronic search was conducted between February and April 2021 using the PsycInfo and PubMed databases, and a new search was conducted in August 2022 to update the text with more recent articles.	Novelty enhances memory most effectively when encountered during a specific, critical time window surrounding a learning event, acting as a cognitive "highlighter" for adjacent information. Furthermore, it identifies the mechanistic role of the hippocampus and associated neuro modulatory systems (like dopamine) in tagging these novel events for preferential consolidation, thereby explaining how the memory	The behavioral findings to potential neurobiological mechanisms and discuss the relevance of specific findings in light of potential clinical and educational applications that could leverage novelty to improve memory.

					boost is achieved at a neural level.	
3	Wang *et al*., (2024); An effective framework for measuring the novelty of scientific articles through integrated topic modeling and cloud model	China	The aim of compiling this article is to create a practical framework for finding effective methods for determining novelty	Integrated Topic Modeling and Cloud Model, (ITMCM), BERTopic model to generate semantically informed topics.	This study successfully developed a quantitative framework that measures scientific novelty by integrating topic modeling with a cloud model, effectively translating textual content into a multi-dimensional novelty score. The framework was validated to strongly correlate expert assessments and demonstrated predictive power for an article's future citation impact, providing a more objective and granular tool for early-stage research evaluation.	The proposed framework is applicable across diverse scientific disciplines and publication venues, benefiting researchers, librarians, science evaluation agencies, policymakers, and funding organizations by improving the efficiency and comprehensiveness of identifying novelty research.
4	Islam *et al*., (2024); Challenges and future in deep learning for sentiment analysis: a comprehensive review and a proposed novel hybrid approach	Bangladesh	The approach of this study diverges by offering a thorough analytical perspective with critical analysis, research findings, identified gaps, limitations, challenges, and future prospects Specific to deep learning-based sentiment analysis in recent times.	Deep learning-based sentiment analysis	Achieved remarkable accuracy across different databases: IMDB (88.15%), Toxic (98.28%), CrowdFlower (92.34%), and ER (95.48%). Hence, this method holds promise for automated sentiment analysis and potential deployment.	The tendency in research is to enhance current tasks or create a new approach to address the issues of lack of coherence, negation, intensifier, and semantic meaning handling that text-based sentiment analysis encounters. Managing multimodal data, various data sources, live data, and feedback data are just a few of the many duties and difficulties. This highlights the necessity of exploring novel computational methods to enhance the precision of sentiment analysis on the social web and other associated domains.
5	Lv *et al*., (2024);	China	To effectively process and	The adaptive novelty-fitness	ERLNEIL-MDP, establishes a new	The algorithm's success can be

	ERLNEIL-MDP: Evolutionary reinforcement learning with novelty-driven exploration for medical data processing		analyze this complex and heterogeneous data, it propose evolutionary reinforcement learning with novelty-driven exploration and imitation learning for medical data processing (ERLNEIL-MDP) algorithm, including a novelty computation mechanism, an adaptive novelty-fitness selection strategy, an imitation-guided experience fusion mechanism, and an adaptive stability preservation module.	selection strategy balances exploration and exploitation by considering policies' novelty and fitness during selection.	state-of-the-art by achieving statistically significant improvements of 6.0% and 6.7% in F1-score on the MIMIC-III and n2c2 datasets, respectively, demonstrating a substantial and validated performance leap over previous best methods.	attributed to its novel integration of evolutionary strategies and RL, particularly its adaptive novelty-fitness selection and imitation-guided experience fusion mechanisms.
6	Saeed Akbari *et al*., (2024); Sustainability and building information modelling: Integration, research gaps, and future directions	Netherlands	These papers have pro-voided useful insights; it go deeper into the body of knowledge through a critical lens.	This paper seeks to thoroughly review the current literature concerning the integration of sustainability and Building Information Modelling (BIM)	98 journal articles are selected and grouped into four major categories, namely: (i) BIM-based Life-Cycle Sustainability Assessment (LCSA); (ii) BIM for green buildings; (iii) BIM-aided construction waste management; (iv) state-of-the-art topics. The novelty lies in giving a holistic understanding of previously dismissed issues and a critical area review.	Future research should concentrate on the holistic integration of emerging technologies to enhance sustainability assessments and decision-making processes. Investigating organizational adaptation strategies will be crucial to facilitate the successful adoption of BIM for sustainable construction, addressing challenges related to project de- livery, procurement, and stakeholder collaboration.
7	Hossen *et al*., (2024); Unsupervised novelty detection for time series using a deep	Malaysia	to identify and rectify unusual data and behaviors within Smart Home Systems (SHS)	In many domains, such as object Web threat detection, IoT intrusion prevention	The model's prowess in new detection, which has been successfully applied to benchmark	This novelty detection method targets large volumes of unidentifiable data, leverages domain adaptation for time-

	learning approach		remains a critical challenge.	systems, IoT network activity monitoring, aerial monitoring systems, and more, the use of a DNN in anomaly detection has dramatically increased. The anomaly detection technique, depending on deep learning for time-series data, is provided in this article by extending the unsupervised novel, an integrated unsupervised learning system trained exclusively on the standard dataset.	datasets. However, there is a restriction since deep learning algorithms can recognize noise as abnormalities.	series anomaly detection, and will be extended through deep hybrid learning to enhance forecasting robustness despite data quality challenges.
8	Shiyingzi Huang *et al*., (2026) Human–GenAI collaboration across creative phases: Cognitive mechanisms shaping novelty and usefulness	China	This study addresses to identify varying goals at different creative phases and explore the phase-specific influences of human–Gen AI collaboration on creativity;	Using a multimethod approach, including a qualitative study ($N = 20$), two lab experiments ($N_1 = 42$; $N_2 = 44$), and an online behavioral experiment ($N = 198$)	Human–GenAI collaboration in the idea generation phase (compared with the elaboration phase) enhances creative novelty by increasing cognitive flexibility, whereas human–GenAI collaboration in the idea elaboration phase (compared with the generation phase) improves creative usefulness by reducing cognitive overload	Practically, the findings offer actionable guidelines for creative professionals, including marketers, UX designers, and product managers. Rather than treating GenAI as a universal assistant, creators should strategically deploy it on the basis of the creative phase.
9	Lopez (2025); From Novelty to Necessity: Artificial Intelligence in Medical Education	Mexico	To argue that Artificial Intelligence (AI) has transitioned from being an experimental or supplementary tool ("Novelty") to an indispensable, core component of modern medical	A systematic and analytical approach to literature synthesis to build a compelling case for AI's transition from a novelty to a necessity.	AI in medical education is not a passing novelty but an evolving pedagogical necessity. The task now is to move from exploration to intentionality, from scattered enthusiasm to strategic planning and implementation	Students are invited, educators, and researchers alike to read these contributions not as isolated case studies, but as part of a shared conversation that will define the next decade of health professions education

			education ("Necessity"), and to outline the framework for its successful integration.			
10	Okeke (2025); Understanding Research Novelty and Research Gaps: Strategies for Identifying Unexplored Areas and Pioneering Innovative Contributions	Nigeria	To guide researchers in understanding how to strategically position their work within their academic fields while driving innovative contributions.	Methodological or conceptual review paper	The distinction between research novelty and research gaps, and presents strategies for recognizing uncharted areas of study while pioneering innovative contributions. It is intended to guide early-career researchers, other academics and scholars, toward a deeper understanding of how to contribute meaningfully to their fields.	Practical approaches for developing groundbreaking research that not only fills existing gaps but also drives future inquiry

Three thematic clusters emerged from the synthesis. The pursuit of novelty is a defining aspiration of scholarly work, yet enabling and sustaining it across disciplines remains challenging. Recent scholarship indicates that novelty emerges from the orchestration of diverse teams, methodological pluralism, and intelligent systems capable of surfacing overlooked patterns and ideas (Shin *et al*., 2022). Synthesizing current developments, three thematic clusters illuminate complementary pathways to novelty: (1) interdisciplinary collaboration and knowledge recombination, (2) advanced measurement frameworks beyond citation-based proxies, and (3) AI-enabled identification and generation of novel insights (Wang *et al*., 2024; Jeon *et al*., 2023; Islam *et al*., 2024; Lv *et al*., 2024; Huang *et al*., 2026).

Interdisciplinary Collaboration and Knowledge Recombination

Interdisciplinary collaboration is a fertile ground for innovation, particularly when teams span epistemic communities with distinct methods, vocabularies, and problem framings. Diverse teams are positioned to create novel conceptual linkages and methodological syntheses, enabling knowledge recombination that escapes domain constrained thinking (Shin *et al*., 2022). Organizational routines cross disciplinary seminars, shared lab spaces, co-supervision, and joint grants cultivate conditions for serendipitous alignment, while leadership interventions such as recognition of team-based outputs and seed funding help convert friction into productive tension that fuels originality (Shin *et al*., 2022). For postgraduate training, mixed-methods cohorts and translational problem statements equip early-stage researchers to navigate conceptual pluralism and articulate novel hypotheses (Mohammadi *et al*., 2025).

Measurement Frameworks Beyond Citation-Based Proxies

Citation counts are blunt instruments for capturing novelty because they lag-behind conceptual breakthroughs and conflate popularity with originality. Content-based analytics provide a more granular lens. Topic modeling approaches such as BER Topic, leveraging transformer embeddings to derive semantically coherent topics, allow researchers to track micro-shifts in discourse and identify emergent clusters deviating from mainstream trajectories (Wang *et al*., 2024). When combined with probabilistic cloud models, these methods yield nuanced portraits of conceptual landscapes, capturing ambiguity and dispersion typical of nascent ideas (Wang *et al*., 2024). Text-embedding outlier detection locates papers whose semantic vectors sit at the margins of established clusters; systematic analysis coupled

with expert review can reveal underappreciated innovations (Jeon *et al*., 2023). Multidimensional scoring, structural, methodological, and contextual novelty, prevents overfitting novelty to a single definition (Steyn, 2025).

AI-Enabled Identification and Generation of Novel Insights

Novelty detection is transforming from manual, expert-driven processes to scalable AI-enabled systems (Lv *et al*., 2024). Deep learning models trained on large corpora detect subtle semantic patterns, propose connections across literatures, and flag hypothesis spaces that warrant exploration (Islam *et al*., 2024). Reinforcement learning frameworks that incorporate novelty-driven exploration reward agents for venturing into less traversed conceptual territories, mitigating exploitation bias common in recommendation systems (Lv *et al*., 2024). Human–GenAI collaboration is a pragmatic equilibrium: AI surfaces candidate ideas and gaps, while human experts evaluate plausibility, relevance, and ethics (Huang *et al*., 2026). Guardrails and transparency in criteria, domain-bias audits, and human-in-the-loop validation to ensure AI-enabled novelty serves scholarly integrity (Islam *et al*., 2024; Huang *et al*., 2026).

Integrating the Clusters: A Conceptual Pathway

These clusters are mutually reinforcing collaboration provides the social and cognitive infrastructure for recombination; measurement frameworks articulate novelty in interpretable, multidimensional ways; and AI systems operationalize detection at scale, shortening the time from idea emergence to recognition and evaluation (Shin *et al*., 2022; Wang *et al*., 2024; Islam *et al*., 2024). Figure 3 indicates the novelty identification pipeline. Interdisciplinary teams generate candidate ideas, which are scored and visualized through content-based analytics. AI agents scan for underexplored connections and propose expansions, followed by human expert refinement and validation. Measurement updates inform future team composition and resource allocation (Jeon *et al*., 2023; Huang *et al*., 2026).

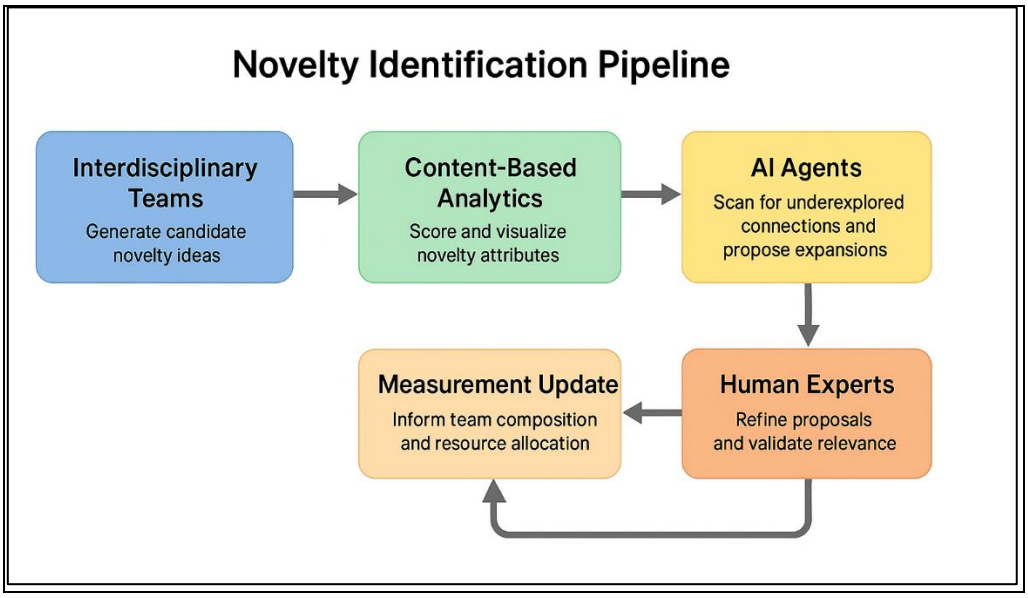

Figure 3: The Conceptual Pathway of Novelty Identification Pipeline

Discussion

The present systematic conceptual review synthesized recent scholarship on research novelty and research gaps, revealing three complementary thematic clusters: (1) interdisciplinary collaboration and knowledge recombination, (2) advanced measurement frameworks beyond citation-based proxies, and (3) AI-enabled identification and generation of novel insights. Collectively, these findings shift the discussion on novelty from an abstract aspiration to actionable, technology-driven strategies.

The first cluster confirms novelty rarely emerges from isolated, single-discipline efforts. Instead, it thrives in teams crossing epistemic boundaries, integrating diverse methods, vocabularies, and problem

framings (Chen *et al*., 2025). Crucially, assembling diverse experts alone is insufficient; intentional organizational routines—like joint grant applications, shared lab spaces, and co-supervision—are essential for transforming potential friction into productive tension (Liu *et al*., 2022). This aligns with recent calls to redesign academic incentive structures, rewarding team-based outputs over solo authorship (Gasparetto *et al*., 2025). In training environments, mixed-methods cohorts and translational problem statements prepare early-stage researchers to navigate conceptual pluralism and articulate novel hypotheses often unseen within a single discipline (James *et al*., 2024).

Traditional novelty assessment is significantly limited by an over-reliance on citation counts, which are retrospective, slow to accrue, and conflate popularity with originality (Haynes-Brown, 2025). This section highlights emerging content-based analytics that offer a more granular and immediate perspective (Hou *et al*., 2023). Transformer based topic modelling (BER Topic), combined with probabilistic cloud models, can capture semantic coherence and identify emergent research clusters that deviate from mainstream trajectories. Similarly (Jeong *et al*., 2024) utilized text embedding outlier detection to locate papers whose semantic vectors are situated at the periphery of established clusters, thereby flagging potentially underappreciated innovations for systematic review (Gogo, 2022). These methods move beyond binary (novel vs. not) judgments toward multidimensional scoring—structural, methodological, and contextual novelty—preventing overfitting to a single definition (Del Castillo & Guerguerian, 2026). For research gap identification, these tools systematically reveal underrepresented topics, unreplicated findings, or contradictory evidence that have eluded collective attention (Cochrane Central Editorial Service *et al*., 2025).

This third cluster represents a paradigm shift in novelty detection, transitioning from manual, expert-driven processes to scalable, AI-enabled systems (Michael Knop *et al*., 2024). Deep learning models trained on extensive corpora can discern subtle semantic patterns and posit connections across disparate literatures (Palumbo *et al*., 2026). Furthermore, advanced reinforcement learning frameworks that utilize novelty-driven exploration reward agents for venturing into less-traversed conceptual territory, thereby mitigating the exploitation bias common in recommendation systems (Muna, 2025). Nonetheless, the review also underscores several critical caveats: AI systems possess the capacity to entrench existing biases or generate superficially novel but implausible or unethical ideas (Lopez, 2025). Consequently, a pragmatic equilibrium necessitates human-GenAI collaboration, wherein AI identifies candidate ideas and potential gaps, and human experts critically evaluate their plausibility, relevance, and ethical implications (Jusoh *et al*.,2025; Leung *et al*., 2025) Robust safeguards, comprehensive domain-bias audits, and transparent evaluative criteria are thus paramount to ensure that AI-enabled novelty genuinely contributes to scholarly integrity, rather than inadvertently compromising it (Cochrane Central Editorial Service *et al*., 1996) .

A core argument of this review is that the three clusters are not independent but mutually reinforcing (El Arab *et al*., 2025). Specifically, interdisciplinary collaboration builds the social and cognitive infrastructure for knowledge recombination (Flindris *et al*., 2025). Advanced measurement frameworks then articulate novelty through interpretable, multidimensional analyses. Finally, AI systems operationalize detection at scale, significantly shortening the time from idea emergence to recognition (Yardibi *et al*., 2025).

Figure 3 illustrates how an integrated pipeline could operate: First, interdisciplinary teams generate candidate ideas. These ideas are then scored and visualized using content-based analytics. Next, AI agents scan for underexplored connections and propose hypothesis expansions, which human experts then refine and validate (Schlicht *et al*., 2025). Finally, measurement feedback continuously informs future team composition and resource allocation. This closed-loop system transforms novelty from an elusive ideal into a manageable, transparent, and scalable objective (Quistberg *et al*., 2025).

The findings highlight a paradigm shift from traditional citation-based measures toward AI-driven, content-centric approaches (Jeon *et al*., 2023). Measurement frameworks that integrate topic modeling and anomaly detection yield earlier and more granular signals of originality (Wang *et al*., 2024). Human–GenAI collaboration should be aligned with creative-phase goals to maximize novelty in ideation and

usefulness in elaboration (Huang *et al*., 2026). Interdisciplinary collaboration remains a cornerstone but requires attention to funding structures and team composition (Shin *et al*., 2022). Ethical considerations algorithmic bias, transparency, interpretability, and risk of metric gaming—must guide adoption to ensure responsible evaluation (Akbari *et al*., 2024).

Similarity and Integrity

This manuscript underwent an internal similarity and redundancy check using local tools. No external similarity services were used in this draft. Prior to journal submission, the manuscript will be screened using Turnitin/iThenticate, and a similarity certificate will be provided to ensure compliance with publication ethics.

Limitations and Future Directions

Novelty is field-contingent; definitions and baselines vary across disciplines, requiring domain calibration and expert input (Wang *et al*., 2024). AI systems inherit training-data biases that can marginalize non-English or regional scholarship; diverse corpora and regular bias audits are essential (Islam *et al*., 2024; Lv *et al*., 2024). Collaboration can be performative without genuine methodological integration; co-developed protocols and shared standards are more predictive of novelty than nominal interdisciplinarity (Shin *et al*., 2022; Ni & Wang, 2025). Future work should pursue hybrid models that combine semantic metrics with experimental validation and RL frameworks that reward relevance, robustness, and equity (Lv *et al*., 2024; Huang *et al*., 2026).

For individual researchers and trainees, the findings suggest several actionable steps: participate in mixed-methods cohorts, leverage topic modeling tools to delineate the periphery of a field prior to study design and integrate AI as a collaborative tool for ideation rather than an infallible authority (Gasparetto *et al*., 2025). For editors and peer reviewers, multidimensional novelty scoring (Choi & Lim, 2025) could effectively complement traditional peer review, thereby mitigating reliance on unsubstantiated "novelty claims" often presented in cover letters. For funding agencies, prioritizing interdisciplinary, team-based proposals that integrate AI-assisted literature analytics may generate outputs of heightened novelty compared to conventional investigator-initiated grants (El Arab *et al*., 2025). For developers of scholarly infrastructure, the development of transparent, auditable AI systems incorporating domain-specific guardrails is paramount to prevent the reinforcement of citation biases or the marginalization of non-mainstream methodologies (Mohammadi *et al*., 2025).

Conclusion

This review demonstrates that interdisciplinary collaboration and AI-driven methodologies represent a transformative paradigm for identifying research gaps and articulating novelty. By moving beyond conventional literature reviews toward computationally enhanced, data-driven strategies, researchers can more precisely map intellectual landscapes and target high-impact, underexplored areas. The integration of artificial intelligence into scholarly inquiry offers a powerful pathway for guiding future research with enhanced rigor, predictive capacity, and societal relevance across disciplines.

CRediT Authorship Contribution Statement

FMS: Conceptualization, methodology, analysis, drafting; EP: Literature search, data extraction, validation, and critical review.

AI Assistance Declaration

The author hereby declares that, during the preparation of this manuscript, generative AI tools such as ChatGPT, Microsoft Copilot, and Google Gemini were utilized to assist with language enhancement and grammar correction. Following the use of these tools, the author thoroughly reviewed and revised the content and takes full responsibility for the final version of the manuscript, ensuring its accuracy and adherence to the required academic standards.

Conflict of Interest

The authors declare that they have no conflicts of interest.

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References

Akbari, S., Sheikhkhoshkar, M., Rahimian, F. P., El Haouzi, H. B., Najafi, M., & Talebi, S. (2024). Sustainability and building information modelling: Integration, research gaps, and future directions. *Automation in Construction, 163*, 105420. https://doi.org/10.1016/j.autcon.2024.105420

Baako, I., Alhassan, H., & Gidisu, P. (2022). Understanding and spotting research gaps through a systematic literature review. *International Journal of Research and Innovation in Social Science, 6*(3), 549-554. https://shorturl.at/KZRa5

Chen, C. C., Wung, S. F., Rozenblit, J. W., & Roveda, J. M. (2025). The Value of a Nurse-Engineer Team in Evaluating Technology for Patient Care. *Critical Care Nursing Clinics of North America, 37*(2), 207-216. https://doi.org/10.1016/j.cnc.2025.02.002

Choi, S., & Lim, S. (2025). Artificial Intelligence in Pediatric Nursing Care: A Bibliometric and Visualization Analysis of the Literature (2000–2024). *CIN: Computers, Informatics, Nursing*, 10-1097. https://doi.org/10.1097/CIN.0000000000001360

Cochrane Central Editorial Service, Palacios, C., Hernandez, J., Ajmal, A., Rodriguez, A. J., Hassan, A. Y. I., ... & Ramella-Roman, J. C. (1996). Digital health, technology-driven or technology-assisted interventions for the management of obesity in children and adolescents. *Cochrane Database of Systematic Reviews, 2025*(7). https://doi.org/10.1002/14651858.CD015968

Cohen, W. M., Nelson, R. R., & Walsh, J. P. (2002). Links and impacts: the influence of public research on industrial R&D. *Management Science, 48*(1), 1-23. https://doi.org/10.1287/mnsc.48.1.1.14273

Czakó, A., Potenza, M. N., Hodgins, D. C., Yu, S. M., Wu, A. M., Jiménez-Murcia, S., ... & Demetrovics, Z. (2025). Research priorities in gambling: Findings of a large-scale expert study. *Journal of Behavioral Addictions, 14*(3), 1222-1249. https://doi.org/10.1556/2006.2025.00072

Del Castillo, J., & Guerguerian, A. M. (2026). Navigating the Evidence Gap: Expert Consensus as a Bridge to Research in Extracorporeal Cardiopulmonary Resuscitation for Adults. *Journal of the American Heart Association, 15*(4), e048459. https://doi.org/10.1161/JAHA.126.048459

El Arab, R. A., Almoosa, Z., Alkhunaizi, M., Abuadas, F. H., & Somerville, J. (2025). Artificial intelligence in hospital infection prevention: an integrative review. *Frontiers in Public Health, 13*, 1547450. https://doi.org/10.3389/fpubh.2025.1547450

Flindris, K., Flindris, S., Nteka, F., & Kaliardas, A. (2025). Interdisciplinary Collaboration and Job Satisfaction Among Doctors and Nurses in Greek Public Hospitals: A Cross-Sectional Study. *Cureus, 17*(7). https://doi.org/10.7759/cureus.88712

Gasparetto, M., Narula, P., Wong, C., Ashton, J., Kammermeier, J., Pierik, M., ... & Arebi, N. (2025). Efficacy of digital health technologies in the management of inflammatory bowel disease: an umbrella review. *The Lancet Digital Health, 7*(5), 100843. https://doi.org/10.1016/j.landig.2024.12.007

Gogo, S., & Musonda, I. (2022). The use of the exploratory sequential approach in mixed-method research: A case of contextual top leadership interventions in construction H&S. *International Journal of Environmental Research and Public Health, 19*(12), 7276. https://doi.org/10.3390/ijerph19127276

Haynes-Brown, T. K. (2025). The role of sampling in an explanatory sequential mixed methods study: General applications of the transformative paradigm. *Methods in Psychology, 12*, 100176. https://doi.org/10.1016/j.metip.2025.100176

Hossen, M. J., Hoque, J. M. Z., Ramanathan, T. T., & Raja, J. E. (2024). Unsupervised novelty detection for time series using a deep learning approach. *Heliyon, 10*(3). https://doi.org/10.1016/j.heliyon.2024.e25394

Hou, H., Li, X., Song, Y. A., Ji, Y., Sun, M., Wang, D., ... & Gu, H. (2023). Effect of interactive, multimedia-based home-initiated education on preoperative anxiety inchildren and their parents: a single-center randomized controlled trial. *BMC Anesthesiology, 23*(1), 95. https://doi.org/10.1186/s12871-023-02055-7

Huang, S., Long, L., Zhu, Y., & Zhu, J. N. (2026). Human–GenAI collaboration across creative phases: Cognitive mechanisms shaping novelty and usefulness. *International Journal of Information Management, 86*, 102986. https://doi.org/10.1016/j.ijinfomgt.2025.102986

Islam, M. S., Kabir, M. N., Ghani, N. A., Zamli, K. Z., Zulkifli, N. S. A., Rahman, M. M., & Moni, M. A. (2024). Challenges and future in deep learning for sentiment analysis: a comprehensive review and a proposed novel hybrid approach. *Artificial Intelligence Review, 57*(3), 62. https://doi.org/10.1007/s10462-023-10651-9

James, T. G., DeJonckheere, M., & Guetterman, T. C. (2024). Integrating transformative considerations and quantitative results through a participant selection joint display in explanatory sequential mixed methods studies. *Journal of Mixed Methods Research, 18*(1), 14-30. https://doi.org/10.1177/15586898221149470

Jeon, D., Lee, J., Ahn, J. M., & Lee, C. (2023). Measuring the novelty of scientific publications: A fastText and local outlier factor approach. *Journal of Informetrics, 17*(4), 101450. https://doi.org/10.1016/j.joi.2023.101450

Jeong, H., Park, D., Ha, E. K., Kim, J. H., Shin, J., Baek, H.-S., Hwang, H., Shin, Y. H., Jee, H. M., & Han, M. Y. (2024). Efficacies of different treatment strategies for infants hospitalized with acute bronchiolitis. *Clinical and Experimental Pediatrics, 67*(11), 608–618. https://doi.org/10.3345/cep.2023.01676

Jusoh, A. S., Remli, M. A., Mohamad, M. S., Cazenave, T., & Fong, C. S. (2025). How generative Artificial Intelligence can transform drug discovery?. *European Journal of Medicinal Chemistry, 295*, 117825. https://doi.org/10.1016/j.ejmech.2025.117825

Knop, M., Mueller, M., Kaiser, S., & Rester, C. (2024). The impact of digital technology use on nurses' professional identity and relations of power: a literature review. *Journal of Advanced Nursing, 80*(11), 4346-4360. https://doi.org/10.1111/jan.16178

Leung, T. I., Coristine, A. J., & Benis, A. (2025). AI scribes in health care: balancing transformative potential with responsible integration. *JMIR Medical Informatics, 13*(1), e80898. https://doi.org/10.2196/80898

Liu, M., Bu, Y., Chen, C., Xu, J., Li, D., Leng, Y., ... & Ding, Y. (2022). Pandemics are catalysts of scientific novelty: Evidence from COVID-19. *Journal of the Association for Information Science and Technology, 73*(8), 1065-1078. https://doi.org/10.1002/asi.24612

Lopez, M. (2025). From novelty to necessity: artificial intelligence in medical education. *Journal of Medical Education and Curricular Development, 12*, 23821205251369656. https://doi.org/10.1177/23821205251369656

Lorents, A., Ruitenberg, M. F. L., & Schomaker, J. (2023). Novelty-induced memory boosts in humans: The when and how. *Heliyon, 9*(3). https://doi.org/10.1016/j.heliyon.2023.e14410

Lorents, A., Ruitenberg, M. F. L., & Schomaker, J. (2023). Novelty-induced memory boosts in humans: The when and how. *Heliyon, 9*(3). https://doi.org/10.1016/j.heliyon.2023.e14410

Lv, J., Kim, B. G., Slowik, A., Parameshachari, B. D., Kumari, S., Chen, C. M., & Li, K. (2024). ERLNEIL-MDP: Evolutionary reinforcement learning with novelty-driven exploration for medical data

processing. *Swarm and Evolutionary Computation, 91*, 101769. https://doi.org/10.1016/j.swevo.2024.101769

Mohammadi, F., Salimi, R., Khazaei, S., & Bijani, M. (2025). Design and psychometric testing of a moral intelligence instrument for pre-hospital emergency medical services personnel: a sequential-exploratory mixed-method study. *BMC Emergency Medicine, 25*(1), 13. https://doi.org/10.1186/s12873-025-01171-6

Muna, N. D. (2025). Bridging the evidence gap: research equity in conflict-affected health systems. *International Journal for Equity in Health, 24*(1), 293. https://doi.org/10.1186/s12939-025-02661-6

Okeke, R. C. (2025). Understanding Research Novelty and Research Gaps: Strategies for Identifying Unexplored Areas and Pioneering Innovative Contributions. *Social Sciences and Education Research Review, 12*(1), 126-130. https://doi.org/10.5281/zenodo.15804528

Palumbo, M. C., Farina, L., & Petti, M. (2026). Precision Medicine Through Network Language: Integrating Clinical Insight and Data Expertise. *Genes, 17*(4), 467. https://doi.org/10.3390/genes17040467

Quistberg, D. A., Mooney, S. J., Tasdizen, T., Arbelaez, P., & Nguyen, Q. C. (2025). Invited commentary: deep learning—methods to amplify epidemiologic data collection and analyses. *American Journal of Epidemiology, 194*(2), 322-326. https://doi.org/10.1093/aje/kwae215

Salter, A. J., & Martin, B. R. (2001). The economic benefits of publicly funded basic research: a critical review. *Research Policy, 30*(3), 509-532. https://doi.org/10.1016/S0048-7333(00)00091-3

Schlicht, L., Wendsche, J., Melzer, M., Tschetsche, L., & Rösler, U. (2025). Digital technologies in nursing: an umbrella review. *International Journal of Nursing Studies, 161*, 104950. https://doi.org/10.1016/j.ijnurstu.2024.104950

Shin, H., Kim, K., & Kogler, D. F. (2022). Scientific collaboration, research funding, and novelty in scientific knowledge. *PLoS One, 17*(7), e0271678. https://doi.org/10.1371/journal.pone.0271678

Steyn, B. (2025). Could a novelty indicator improve science?. *Nature, 642*(8068), 543-543. https://doi.org/10.1038/d41586-025-01882-7

Tennant, J. P., Dugan, J. M., Graziotin, D., Jacques, D. C., Waldner, F., Mietchen, D., ... & Colomb, J. (2017). A multi-disciplinary perspective on emergent and future innovations in peer review. *F1000Research, 6,* 1151. https://doi.org/10.12688/f1000research.12037.3

Wang, Z., Zhang, H., Chen, J., & Chen, H. (2024). An effective framework for measuring the novelty of scientific articles through integrated topic modeling and cloud model. *Journal of Informetrics, 18*(4), 101587. https://doi.org/10.1016/j.joi.2024.101587

Yang, J., Wei, N., Qu, Y., Hu, C., Zhang, W., Liu, L., ... & Zheng, X. (2026). Spider: a flexible and unified framework for simulating spatial transcriptomics data. *Bioinformatics, 42*(1), btaf562. https://doi.org/10.1093/bioinformatics/btaf562

Yardibi, F., Chen, C., Aladag, C. H., & Kose, O. (2025). Current Trends and Future Directions of Statistical Methods in Medical Research: A Scientometric Analysis. *Journal of Evaluation in Clinical Practice, 31*(6), e70257. https://doi.org/10.1111/jep.70257