

A BIBLIOMETRIC ANALYSIS OF COMPETENCE, PROFESSIONAL SKEPTICISM, AND DIGITAL FORENSICS IN INVESTIGATIVE AUDIT QUALITY



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Abstract

The increasing complexity of financial fraud and corporate misconduct has heightened the demand for high-quality investigative audits. Achieving such quality, however, remains challenging, as it requires auditor competence, professional skepticism, and the effective use of digital forensic tools. This study aims at examining how these dimensions are reflected in the academic discourse on investigative audit quality. A bibliometric analysis was conducted using 66 documents indexed in Scopus between 2015 and 2025, mapping global publication trends, thematic clusters, and scholarly collaborations. The results indicate a significant rise in research after 2020, dominated by Business and Accounting, with growing contributions from Computer Science. Four thematic clusters emerged: audit quality and skepticism, fraud detection and competence, digitalization and forensic technology, and ethics and governance. These findings reveal research gaps, particularly in the combined study of skepticism and forensic technology, and emphasize the need for curriculum redesign, professional training, and adaptive regulation.

INTRODUCTION

In today's financial oversight landscape, investigative auditing has shifted from a supplementary role to a central mechanism for detecting, preventing, and addressing fraud, corruption, and financial misconduct. As economic systems grow increasingly globalized and technologically complex, so too

do the methods used by perpetrators to conceal illicit activities. In this context, the quality of investigative audit procedures becomes paramount not only to safeguard financial integrity but also to uphold public trust in both private and public sector institutions.

The quality of investigative audits rests on several critical components, notably auditor competence, professional skepticism, and the effective use of digital forensic tools (Muhdsan et al., 2024). In practice, investigative audit quality is demonstrated through the auditor's ability to conduct systematic fraud examinations (Muhdsan et al., 2024), gather and preserve legally admissible evidence, and apply rigorous procedures consistent with professional standards such as ISA 240 and ACFE guidelines. Auditor competence extends beyond technical expertise to encompass investigative acumen, regulatory knowledge, and contextual awareness—enabling auditors to analyze complex transactions, conduct interviews, interpret forensic evidence, and prepare comprehensive reports for potential legal proceedings. These competencies require both cognitive and practical skills to dissect intricate financial transactions, identify red flags, and interpret hidden patterns within vast and complex datasets (Bierstaker et al., 2006). Their importance is heightened in forensic contexts, where audit conclusions may carry legal weight and serve as evidence in court.

Beyond technical competence, professional skepticism represents a core attitudinal attribute that distinguishes effective investigative auditors. It refers to an auditor's propensity to maintain a questioning mindset, critically evaluate audit evidence, and resist pressures from confirmatory bias or client influence (Hurtt, 2010). In fraud-related audits, where management may deliberately conceal or distort information, maintaining professional skepticism is essential to uncovering misstatements and manipulations. Empirical studies have consistently shown that higher levels of skepticism are associated with stronger audit judgments and improved fraud detection capabilities (Quadackers et al., 2014).

Digital forensics equips auditors with advanced tools and techniques to extract, preserve, analyze, and present electronic data as evidence. From the Resource-Based View (Barney, 1991), these tools are strategic resources that enhance audit quality, while the Theory of Planned Behavior suggests their effectiveness depends on auditors' attitudes and perceived control in applying them (Tekavčič & Damijan, 2021). Forensic technologies allow auditors to uncover deleted files, unauthorized access logs, or data anomalies that traditional audit methods might overlook. As organizations increasingly store sensitive information in cloud environments, social platforms, and encrypted databases, mastery of digital forensic tools has become a crucial determinant of audit quality (Yanthi et al., 2021).

However, despite the recognized importance of these three factors, existing literature remains fragmented, with most studies addressing competence, skepticism, or digital forensics separately rather than integrating them to assess their combined impact on investigative audit quality. Previous bibliometric analyses have tended to examine audit quality or forensic accounting in general, without systematically synthesizing how these specific factors intersect and evolve in scholarly research. This highlights a research gap in understanding the holistic and interrelated dynamics among competence, professional skepticism, and digital forensics within investigative auditing.

To address this gap, this study conducts a comprehensive bibliometric analysis that: (1) maps global publication trends related to competence, professional skepticism, and digital forensics in investigative auditing; (2) identifies key thematic clusters and scholarly collaborations; and (3) clarifies underexplored intersections to inform future research directions. The research is guided by the following questions:

- RQ1: How has the global research landscape evolved regarding competence, professional skepticism, and digital forensics in investigative audits?
- RQ2: What thematic clusters and collaborative patterns characterize this body of literature?
- RQ3: What gaps or underdeveloped intersections can be identified to guide future research, and to what extent do current research trends align with actual investigative audit practices?

To provide a stronger theoretical foundation, this study integrates multiple perspectives. Agency Theory (Jensen & Meckling, 1976) underscores the necessity of investigative audits as a mechanism to address conflicts of interest between managers and stakeholders. The Theory of Planned Behavior (Ajzen, 1991) explains how auditors' professional skepticism is influenced by attitudes, subjective norms, and perceived behavioral control in making investigative judgments. From the Resource-Based

View (Barney, 1991), auditor competence and digital forensic tools are conceptualized as strategic resources that enhance audit quality and provide organizations with sustained advantages in fraud detection. Together, these perspectives frame how competence, skepticism, and digital forensics interact to shape investigative audit quality and enrich the bibliometric analysis.

By contributing a structured synthesis of the extant literature, this study seeks not only to advance theoretical understanding but also to inform policy design, professional training, and technological integration in investigative auditing practices. Ultimately, the findings are expected to emphasize the importance of aligning auditor competence, professional skepticism, and forensic technology to safeguard the financial and ethical integrity of institutions worldwide.

Based on the literature review and identified research gaps, this study proposes a conceptual framework that integrates auditor competence, professional skepticism, and digital forensics as interrelated determinants of investigative audit quality (Figure 1). This framework serves as the theoretical foundation for the bibliometric analysis undertaken in this study.



Figure 1. Conceptual Framework: The Influence of Competence, Professional Skepticism, and Digital Forensics on Investigative Audit Quality

METHOD

All documents were retrieved exclusively from the Scopus database, as it provides the most comprehensive and reliable indexing of peer-reviewed literature across business, finance, technology, and social sciences (van Eck & Waltman, 2010). Scopus indexes a wide range of high-impact journals, ensuring that both leading and emerging scholarship in the field are captured. In addition, its advanced analytics and standardized metadata enable robust bibliometric mapping, enhancing transparency, replicability, and comparability across studies (Bukar et al., 2023). The database also integrates seamlessly with tools such as VOSviewer for network visualization, cluster analysis, and co-occurrence mapping, which are widely regarded as best practices in bibliometric research (He et al., 2023). For these reasons, Scopus was selected as the sole data source to ensure methodological rigor and comprehensive coverage of literature on competence, professional skepticism, and digital forensics in investigative auditing.

The initial search query was constructed using a combination of keywords and Boolean operators to achieve both inclusivity and precision. The search string included the terms “investigative audit,” “competence,” “professional skepticism,” “digital forensics,” and “audit quality.” These keywords were selected for their conceptual relevance in the auditing literature and their frequent use in prior systematic reviews and audit quality frameworks. The application of Boolean operators ensured the retrieval of documents that explicitly address the intersection of these domains.

All documents were retrieved from the Scopus database, which was selected for its comprehensive coverage of peer-reviewed publications across business, finance, and technology. The search was limited to the period 2015–2025 to capture recent developments in investigative auditing within the context of digital transformation. However, reliance on a single database presents a limitation, as it excludes potentially relevant studies indexed in other platforms such as Web of Science or Dimensions.

An initial pool of 102 documents was retrieved, and titles and abstracts were screened for relevance to the study's thematic scope. Two researchers independently reviewed all abstracts using predefined inclusion and exclusion criteria, focusing on competence, professional skepticism, digital forensics, and audit quality. In addition to the bibliometric dataset, supporting case evidence was integrated from selected literature and practitioner interviews with investigative auditors from state institutions, providing contextual insights into how competence, skepticism, and digital forensics shape investigative audit practices. This case-based approach strengthens the study's contribution by linking bibliometric trends with real-world applications. To ensure inter-rater reliability, Cohen's Kappa coefficient was calculated ($\kappa = 0.82$), indicating strong agreement between reviewers. Any disagreements were resolved through consultation with a third reviewer. Following full-text screening, 66 documents were retained for the final analysis.

The metadata (authors, keywords, abstracts, sources, etc.) of the final dataset were exported in CSV format and analyzed using VOSviewer (He et al., 2023). This software was used to construct: (1) Keyword co-occurrence maps; (2) Author collaboration networks; (3) Thematic cluster visualizations.

Clustering in VOSviewer was based on co-occurrence frequency and total link strength (TLS), with clusters generated using the LinLog/modularity optimization algorithm. A minimum threshold of five keyword occurrences was applied to refine granularity. Clusters are visualized through color coding and spatial proximity in the network map.

In the VOSviewer analysis, keywords occurring fewer than five times were excluded to enhance the interpretability of the co-occurrence network. Clustering employed the built-in LinLog/modularity algorithm to group frequently co-occurring keywords and visualize their thematic relationships. This procedure highlights the main research themes and connections within the literature. Bibliometric analysis remains descriptive and exploratory, relying on publication metadata to map research trends and thematic clusters.

RESULTS

This section presents findings that address the three research questions outlined in the introduction. It first examines the evolution of global research on competence, professional skepticism, and digital forensics in investigative audits. It then identifies thematic clusters and collaboration patterns. Finally, it highlights research gaps and underexplored intersections to guide future studies.

A total of 66 documents were identified and analyzed using the Scopus "Analyze search results" feature and visualized with VOSviewer (van Eck & Waltman, 2010). The following section presents the temporal trends, subject area distribution, country contributions, document types, and thematic clustering of research on competence, professional skepticism, and digital forensics in investigative auditing.

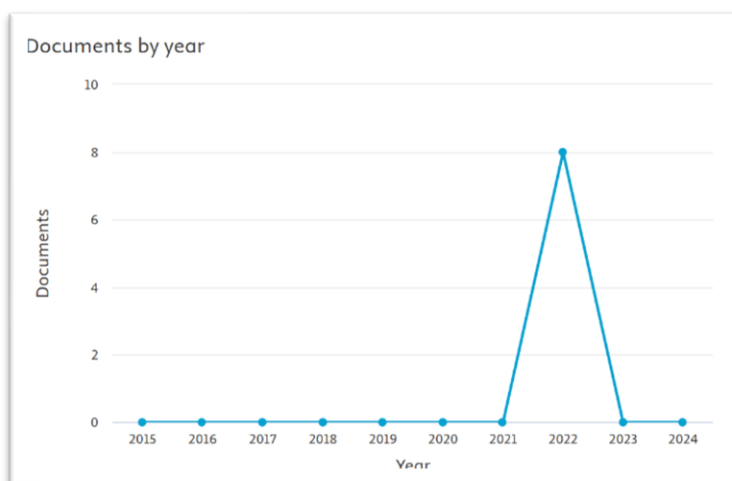


Figure 2. Document by Year

Figure 2 shows annual publication trends from 2015 to 2025. A notable peak occurs in 2022, with eight documents published in that year. Before 2022, research output remained relatively stagnant, and no further growth was observed afterwards. This temporal concentration indicates that scholarly attention to the integrated study of competence, skepticism, and digital forensics is relatively recent, emerging in response to heightened awareness of fraud risks and digital transformation pressures around 2020–2022 (Xu et al., 2023). Comparable bursts in auditing research activity have been documented during periods of regulatory reform or high-profile fraud scandals (DeFond & Zhang, 2014).

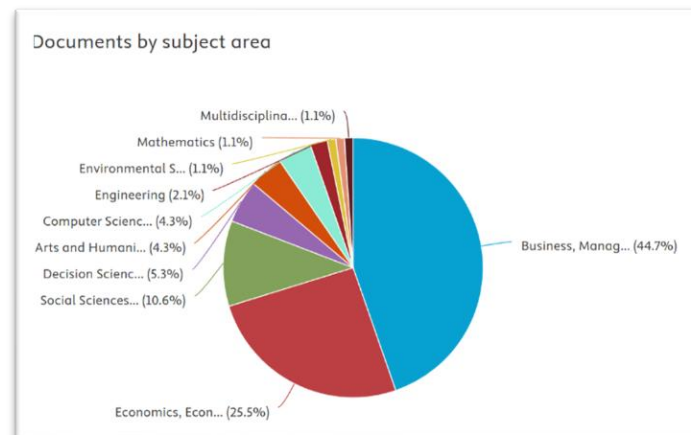


Figure 3. Document by Subject Area

Figure 3 shows that Business, Management, and Accounting account for nearly 45% of publications, while Economics, Finance, Social Sciences, and Computer Science make up the remainder. (1) The purpose of this subject-area breakdown is to highlight the interdisciplinary nature of the field, with two main implications. (2) The dominance of Business and Accounting reflects the applied, practitioner-oriented emphasis of investigative audit research, centered on fraud prevention and assurance quality. (3) The presence of Computer Science and Engineering indicates the growing integration of digital forensic technologies into audit practice (Tekavčič & Damijan, 2021).

Such analysis suggests that future research should strategically foster collaboration between auditing professionals and computer scientists to develop technology-enhanced investigative frameworks. At the same time, the subject-area distribution indicates the need for greater expansion into ethics and law, particularly to address governance and regulatory enforcement challenges in forensic auditing (Evinita & Kambey, 2021).

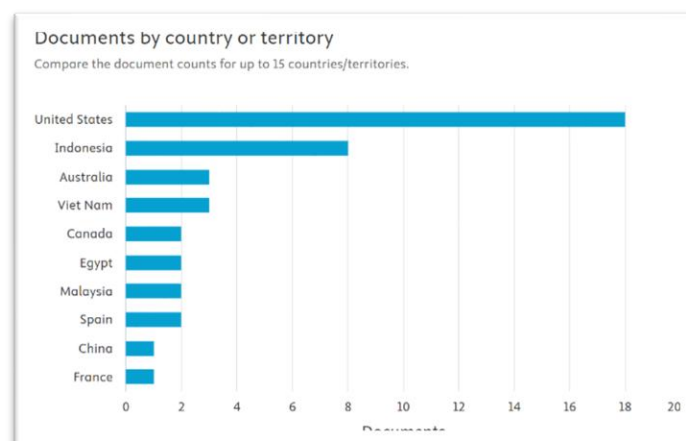


Figure 4. Document by Country/Territory

Figure 4 reveals that the United States leads with 19 publications, followed by Indonesia with eight. The high volume of publications in the United States can be attributed to several factors, including strong investment in audit quality research, mature regulatory frameworks such as the PCAOB requirements that encourage studies on professional skepticism and forensic readiness, as well as extensive academic-practitioner partnerships that support empirical fraud detection research (Quadackers et al., 2014). Meanwhile, Indonesia's significant contribution reflects contextual drivers such as the rapid digitization of financial systems in Southeast Asia, increasing digital fraud incidents in emerging markets, and a growing policy emphasis on strengthening anti-corruption measures and auditor competencies. This pattern reinforces that research interest often mirrors practical audit challenges and regulatory imperatives specific to each setting, highlighting the importance of context-sensitive capacity-building in forensic auditing, particularly within developing economies.

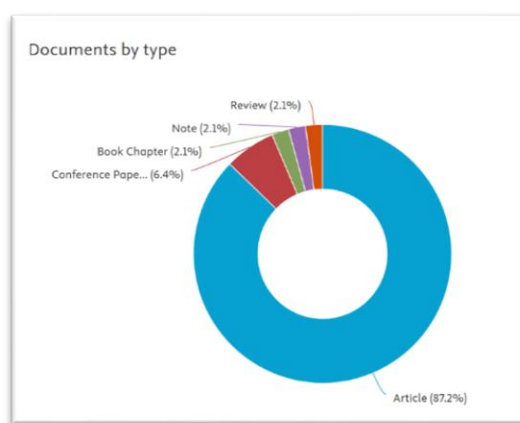


Figure 5. Document by Type

Figure 5 presents the distribution of documents by type on the topic of competence, independence, and big data analytics in investigative auditing. The majority are journal articles (87.2%), reflecting the dominance of peer-reviewed outlets and underscoring the academic community's strong methodological engagement with investigative audit effectiveness. Other document types include conference papers (6.4%), book chapters (2.1%), notes (2.1%), and reviews (2.1%), each contributing through alternative formats such as proceedings, edited volumes, brief communications, and syntheses. This distribution illustrates both the maturity of the field, shown by the prevalence of full-length research articles, and a measure of diversity in scholarly dissemination addressing emerging issues in investigative auditing and digital integration.

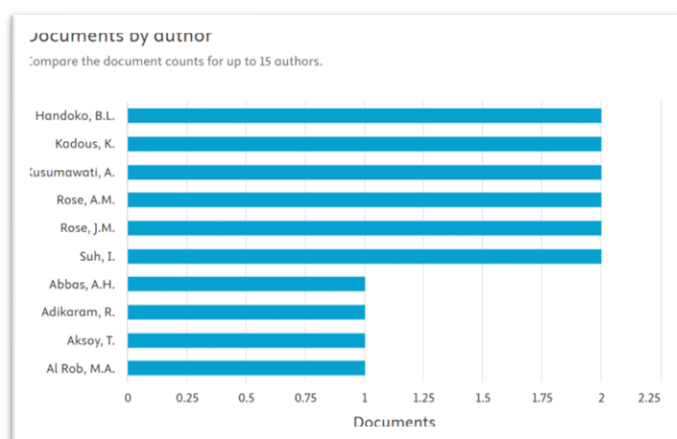


Figure 6. Document by Type

Figure 6 illustrates the top contributing authors in the Scopus-indexed literature on competence, independence, and big data analytics in the context of investigative audit effectiveness. Each listed author has contributed either one or two documents, indicating an even distribution of scholarly output across researchers in this emerging domain. Handoko, B.L., Kadous, K., Kusumawati, A., Rose, A.M., Rose, J.M., and Suh, I. have each published two documents, showing consistent engagement with the topic. Other contributors, such as Abbas, A.H., Adikaram, R., Aksoy, T., and Al Rob, M.A., have published one document each, reflecting broader academic interest despite relatively low frequency per author. This pattern shows that no single scholar dominates the discourse, and the dispersed authorship highlights the interdisciplinary and global relevance of research on investigative audit effectiveness.

A total of 15 contributing authors were identified in the field of competence, independence, and big data analytics in enhancing investigative audit effectiveness. These authors were selected based on the number of documents published in the Scopus database related to the topic. As shown in the figure, each author has contributed either one or two documents, indicating a broad distribution of research efforts without the dominance of a single scholar. This pattern reflects the growing academic interest and the collaborative nature of this emerging field.

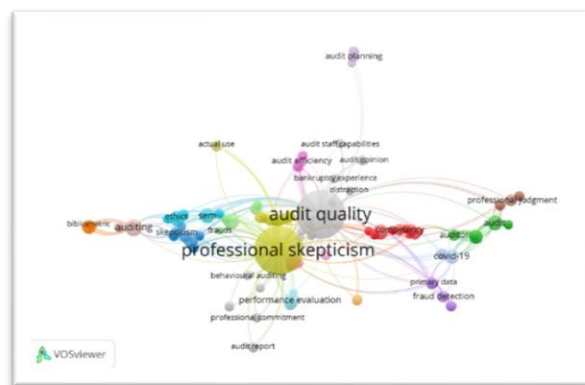


Figure 7. Keyword Co-occurrence Network in Investigative Audit Research
(Minimum 5 Occurrences, VOSviewer)

Figure 7 presents the keyword co-occurrence network generated using VOSviewer, where larger nodes represent keywords with higher frequency and thicker links indicate stronger co-occurrence relationships. The different colors in the visualization illustrate distinct clusters, reflecting the thematic distribution of research on investigative auditing. Based on VOSviewer's co-occurrence analysis, twelve thematic clusters were identified (see Table 1 and Figure 7). These clusters were generated using keyword co-occurrence and total link strength (TLS) through the LinLog/modularity optimization algorithm.

The key thematic clusters include Audit Quality and Professional Skepticism (Clusters 1 and 4), which emphasize the auditor's mindset and evidence assessment as central to the effectiveness of investigative audits (Hurt, 2010; Quadackers et al., 2014). Fraud Detection and Competency (Clusters 3 and 5) reflect the need for enhanced training and forensic capabilities to strengthen investigative procedures (Bierstaker et al., 2006). Digitalization and Technology Use (Clusters 2 and 8) highlight the increasing reliance on digital forensic tools and technological expertise in audit practice (Tekavčič & Damijan, 2021). Lastly, Ethics and Governance (Clusters 6 and 11) underscore the importance of ethical frameworks and governance mechanisms in maintaining audit integrity and accountability (Evinita & Kambey, 2021).

While VOSviewer provides an objective mapping of these relationships, the interpretation of clusters reveals underexplored intersections—particularly the integration of digital forensic training within professional skepticism education. Previous studies indicate that such integration enhances fraud detection effectiveness (Olubusola Odeyemi et al., 2024); however, only a few of the reviewed papers explicitly address this synergy.

Table 1. Analysis with VOSviewer Competence, Professional Skepticism, and Digital Forensics on Investigative Audit Quality

Cluster	Explanation
Cluster 1 (Red)	(17 Items) antagonistic narcissism, artificial intelligence audit, audit quality, jel classification, audit tenure, auditor experience, competency, fraud red flags, effects, independency, independent auditors, integrity, moderating variable, professional ethics, professional scepticism, skepticism and experience, structural equation model, Vietnam.
Cluster 2 (Dark Green)	(17 Items) accounting firms, audit, auditor, condition, digital devices, digitalization, digitization, least squares approximation, online technology, power, public accounting, quality, quality control, technology use, tradition, trait skepticism, values.
Cluster 3 (Dark Blue)	(15 Items) accountability, attitudes, audit judgments, auditors, client-specific previous, experiment, fraud, individual behaviour, joint audit, judgment, personality, professionalism, skepticism, subjective norms, theory of planned behaviour.
Cluster 4 (Yellow)	(15 Items) audit risk assessment, auditor judgment, auditor personality, cognitive dissonance, ethical culture, fsqca, materiality, pcaob, pls-sem, professional skepticism, professionally skeptical, professionally skeptical traits, reasonable assurance, reduced audit quality practices, time pressure.
Cluster 5 (Purple)	(13 Items) audit risk, auditor competency, fraud detection, Hurtt's professional skepticism, interpersonal understanding, non-big 4, primary data, professional aspects, questioning the mind, random sampling method, self-determining, simple random sampling, suspension judgement.
Cluster 6 (Light Blue)	(13 Items) audit firms, auditor's perception, commitment, competence, corruption, emotional quotient, ethics, experience and professionalism, governance, independence, integrated reporting, quality audit, sem.
Cluster 7 (Orange)	(12 Items) bibliometric, bibliometric analysis, co-citation analysis, co-word analysis, corporate governance, corporate-sustainability, emerging technologies, financial crisis, global economic crisis, industrial management, information analysis, sustainable development.
Cluster 8 (Dark Brown)	(11 Items) artificial intelligence, audit methodology, data analytics, governance, information overload, machine learning, perception, performance, professional judgment, robotic process automation, scepticism, technology.
Cluster 9 (Hot Pink)	(10 Items) audit effectiveness, audit efficiency, audit experience, audit outcome, audit review, external auditor, job satisfaction, on-site audits, remote audits, tax auditor.
Cluster 10 (Light Pink)	(9 Items) accounting estimates, attitude, auditing deficiencies, cognitive processing, counterfactual, fair value, fraud risk, impairment, mindset.
Cluster 11 (Light Green)	(9 Items) audit partner, auditor ethics, auditor motivation, auditor professional skepticism, Egypt, frauds, locus of control, perfectionism, personality traits.
Cluster 12 (Pale Blue)	(8 Items) audit report lag, COVID-19, discretionary accruals, health, human capital, influenza-like illness, material weaknesses, non-timely filings.

Table 1 shows the influence of competence, professional skepticism, and digital forensics on investigative audit quality, as synthesized from prior research in this bibliometric study, highlights several determining factors. First, auditor competence is central to improving audit quality, particularly in investigative contexts where case complexity demands strong analytical ability and contextual understanding (DeFond & Zhang, 2014; Lennox & Wu, 2018). However, competence without sufficient ethical grounding may result in rigid, rule-based assessments rather than nuanced forensic evaluations (Wygant & Lareau, 2015). Second, professional skepticism strengthens auditors' capacity to critically evaluate evidence and remain objective, which is essential for uncovering fraud and irregularities (Xu et al., 2023). A lack of skepticism, by contrast, risks excessive reliance on management representations, thereby weakening investigative outcomes. Third, digital forensics has emerged as a critical factor in modern auditing, enabling auditors to extract, preserve, and analyze digital evidence efficiently (AllahRakha, 2024). The integration of forensic technology improves both the accuracy and timeliness of fraud detection, though its effectiveness depends on auditors' digital literacy and access to technological resources (Olubusola Odeyemi et al., 2024; Taher et al., 2024). Moreover, organizational elements—such as robust internal control systems and competent audit committees—can mediate the effects of these three factors on audit outcomes (Evinita & Kambey, 2021). Collectively, the literature underscores that high-quality investigative audits are shaped not only by individual auditor capabilities but also by institutional support, ethical standards, and the strategic application of digital forensic tools.

DISCUSSION

This section presents findings that address the three research questions outlined in the introduction. First, it examines the evolution of global research on competence, professional skepticism, and digital forensics in investigative auditing. Second, it identifies thematic clusters and collaboration patterns across the literature. Finally, it highlights research gaps and underexplored intersections, offering directions to guide future studies.

The growing complexity of financial transactions and the increasing digitization of business processes present both opportunities and challenges for the audit profession. As organizations adopt new technologies and confront emerging fraud risks, investigative auditing must adapt to safeguard the integrity and reliability of financial reporting (Adetunji Paul Adejumo & Chinonso Peter Ogburie, 2025; Han et al., 2023; Kokina et al., 2025). Prior research emphasizes that auditors with strong analytical skills, professional skepticism, and digital forensic competence are in rising demand (Hurt, 2010). In particular, the profession increasingly requires practitioners who can critically evaluate evidence in complex, technology-mediated contexts while effectively utilizing advanced forensic tools. The integration of these competencies is therefore essential for developing a resilient and future-ready audit workforce.

The results of this bibliometric analysis underscore a growing scholarly focus on competence development, professional skepticism, and the application of digital forensic tools, with a notable surge in publications during 2022. This trend likely reflects the audit profession's response to heightened fraud risks in the aftermath of the COVID-19 pandemic and the rapid digital transformation of financial operations (DeFond & Zhang, 2014; Taher et al., 2024). In parallel, audit regulators and professional bodies have increasingly emphasized the importance of equipping auditors with advanced forensic technologies, including data extraction tools, visualization software, and analytic techniques to automate routine tasks and strengthen the accuracy of fraud detection (Tekavčič & Damijan, 2021).

Hence, there is a strong imperative for audit educators to redesign curricula that systematically integrate forensic technologies alongside critical thinking training. Programs should incorporate practical modules that familiarize students with digital forensic tools such as Caseware, ACL, Oversight, and Python, which support the automation of audit procedures and strengthen evidence-based judgments. Equally important is the cultivation of professional skepticism, achieved by training students to critically evaluate data sources, assess the reliability of digital evidence, and remain alert to increasingly sophisticated fraud schemes (Pérez-Calderón et al., 2025). Future research could evaluate the effectiveness of such curricular interventions in producing auditors who are competent, skeptical, and technologically proficient (Olubusola Odeyemi et al., 2024; Pimentel & Boulianne, 2022). In addition, further inquiry into the specific forensic analysis skills most valued by practitioners would enable the design of educational programs that are better aligned with the profession's evolving demands.

Several studies have underscored the importance of competence and professional skepticism in enhancing fraud detection effectiveness; however, few have presented empirically tested models that systematically integrate digital forensic training into audit education and professional development. Building on curriculum redesign principles proposed by Sarkar et al. (2021), scholars and educators are therefore urged to design and evaluate training frameworks that embed these competencies in a cohesive manner. Currently, there is a notable scarcity of pedagogical resources that support the incorporation of forensic analytics into auditing curricula, particularly within fraud investigation courses. Bridging this gap between academic preparation and professional practice requires the inclusion of modules on digital evidence collection, chain of custody documentation, and analytical review procedures enhanced through forensic tools.

Additionally, audit education researchers should prioritize the development and dissemination of practice-oriented teaching materials and case studies that equip students with hands-on experience in forensic audit software. Such resources should not only encourage critical reflection on internal control issues arising from digital technologies but also cultivate a skeptical mindset toward the manipulation and limitations of data-driven evidence. Moreover, they should provide structured guidance on applying

forensic analysis to real-world fraud scenarios within simulated audit environments. Beyond technical competence, curricula should also embed regular ethics seminars that emphasize public interest, accountability, and social responsibility, thereby ensuring that graduates recognize and internalize the ethical dimensions of forensic investigation (van Rooyen, 2020).

Aside from curriculum development, emerging pedagogical technologies present significant opportunities to enhance audit education. Interactive learning platforms and social media communities can facilitate knowledge exchange and peer support, provided that educators implement clear guidelines to minimize potential distractions or misuse (Stone et al., 2014). Additionally, the rise of generative AI tools offers potential for designing interactive fraud case studies, supporting students in practicing critical questioning, and explaining complex auditing concepts in accessible ways. Future research could examine the feasibility of developing audit-specific AI assistants to guide students in completing case exercises or applying forensic audit techniques (Al-Omush et al., 2025; Leocádio et al., 2024). Key questions remain regarding how to encourage students to use these tools responsibly, ensuring they enhance understanding of investigative audit principles without enabling plagiarism.

Another promising research avenue involves leveraging exogenous data sources, such as court records of fraud cases, news archives, or industry audit reports, for empirical analysis or to inform practical pedagogical exercises. Students could be tasked with collecting and analyzing these data to conduct fraud risk assessments, apply forensic procedures, and document their findings in audit working papers. Furthermore, collaboration between practitioners and educators can help evaluate whether current audit courses effectively address the increasing demand for training in digital forensics and professional skepticism.

While this study underscores the integrated importance of competence, skepticism, and forensic tools, some prior studies emphasize potential limitations. For instance, excessive skepticism may reduce efficiency if not balanced with contextual judgment. Similarly, Wygant & Lareau (2015) caution that overreliance on digital forensic tools can lead to overconfidence in technological outputs, potentially overlooking subtle behavioral cues. These perspectives highlight the need for nuanced training and critical reflection in applying these tools, reinforcing that no single factor alone guarantees audit effectiveness.

In sum, this study emphasizes that integrating competence, professional skepticism, and digital forensic tools in investigative auditing is not merely an academic concern but a professional imperative. The evolution of fraud risks and the widespread adoption of digital technologies require a corresponding transformation in audit education and professional development. By equipping future auditors with the necessary technical, analytical, and ethical skills, the profession can better safeguard financial integrity and maintain public trust. Nevertheless, significant gaps remain, presenting abundant opportunities for future research. Scholars and educators are encouraged to pursue these avenues to cultivate a more resilient, technologically literate, and ethically grounded audit profession.

A closer examination of the studies in our bibliometric dataset reveals distinct methodological trends shaping the current understanding of investigative audit quality. Archival and survey-based studies typically provide large-sample evidence on the relationship between auditor competence and audit outcomes but often overlook the behavioral dynamics underlying professional skepticism. Conversely, experimental and case-based research better captures auditors' cognitive processes and decision-making under uncertainty, yet these approaches are limited in generalizability. Few studies employ mixed-methods designs that integrate behavioral insights with large-scale data analysis, leaving a gap for approaches that simultaneously reflect both practical and psychological dimensions of auditing.

The theoretical synthesis from these studies suggests that the three determinants of investigative audit quality—competence, professional skepticism, and digital forensics—operate interdependently rather than in isolation. Competence provides the technical foundation for evaluating evidence, but without sustained skepticism, auditors may miss subtle fraud indicators. Digital forensic tools enhance detection capabilities, yet they are most effective when combined with human analytical skills and critical judgment. This synthesis highlights the need for future research to examine interaction

effects among these variables, such as whether the adoption of forensic technologies amplifies the impact of professional skepticism or mitigates the effects of limited auditor experience.

The findings of this study directly address the three research questions. Regarding RQ1, which concerns the evolution of global research, the bibliometric results reveal a marked increase in studies after 2020, reflecting the audit profession's response to rising fraud risks and accelerated digital transformation. This trend aligns with the Theory of Planned Behavior, which explains how attitudes such as professional skepticism influence auditors' actions, and with the Resource-Based View, which positions auditor competence as a strategic organizational capability. Prior research, including DeFond and Zhang (2014), also noted that financial crises stimulate audit-related studies, highlighting skepticism as a critical judgmental trait. Collectively, these findings underscore the importance of aligning auditor skills with the complexities of a technology-mediated audit environment.

In addressing RQ2, which concerns thematic clusters and collaboration patterns, four main streams emerged: audit quality and professional skepticism, fraud detection and competence, digitalization and forensic tools, and ethics and governance. These clusters reflect integrative theories of audit judgment and ethical governance frameworks, confirming that investigative audit quality is shaped by multiple interrelated dimensions. Collaboration patterns, however, remain concentrated in developed countries, with contributions from emerging economies notably underrepresented. This observation aligns with Pimentel and Boulianne (2022), who highlighted global disparities in audit research, and underscores the need for enhanced cross-country collaborations, particularly in regions where forensic auditing capabilities are still developing.

Finally, RQ3, which examines research gaps, reveals a limited integration of forensic tools, auditor competence, and professional skepticism, alongside underdeveloped pedagogical strategies for embedding these elements into audit education. Methodologically, archival and survey-based studies dominate but often overlook behavioral insights, whereas experimental designs provide insights into auditor cognition but suffer from limited generalizability. This fragmentation highlights the need for mixed-method approaches that combine behavioral evidence with large-scale data analysis. While Sarkar et al. (2021) propose curriculum redesigns incorporating forensic analytics, few empirical studies have validated such frameworks. Additionally, Wygant and Lareau (2015) caution against over-reliance on forensic technologies, which may cause auditors to miss subtle fraud cues. Collectively, these findings indicate that future research should explore interaction effects among competence, skepticism, and digital forensic tools, while audit education programs should integrate forensic analytics, critical thinking, and ethics training to prepare auditors for increasingly complex fraud scenarios.

Overall, the discussion indicates that competence, professional skepticism, and digital forensic tools should not be treated as isolated determinants but as mutually reinforcing components of investigative audit quality. This synthesis extends prior theoretical perspectives on audit judgment by demonstrating that their importance is heightened in a digital environment, where auditors must balance human judgment with technological capabilities. The findings also contribute to pedagogical debates (Stone et al., 2014; Sarkar et al., 2021) by offering evidence-based guidance for curriculum redesign. By situating these insights within the broader literature, this study not only maps research trends but also advances a more integrated theoretical understanding of investigative auditing.

CONCLUSION

This study underscores that integrating auditor competence, professional skepticism, and digital forensic tools is critical for enhancing investigative audit quality. The findings reveal notable gaps in both research and practice, particularly regarding the simultaneous development of these competencies through education and training. Audit educators are encouraged to design curricula that incorporate forensic technologies and foster skeptical thinking, equipping graduates to navigate complex, technology-driven audit environments. At the same time, audit firms should implement targeted professional development programs to strengthen auditors' abilities in detecting contemporary fraud schemes. Policymakers may leverage these insights to design adaptive regulations tailored to the evolving digital audit landscape, particularly in emerging economies where such tools remain

underutilized. By clarifying these priorities and promoting integrated strategies, this study offers actionable guidance for stakeholders committed to advancing investigative auditing in a dynamic, digitized world.

Nevertheless, this study is limited by its exclusive reliance on bibliometric analysis of Scopus-indexed publications, which may omit relevant regional or non-indexed studies and does not capture auditors' actual practices. Future research should complement bibliometric insights with empirical investigations such as surveys, interviews, or case studies and cross-country comparisons to examine how competence, skepticism, and forensic tools interact in practice. Such approaches would enhance both the external validity and practical relevance of research aimed at advancing investigative audit quality.

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