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Computational Accounting Theory: Addressing Breton's Epistemological Critique Through Artificial Intelligence and Blockchain Technology

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ABSTRACT

The scientific legitimacy of accounting has been contested for decades, with recent critiques questioning whether it possesses the characteristics of a scientific discipline. Breton's 2019 analysis argued that traditional accounting theory fails to meet fundamental scientific standards because of its normative orientation and its lack of predictive capability. This conceptual paper examines technological developments between 2020 and 2025 and proposes a theoretical framework, Computational Accounting Theory, that addresses these epistemological concerns. Through a systematic analysis of recent literature, we demonstrate that machine learning algorithms provide falsifiable predictions with measurable accuracy, while blockchain-based systems establish fundamentally different epistemological foundations compared to conventional accounting. Our framework identifies four distinguishing characteristics: descriptive-predictive orientation, empirical falsifiability, practical implementability, and paradigmatic structure. Evidence from implementations in major accounting firms and empirical studies supports the viability of this framework. However, challenges, including algorithmic bias, transparency deficits, and regulatory lag, remain significant. This research provides novel theoretical foundations for understanding accounting as a computational discipline, identifying implications for methodology, practice, and education.

Keywords: *Accounting theory, computational methods, machine learning, blockchain technology, epistemology, paradigm shift*

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INTRODUCTION

Academic debates surrounding accounting's status as a scientific discipline have intensified over recent decades, transcending mere taxonomic classification to encompass profound implications for knowledge generation, validation procedures, and practical application. While accounting has achieved professional legitimacy and institutional recognition, its theoretical foundations remain subject to sustained epistemological scrutiny. This tension between professional acceptance and theoretical ambiguity creates fundamental questions about how accounting knowledge should be developed and evaluated.

Breton's 2019 comprehensive examination articulated particularly stringent critiques of accounting's scientific claims. His analysis identified four principal deficiencies: theoretical frameworks predominantly prescribe practices rather than generating testable predictions; paradigm terminology has been misappropriated without corresponding substantive characteristics; research outputs demonstrate limited relevance to professional contexts; and methodological choices reflect institutional interests rather than objective scientific criteria. These concerns build on established philosophy of science frameworks, particularly Popper's falsifiability criterion and Kuhn's paradigm theory, to question whether any existing accounting framework satisfies the basic requirements of scientific inquiry.

The critique resonates with fundamental tensions in the development of accounting theory. Traditional approaches have oscillated between normative prescription and positive explanation, with neither successfully establishing accounting as genuinely scientific. Normative frameworks offer guidance but resist empirical testing, while positive theories claim scientific status but deliver minimal predictive or explanatory power. This theoretical impasse left the discipline in epistemological ambiguity, raising questions about whether accounting could ever achieve scientific legitimacy or must remain primarily a technical practice supported by prescriptive conventions.

The temporal context of existing critiques creates important analytical opportunities. Breton's assessment preceded substantial technological developments during the 2020-2025 period, an interval marked by accelerated integration of computational methods into accounting contexts. Machine learning algorithms, blockchain-based systems, and automated data processing technologies have fundamentally altered both research possibilities and practical implementations during this timeframe. Contemporary evidence suggests potential resolution of previously identified epistemological challenges. Recent systematic reviews document that algorithmic methods now demonstrate substantial predictive capabilities across multiple accounting domains, with accuracy rates consistently exceeding traditional approaches (Kureljusic & Karger, 2023; Ranta et al., 2023). Blockchain technology enables real-time verification systems that operate on fundamentally different trust mechanisms than conventional frameworks (Chowdhury, 2021; Han et al., 2023). Major professional services organizations have implemented computational systems at scale, with measurable operational impacts documented in recent empirical studies (Zhang et al., 2025).

These technological shifts create a critical gap in theoretical literature. While existing critiques effectively demonstrated limitations of traditional frameworks, the epistemological implications of computational methods remain largely unexamined. Three fundamental questions emerge: whether algorithmic approaches satisfy falsifiability requirements through objective validation procedures; whether blockchain-based systems constitute genuine paradigmatic shifts with incompatible epistemological foundations; and whether computational methods bridge the theory-practice divide through directly implementable knowledge generation. Addressing these questions requires systematic theoretical development grounded in both philosophy of science and contemporary technological capabilities.

This paper addresses identified gaps by developing a comprehensive theoretical framework termed Computational Accounting Theory. Our analysis pursues three specific objectives: articulating epistemological foundations that distinguish computational approaches from conventional frameworks; demonstrating, through a literature synthesis, that machine learning methods enable empirically falsifiable accounting knowledge; and examining whether blockchain-based systems satisfy the requirements for paradigmatic transformation in the Kuhnian sense. The research makes multiple contributions to the discourse on accounting theory. Theoretically, we establish computational methods as epistemologically defensible foundations for accounting knowledge, thereby transcending the normative-positive dichotomy that dominates academic debates. We propose four defining characteristics, descriptive-predictive orientation, empirical falsifiability, practical implementability, and paradigmatic structure, that collectively distinguish computational approaches from traditional frameworks. Methodologically, we demonstrate how validation procedures employed in machine learning operationalize Popper's falsifiability in ways unavailable to conventional accounting research, enabling objective testing of theoretical claims through out-of-sample validation and performance metrics.

Practically, our analysis provides guidance for technology adoption grounded in epistemological clarity rather than technological determinism or uncritical enthusiasm. By articulating how computational methods address fundamental theoretical deficiencies, we offer frameworks for evaluating which technologies merit adoption and how they should be implemented. Additionally, we identify implications for accounting education, suggesting that computational literacy entails fundamental shifts in knowledge-generation processes rather than merely supplementary technical skills.

LITERATURE REVIEW

Evolution of Accounting Theory: From Normative to Positive Frameworks

Accounting theory has traversed distinct developmental phases, with normative and positive approaches representing successive, yet ultimately inadequate, attempts to establish theoretical foundations. Understanding these historical developments provides essential context for evaluating computational alternatives and their potential to address longstanding epistemological challenges. The normative tradition, prevalent from the 1940s through 1960s, pursued logical derivation of optimal accounting practices from foundational axioms or organizational objectives. Scholars working within this tradition employed deductive reasoning to prescribe measurement and disclosure practices they considered superior to existing conventions. This approach assumed that rigorous logical analysis could identify objectively better accounting methods, with implementation expected to follow once proper procedures were demonstrated.

However, normative theory encountered devastating critiques across multiple dimensions. Prescriptive statements resist empirical testing because they reflect value judgments rather than factual claims about observable phenomena. Competing normative frameworks cannot be adjudicated on the basis of evidence because disagreements stem from divergent axioms rather than empirical errors. The approach provides no mechanism for explaining observed diversity in actual practices, focusing instead on what should occur rather than what does occur. Breton (2019) synthesized these critiques, characterizing normative approaches as combinations of personal preferences and informal inductions that inappropriately claim scientific status and seek prestige through scientific terminology. Positive accounting theory emerged during the 1970s-1980s as an explicit reaction to normative approaches, claiming to explain and predict rather than prescribe. This framework employed economic reasoning to derive hypotheses about how managers select accounting methods, emphasizing contractual arrangements, political costs, and information asymmetries as explanatory factors. Proponents positioned this approach as a scientific advancement, asserting that explanation and prediction rather than prescription constitute legitimate theoretical objectives (Watts & Zimmerman, 1986).

Despite scientific aspirations, positive theory encountered substantial difficulties in execution. Empirical validation consistently showed limited explanatory power, with typical studies accounting for only a minimal amount of variance in accounting choices. Predictive performance remained weak, with models frequently failing when tested on new samples not used during model development. Breton (2019) noted that empirical tests have shown that the core hypotheses generated by positive accounting theory possess both low predictive and explanatory power, raising fundamental questions about the approach's scientific credentials. This historical trajectory left accounting in epistemological ambiguity. Normative frameworks offered prescriptive guidance but lacked scientific foundations, while positive approaches claimed scientific status but demonstrated minimal predictive or explanatory capability. Neither framework satisfied basic requirements for scientific theorizing as articulated in philosophy of science, creating opportunities for alternative foundations grounded in different methodological approaches.

Philosophical Foundations: Falsifiability and Paradigmatic Structure

Evaluating accounting's scientific status requires explicit engagement with philosophical frameworks of science. Two approaches prove particularly relevant: Popper's falsificationism and Kuhn's paradigm theory. These frameworks provide criteria for distinguishing scientific from non-scientific claims and for understanding how disciplines develop and transform over time. Falsificationist philosophy, developed extensively by Popper (1959), establishes demarcation criteria for distinguishing scientific from non-scientific claims. Scientific theories must generate risky predictions that empirical evidence could potentially disconfirm. Theories that explain all possible observations lack scientific content because they cannot be meaningfully tested. If a theory accommodates any conceivable outcome, it makes no genuine predictions. Genuine scientific claims specify conditions under which they would be refuted, enabling empirical adjudication between competing theories through observation and experimentation. In accounting contexts, falsifiability requires that theoretical frameworks generate specific, testable predictions about accounting phenomena rather than offering general prescriptions or post hoc rationalizations. A theory claiming that highly leveraged firms will select income-increasing accounting methods makes a falsifiable prediction; empirical observation can reveal whether this relationship holds or fails. Conversely, normative claims about optimal accounting practices cannot be falsified because they address what should occur rather than what will occur, placing them outside the domain of empirical science.

Traditional accounting frameworks struggle with falsifiability requirements. Normative theories resist testing because prescriptive statements do not make factual claims subject to empirical validation or refutation. Positive theories attempt testable predictions but encounter difficulties: low explanatory power suggests fundamental theoretical weaknesses, yet researchers frequently employ auxiliary hypotheses to explain away disconfirming evidence rather than treating failures as genuine theory falsification. This practice undermines testability by making theories increasingly flexible rather than increasingly precise. Paradigmatic frameworks, articulated by Kuhn (1962), offer complementary perspectives on scientific development and transformation. Mature sciences operate within paradigms characterized by shared exemplars that provide templates for problem-solving, symbolic generalizations that structure theoretical discourse, and methodological commitments that guide research activities. These shared elements enable communities of researchers to work productively within established frameworks while recognizing and addressing anomalies.

Paradigmatic transformation occurs when anomalies accumulate sufficiently to provoke revolutionary shifts, with crucial characteristics being incommensurability between competing frameworks. Revolutionary paradigms rest on incompatible fundamental assumptions and cannot be directly compared or evaluated using common criteria. This incommensurability means that paradigm shifts represent wholesale transformations in how disciplines conceptualize their domains rather than merely adopting new techniques within existing frameworks. Breton (2019) provided an extensive critique of the use of paradigm terminology in the accounting literature, demonstrating that claimed paradigms typically represent methodological variations rather than comprehensive theoretical frameworks with genuinely incompatible foundations. Attempts to apply Kuhnian developmental stages to accounting history founder because the discipline never achieved genuine paradigmatic unity, characterized by shared exemplars, symbolic generalizations, and fundamental commitments that structure research activities. This analysis raises questions about whether accounting could undergo a genuine paradigm shift or whether such terminology fundamentally misrepresents the discipline's developmental patterns and theoretical structure.

Machine Learning and Artificial Intelligence in Contemporary Accounting

Recent technological developments have substantially transformed both accounting practice and research possibilities, with machine learning applications demonstrating capabilities previously unavailable within traditional frameworks. Understanding these developments provides empirical foundations for evaluating whether computational methods enable genuine epistemological advances beyond conventional approaches. A comprehensive synthesis by Ranta et al. (2023) examined machine learning applications in management accounting through a systematic review of over 50 recent studies. Their analysis identified diverse applications, including cost prediction, budgeting optimization, performance measurement systems, and variance analysis. The review documented consistent performance gains over traditional statistical methods, with algorithmic approaches demonstrating superior accuracy across multiple prediction tasks. Critically, the authors argued that machine learning enables pattern recognition at scales and complexities exceeding human analytical capabilities, suggesting fundamental transformations in how accounting knowledge is generated and applied rather than merely incremental improvements in existing processes.

Kureljusic and Karger (2023) focused specifically on forecasting applications through a systematic literature review that synthesized findings from 52 studies spanning 2 decades. Their analysis revealed consistent patterns: algorithmic approaches employing random forests, support vector machines, and neural networks substantially outperform traditional statistical methods across earnings predictions, cash flow forecasts, and bankruptcy assessments. Accuracy rates cluster in the seventy-five to ninety percent range, representing substantial improvements over conventional approaches that typically explain less than twenty-five percent of variance in accounting outcomes. Notably, some studies documented cases in which algorithms outperformed professional analysts' predictions, suggesting genuine advances in predictive capability rather than mere computational efficiency. These machine learning applications satisfy Popper's falsifiability requirements through standard validation methodologies, establishing clear criteria for theory evaluation. Models are trained on historical data samples, then rigorously tested on previously unseen data to assess generalization performance. Researchers employ objective metrics, including precision, recall, F-score, and area under receiver operating characteristic curves, to quantify predictive accuracy with mathematical precision. Models making specific accuracy claims can be empirically disconfirmed when tested on new samples; a model claiming 85% accuracy but achieving only 70% faces clear falsification of its predictive claims.

This validation structure represents a substantive epistemological advance over traditional accounting research, in which theoretical failures are frequently attributed to measurement difficulties or omitted variables rather than to fundamental theoretical inadequacies. Machine learning frameworks treat predictive failures as evidence requiring model modification or abandonment, establishing clearer standards for knowledge accumulation through iterative refinement of theoretical understanding. Research by Zhang et al. (2025) examined organizational adoption patterns using the Technology Acceptance Model and Technology-Organization-Environment frameworks. Their empirical investigation of over 300 accounting professionals revealed widespread adoption across major firms, with particular emphasis on audit automation enabling comprehensive transaction analysis, fraud detection through anomaly identification algorithms, and regulatory compliance verification through automated rule checking. Adoption appears driven by demonstrated utility and measurable performance improvements rather than technological enthusiasm, with critical barriers including concerns about algorithmic transparency, data privacy implications, and organizational readiness for technological transformation.

Contemporary implementations document substantial deployment in professional contexts. Major accounting firms have operationalized algorithmic systems that enable the examination of complete transaction populations rather than traditional sampling approaches, real-time anomaly detection for proactive fraud prevention, and automated compliance checking for complex regulatory requirements. These implementations demonstrate practical viability while generating measurable operational impacts, including efficiency gains ranging from forty to sixty percent and error reduction of seventy to eighty-five percent in automated processes. Recent comprehensive reviews further document this technological transformation. The 2025 systematic analysis examining management accounting and artificial intelligence synthesized 91 articles across AI, machine learning, deep learning, and generative AI applications. This review emphasized that digital technologies fundamentally reshape management accountants' roles, moving them from data processors to strategic advisors, suggesting that the transformation extends beyond technical tools to encompass professional identity and organizational functions.

Blockchain Technology and Accounting System Transformation

Blockchain technology represents another significant development with profound epistemological implications distinct from machine learning applications. While algorithmic approaches enhance prediction and analysis within existing structures, blockchain systems enable fundamentally different organizational and verification architectures. Recent scholarship has examined whether these differences constitute genuine paradigmatic transformation or merely technological evolution within existing theoretical frameworks. Chowdhury (2021) articulated the concept of triple-entry accounting, arguing that blockchain enables qualitatively different systems compared to conventional double-entry frameworks. Traditional approaches rely on independent ledgers maintained by transaction parties, requiring subsequent reconciliation processes and external verification to establish accuracy. Blockchain systems create shared, cryptographically secured records of transactions visible to all network participants, fundamentally altering trust mechanisms and verification processes. Rather than relying on institutional actors to maintain accurate records, blockchain systems use distributed consensus protocols and cryptographic verification, providing mathematical certainty about transaction integrity.

Dai and Vasarhelyi (2017) explored implications for audit and assurance functions, arguing that blockchain enables continuous verification rather than periodic examination characteristic of traditional approaches. Conventional audit methodologies sample transactions at intervals, testing whether recorded amounts correspond to underlying economic events through retrospective examination of documentation. Blockchain systems provide real-time verification through cryptographic validation and consensus mechanisms, potentially transforming audit from retrospective examination to concurrent assurance. Smart contracts enable automated execution of predefined business rules, further reducing reliance on human judgment and subsequent verification processes. Han et al. (2023) conducted a comprehensive literature review examining the integration of blockchain technology and artificial intelligence in accounting and auditing contexts. Their synthesis revealed growing recognition that these technologies function synergistically rather than independently. Blockchain provides immutable data storage and verification infrastructure, while artificial intelligence enables sophisticated pattern recognition and predictive analytics operating on blockchain-secured data. This integration suggests the emergence of comprehensive computational accounting systems combining multiple technological capabilities within unified frameworks.

Research published in specialized journals has examined integration possibilities combining blockchain storage with Internet of Things sensors and standardized reporting protocols. These analyses propose comprehensive architectures in which sensors automatically capture transaction data at the point of occurrence, blockchain systems provide immutable storage and cryptographic verification, and automated reporting engines generate standardized financial statements without manual intervention. While technical challenges remain substantial, including scalability limitations and interoperability concerns, these proposals demonstrate potential for fundamental transformation in how accounting systems operate and generate information. A critical analysis of these developments requires examining whether they satisfy the requirements for a paradigmatic transformation in Kuhn's sense. Do blockchain-based systems rest on fundamentally incompatible assumptions compared to conventional frameworks, or do they represent evolutionary improvements within existing paradigms? Can both systems coexist indefinitely, or does blockchain adoption require abandonment of traditional approaches? Does blockchain accounting possess distinct symbolic generalizations, shared exemplars, and methodological commitments that structure research and practice differently than conventional accounting? These questions require a systematic analysis of paradigmatic criteria applied to specific technological capabilities and their theoretical implications.

Theoretical Framework: Computational Accounting Theory

Conceptual Foundations and Epistemological Positioning

Computational Accounting Theory is a comprehensive framework that addresses epistemological deficiencies in traditional approaches while incorporating capabilities enabled by technological developments. This framework rests on the fundamental recognition that computational methods enable qualitatively different relationships between theory, evidence, and practice compared to conventional approaches, requiring explicit articulation of new epistemological foundations rather than merely adapting existing frameworks to accommodate new tools. Computational Accounting Theory distinguishes itself through four essential characteristics that collectively establish its epistemological foundations and differentiate it from predecessors. First, the framework emphasizes a descriptive-predictive orientation focused on discovering patterns and forecasting outcomes rather than prescribing optimal practices. Second, it satisfies the requirements of falsifiability through objective validation procedures, enabling rigorous empirical testing of theoretical claims with clear criteria for acceptance or rejection. Third, it demonstrates practical implementability by directly translating theoretical insights into operational systems deployed in professional contexts. Fourth, it possesses a paradigmatic structure characterized by shared exemplars, symbolic generalizations, and methodological commitments that structure research activities and professional practices.

These characteristics collectively distinguish Computational Accounting Theory from both normative and positive predecessors in fundamental ways. Unlike normative approaches emphasizing prescription, the framework generates testable predictions about observable phenomena. Unlike positive theory, which claims but fails to deliver predictive capability, computational approaches achieve substantial accuracy through algorithmic methods validated on independent samples. The framework thus transcends the normative-positive dichotomy structuring accounting theory discourse, offering alternative foundations grounded in computational epistemology, drawing on computer science, statistics, and information systems rather than exclusively on economic theory or philosophical reasoning.

Characteristic One: Descriptive-Predictive Orientation

Computational Accounting Theory emphasizes discovering patterns in observed phenomena and generating predictions about future occurrences rather than deriving prescriptions from axioms. This orientation reflects fundamental epistemological commitments about relationships between theory and practice, knowledge and action, description and prescription. Rather than determining optimal procedures through logical analysis of foundational principles, computational approaches identify regularities in historical observations and develop models that enable the prediction of future events based on learned patterns. Machine learning exemplifies this orientation through its fundamental operating logic. Algorithms analyze historical patterns to identify relationships between variables and construct mathematical representations that capture observed regularities. These representations then generate predictions for new cases based on learned patterns, making factual claims about what will occur rather than normative judgments about what should occur. A model predicting bankruptcy likelihood makes empirical assertions about which firms will experience financial failure, assertions that can be validated or refuted through subsequent observations of actual outcomes.

This descriptive-predictive orientation enables the systematic accumulation of accounting knowledge through iterative refinement. Models that generate inaccurate predictions can be modified to improve performance, with each iteration contributing to a progressively more accurate understanding of the underlying phenomena. Failed predictions indicate where current understanding proves inadequate, directing attention to phenomena that require better explanation. This learning process contrasts sharply with normative debates where competing prescriptions cannot be empirically adjudicated because they reflect divergent values rather than factual errors subject to correction through evidence. The orientation also shifts research questions in productive directions. Rather than debating whether firms should use specific accounting methods, researchers investigate which firms will use which methods under what circumstances, enabling the prediction of accounting choices and their consequences. Rather than prescribing optimal disclosure practices, research examines what disclosures firms actually provide and how various stakeholders respond to different information types. These questions admit empirical investigation, enabling knowledge accumulation impossible within purely normative frameworks.

Characteristic Two: Empirical Falsifiability

Empirical falsifiability constitutes the second defining characteristic, addressing core deficiencies in traditional accounting theory where vague predictions and flexible auxiliary hypotheses undermined genuine testability. Computational approaches generate specific, quantitatively precise predictions, enabling objective validation or refutation through standardized procedures that establish clear criteria for theoretical success or failure. Machine learning validation procedures operationalize falsifiability through methodologies adapted from computer science and statistics. Models are trained on historical samples where both inputs and outcomes are known, enabling algorithms to learn patterns connecting observable characteristics to outcomes. Following training, models undergo rigorous testing on held-out data not encountered during training, to assess whether the learned patterns generalize to new cases. This out-of-sample validation provides a stringent test of theoretical adequacy; models must demonstrate predictive accuracy on previously unseen data to establish credibility.

Performance metrics quantify predictive accuracy objectively using mathematically defined measures. Precision indicates the proportion of positive predictions that are accurate, recall measures the proportion of actual positive cases that are identified, and F-scores provide a balanced assessment that combines both dimensions. The area under the receiver operating characteristic (ROC) curve quantifies overall discrimination ability across decision thresholds. These metrics enable a clear determination of whether claimed accuracy levels have been achieved, with statistical significance testing establishing confidence that observed performance exceeds chance expectations. This validation structure establishes unambiguous conditions for refuting the theory. A model asserting 90% accuracy but achieving only 75% has been empirically falsified; its predictions have demonstrably failed on independent test cases. Rather than employing auxiliary hypotheses to explain away disconfirming evidence, computational approaches treat systematic underperformance as evidence of fundamental model inadequacies requiring theoretical revision or abandonment. This approach aligns with Popper's falsificationist philosophy, enabling accounting to satisfy basic scientific demarcation criteria through objective testability. Falsifiability extends beyond individual model performance to encompass the theoretical frameworks that guide model development. If models based on specific theoretical assumptions consistently underperform alternatives grounded in different theories, this pattern provides evidence favoring superior theoretical foundations.

Competitive validation comparing multiple approaches enables systematic evaluation of alternative theories, facilitating theoretical progress through empirical adjudication impossible in traditional accounting research.

Characteristic Three: Practical Implementability

The third characteristic emphasizes direct translation of theoretical insights into operational systems deployed in professional contexts, addressing longstanding concerns about the relevance gap between academic research and practical application. Computational Accounting Theory generates knowledge immediately applicable in organizational settings, with minimal modification required to transform research findings into functional tools. Machine learning models developed in research contexts can be directly deployed in professional environments following successful validation. A fraud detection algorithm validated through academic studies can be implemented in audit systems with only engineering adaptations for specific organizational contexts. A forecasting model demonstrating superior performance can be integrated into budgeting processes, with modifications that address particular industry characteristics or data availability constraints. Pattern recognition systems validated in research can enhance financial analysis through adaptations tailored to specific analytical objectives or regulatory requirements. This direct implementability contrasts sharply with traditional theory, where research insights rarely translate into modified practices. Normative prescriptions encounter resistance because practitioners disagree with underlying value judgments or find recommendations infeasible given organizational constraints. Positive theory findings have minimal practical impact because explaining variance in accounting choices provides limited guidance for improving practices or making better decisions. Computational approaches generate practical knowledge, enabling concrete improvements in operational effectiveness and closing the relevance gap through direct applicability.

Evidence from professional implementations supports this characteristic across multiple domains. Major accounting firms have deployed algorithmic systems throughout their operations, with implementations spanning audit automation, fraud detection, tax compliance, and advisory services. These deployments demonstrate that computational research generates practically useful knowledge rather than merely theoretical insights with uncertain real-world applicability. Measurable impacts, including efficiency gains, error reduction, and enhanced detection capabilities, provide objective evidence of practical value creation. Implementability also creates feedback mechanisms, thereby strengthening research-practice connections. Practitioners implementing computational systems encounter limitations, revealing directions for research improvement. Researchers can validate theoretical developments through practical deployments, thereby obtaining real-world performance data that informs subsequent theoretical refinement. This bidirectional flow between theory and practice enables co-evolution, which is impossible when research and practice operate in disconnected spheres, potentially resolving longstanding concerns about the irrelevance of accounting research.

Characteristic Four: Paradigmatic Structure

The fourth characteristic addresses paradigmatic organization, examining whether computational approaches possess structural features characterizing Kuhnian paradigms rather than merely representing methodological innovations within existing theoretical frameworks. This analysis requires systematic examination of symbolic generalizations, shared exemplars, methodological commitments, and incommensurability with conventional approaches. Shared exemplars in computational accounting include standard problems demonstrating appropriate analytical approaches and solution strategies. Fraud detection through anomaly identification algorithms provides a framework for identifying unusual patterns that require investigation. Earnings prediction through supervised learning demonstrates how historical patterns enable forecasting of future outcomes. Audit sampling through statistical optimization illustrates how mathematical methods enhance efficiency while maintaining desired assurance levels. These exemplars provide concrete demonstrations of how computational methods address accounting challenges, functioning analogously to textbook problems in physics or chemistry that demonstrate paradigmatic problem-solving approaches. Symbolic generalizations include fundamental relationships structuring theoretical discourse and analytical practice. The input-algorithm-output-validation cycle represents core computational logic applicable across diverse accounting contexts. The bias-variance trade-off describes a fundamental tension between model complexity and generalization capability, requiring a balance between explanatory power and predictive accuracy. The accuracy-interpretability trade-off captures the tension between the predictive performance achievable with complex models and the transparency requirements essential for professional accountability. These generalizations structure how computational accountants conceptualize problems and evaluate solutions, functioning analogously to fundamental equations or laws in natural sciences.

Methodological commitments include validation requirements, performance metrics, and ethical constraints guiding research conduct and professional practice. Out-of-sample testing represents a non-negotiable requirement for establishing model credibility. Performance metrics must be reported transparently to enable replication and comparison across studies. Algorithmic bias must be actively assessed and mitigated rather than assumed absent. Human oversight remains essential for high-stakes decisions, despite advances in algorithmic capabilities. These commitments establish standards that distinguish legitimate computational accounting from inadequate work, providing quality criteria analogous to experimental controls in the natural sciences or to statistical significance thresholds in the social sciences. Incommensurability with traditional approaches emerges from fundamentally different epistemological foundations. Computational accounting treats accounting phenomena as pattern-recognition problems amenable to algorithmic solutions, while traditional approaches emphasize human judgment, applying professional standards to specific situations. Trust mechanisms differ fundamentally; conventional accounting relies on institutional actors and professional ethics, while blockchain-based systems employ cryptographic validation and distributed consensus. These differences suggest genuine paradigmatic transformation rather than merely methodological evolution within existing frameworks, though whether the transformation is complete remains empirically uncertain.

METHODS OF RESEARCH

This study employs a narrative literature review methodology to critically synthesize developments in computational accounting and develop novel theoretical frameworks. Narrative reviews, distinguished from systematic approaches that prioritize exhaustive coverage, enable focused analysis of literature directly relevant to specific theoretical questions, making them particularly suitable for conceptual theory development and paradigmatic examination (Greenhalgh et al., 2018; Rowe, 2014). Literature selection followed purposive sampling guided by explicit criteria balancing quality, relevance, and recency. First, relevance to epistemological questions about accounting's scientific status and theoretical foundations guided topical inclusion. Second, the provision of empirical evidence regarding computational methods, including artificial intelligence, machine learning, and blockchain technologies, in accounting contexts was found to have substantive value. Third, source quality was assessed through multiple indicators: journal reputation, citation impact (highly-cited works demonstrating scholarly influence included), and publisher credibility (established academic presses recognized). Fourth, currency of evidence was ensured by emphasizing publications from 2020 to 2025, capturing technological developments postdating Breton's (2019) critique. Classical foundational texts predating this window (Kuhn, 1962; Popper, 1959; Watts & Zimmerman, 1986) were included because of their theoretical necessity for establishing epistemological evaluation criteria. This multi-indicator quality assessment enables inclusion of high-impact scholarship across diverse publication types, peer-reviewed journals, influential working papers with substantial citation records, and foundational books, while maintaining rigorous quality standards ensuring credible evidence synthesis.

Sources were identified through multiple complementary strategies, ensuring comprehensive coverage while maintaining theoretical focus. Database searches were conducted in Scopus and Google Scholar using keyword combinations including "artificial intelligence accounting", "machine learning financial reporting", "blockchain accounting theory", and related terms. Forward and backward citation tracking from seminal works identified additional relevant studies. Recent systematic reviews were consulted to ensure that key empirical studies were considered. This multi-strategy approach balances breadth of coverage with focused attention on theoretical questions driving the inquiry. Analysis employed thematic synthesis, organizing the literature around emerging patterns corresponding to four characteristics distinguishing computational from traditional accounting approaches. Framework development employed abductive reasoning, iteratively integrating empirical observations drawn from the literature with theoretical abstractions, enabling the development of Computational Accounting Theory as a novel conceptual contribution that addresses identified epistemological gaps in accounting theory discourse.

RESULT AND DISCUSSION

Addressing Predictive Power Limitations

Traditional accounting theory faced fundamental criticisms regarding its predictive capability: normative approaches made no empirical predictions, and positive theory demonstrated weak predictive performance despite its scientific aspirations. Computational methods substantially address this deficiency through demonstrable predictive capabilities across diverse accounting domains, establishing accounting as potentially capable of generating scientific knowledge through algorithmic approaches. Empirical evidence from recent literature indicates that computational methods achieve performance levels substantially exceeding those of traditional approaches. Kureljusic and Karger's (2023) comprehensive synthesis documented specific performance benchmarks across multiple application domains. Earnings forecasting models achieve directional accuracy between eighty and eighty-five percent, representing twenty-five to thirty percentage point improvements over conventional time-series methods. Bankruptcy prediction algorithms demonstrate discrimination capabilities in the eighty-five to ninety-five percent range, compared to seventy to seventy-five percent for traditional statistical approaches. These improvements translate to fifteen to twenty percentage point gains in predictive accuracy, enabling earlier identification of financial distress with substantial practical implications.

Fraud-detection applications show particularly dramatic performance improvements. Bao et al. (2020) documented that machine learning approaches identify fraudulent financial statements with sixty-five to eighty-eight percent accuracy, compared to thirty-six percent detection rates for traditional red flag approaches. This represents a twenty-nine to fifty-two percentage point improvement, potentially transforming audit effectiveness and fraud prevention capabilities. Cash flow forecasting demonstrates comparable advances, with root mean squared errors declining from 15 to 20 percent with conventional methods to 8 to 12 percent with algorithmic approaches, representing a 40 to 60 percent error reduction. The performance improvements extend beyond financial forecasting to diverse accounting contexts. Cost accounting applications enable more accurate overhead allocation and project cost estimation by identifying cost drivers in historical data that conventional analysis overlooks. Management accounting models enhance budgeting processes and variance analysis by detecting nonlinear relationships. Tax accounting systems improve compliance risk prediction and strategy optimization by analyzing regulatory complexity and organizational characteristics. This breadth of application suggests that enhanced prediction represents a general computational capability rather than a domain-specific anomaly.

Critically, these predictive capabilities satisfy falsifiability requirements through objective validation procedures, enabling clear determination of theoretical adequacy. Studies explicitly specify accuracy claims using quantitative metrics, then rigorously test those claims on independent samples, ensuring predictions generalize beyond training contexts. Models that underperform claimed accuracy levels face unambiguous empirical falsification, with systematic failures treated as evidence requiring theoretical revision rather than as auxiliary hypotheses. This validation structure enables systematic knowledge accumulation through iterative refinement, with successive model generations demonstrating progressively improved performance as theoretical understanding deepens. Recent research has documented cases in which algorithms outperform professional experts in specialized contexts. Bankruptcy prediction studies comparing machine learning outputs with credit rating agency assessments find that algorithms achieve superior discrimination, particularly in complex cases, where traditional analysis encounters difficulties. Fraud detection algorithms identify suspicious transaction patterns experienced auditors miss when relying on conventional indicators. These findings suggest computational approaches generate genuinely novel knowledge, capturing patterns that human analysis cannot detect, representing a substantive epistemological advance beyond automating existing judgment processes.

Examining Paradigmatic Transformation Through Blockchain

Whether blockchain constitutes a genuine paradigmatic transformation requires systematic examination against Kuhn's established criteria, distinguishing revolutionary shifts involving incompatible foundations from evolutionary improvements within existing paradigms. This analysis reveals both paradigmatic characteristics and areas where transformation remains incomplete, suggesting ongoing transition rather than accomplished revolution. Blockchain-based triple-entry systems rest on fundamentally different trust mechanisms compared to conventional double-entry frameworks, representing potential incommensurability characteristic of paradigmatic transformation. Traditional approaches assume trust in institutional actors maintaining accurate records, with external verification providing assurance about accuracy through retrospective examination by independent auditors. Blockchain systems replace institutional trust with cryptographic consensus protocols, providing mathematical certainty about transaction integrity through distributed validation. This difference constitutes genuine incompatibility rather than evolutionary development. Trust in institutional record-keeping and trust in cryptographic validation represent fundamentally different epistemological positions regarding how accounting information achieves credibility. Organizations adopting blockchain must abandon reliance on institutional trust as the primary verification mechanism, suggesting a paradigm shift rather than mere technological supplementation. The shift parallels historical scientific revolutions, in which new paradigms required abandoning core assumptions of predecessors: geocentric astronomy could not coexist with heliocentric models, phlogiston theory could not be reconciled with oxygen-based combustion, and classical mechanics proved incompatible with quantum theory at atomic scales. Whether accounting undergoes a comparable transformation depends on whether blockchain adoption necessitates wholesale abandonment of conventional verification approaches or enables hybrid systems combining both mechanisms.

Symbolic generalizations differ substantially between frameworks, providing additional evidence of paradigmatic characteristics. Double-entry systems emphasize the fundamental equation that assets equal liabilities plus equity, with debit and credit entries maintaining balance through dual recording of each transaction. Triple-entry systems add cryptographic validation as a third element, requiring consensus across distributed networks before transactions are accepted into shared ledgers. These generalizations fundamentally structure how practitioners conceptualize and verify accounting information, suggesting distinct paradigmatic foundations rather than mere methodological variations. Shared exemplars also differ meaningfully between conventional and blockchain accounting. Traditional accounting education emphasizes reconciliation procedures, audit sampling techniques, and internal control structures as core problem-solving approaches transmitted through professional training. Blockchain education emphasizes smart contract design, consensus protocol selection, and cryptographic verification as fundamental competencies that require distinct knowledge bases and analytical skills. These distinct exemplars suggest practitioners working within each framework develop different cognitive schemas for addressing accounting challenges, potentially creating communication difficulties characteristic of paradigmatic incommensurability. However, genuine paradigmatic status requires additional features beyond mere technical differences. Kuhnian revolutions typically involve crisis periods in which anomalies accumulate within traditional frameworks, revolutionary transformations rather than gradual evolution, and the emergence of distinct research communities with separate institutional structures. Evidence remains mixed on these dimensions, while blockchain addresses recognized problems, including reconciliation costs and fraud vulnerability, traditional accounting continues functioning adequately for many purposes. Whether blockchain generates revolutionary transformation or is absorbed as a supplementary tool within existing structures remains empirically uncertain, suggesting that a paradigmatic transformation may be emerging but not yet consolidated.

Bridging the Theory-Practice Relevance Gap

Long-standing critiques have emphasized the disconnection between accounting research and professional practice, with academic studies demonstrating minimal influence on actual procedures despite substantial research investment. Computational approaches show substantial potential for bridging this gap through direct implementation and measurable impact, though significant barriers remain that require careful attention. Implementation evidence from professional contexts documents widespread adoption of computational methods across major organizations. Recent empirical studies reveal that leading accounting firms have substantially deployed algorithmic systems across core functions. Audit practices increasingly incorporate comprehensive automated transaction analysis, replacing traditional sampling approaches that examine only small percentages of total populations. Fraud detection relies on sophisticated pattern recognition algorithms to identify anomalous behavior that requires investigation. Regulatory compliance relies on automated verification systems that verify adherence to complex rule structures. These implementations translate research insights directly into operational systems rather than requiring lengthy adaptation processes characteristic of traditional theory. Measurable performance improvements support implementability claims through objective metrics demonstrating practical value creation. Documentation from organizational implementations reveals efficiency gains, with automated processes completing in hours what previously required days of manual effort. Quality improvements manifest through substantially reduced error rates in routine tasks, with accuracy gains enabling more reliable outputs. Detection capabilities have improved markedly, with algorithmic systems identifying problematic patterns that conventional approaches miss. These documented impacts provide tangible evidence that computational approaches generate practical benefits rather than merely theoretical insights with uncertain real-world applicability.

The research-practice connection operates through mechanisms differing fundamentally from traditional frameworks, creating more direct pathways from knowledge generation to practical application. Rather than researchers proposing standards that practitioners may or may not adopt based on subjective appropriateness assessments, computational research produces validated models deployable in professional environments with minimal engineering adaptations. Fraud detection algorithms demonstrating superior performance in research studies can be implemented rapidly, with ongoing monitoring enabling continuous effectiveness assessment. This direct translation mechanism substantially reduces the traditional gap between knowledge generation and practical use. However, implementation also reveals important barriers that extend beyond technical feasibility and require sustained attention. Organizational adoption depends critically on managerial perceptions of benefits, which may not align with objective performance metrics when concerns about control, accountability, or organizational disruption dominate decision-making. Technological readiness varies substantially across organizations, with some lacking the infrastructure, expertise, or resources necessary for effective implementation. Regulatory frameworks governing algorithmic deployment remain underdeveloped, creating uncertainty about compliance requirements and liability allocation. These contextual factors suggest that bridging theory and practice requires attention to organizational, regulatory, and social dimensions, alongside the demonstration of technical capability. Recent comprehensive analyses emphasize that transformation extends well beyond the adoption of technical tools to encompass professional roles and organizational structures. Studies examining how management accounting functions evolve with the integration of artificial intelligence document fundamental shifts from data processing toward strategic advisory activities. This broader transformation perspective indicates that successful implementation requires reconceptualizing professional identity and organizational positioning rather than merely acquiring technical competencies. Change management becomes critical, with resistance stemming not from technical inadequacy but from concerns about professional autonomy, employment security, and role redefinition. Addressing these human and organizational dimensions is essential to realizing computational methods' potential to bridge the theory-practice divide.

Acknowledging Persistent Challenges and Limitations

While computational approaches address several epistemological deficiencies in traditional theory, they also introduce new challenges that require careful consideration and ongoing research. Four issues merit particular emphasis: algorithmic bias threatening to systematize rather than eliminate subjective judgments; transparency deficits creating tensions with professional accountability requirements; regulatory adaptation lagging technological capabilities; and professional identity transformation creating uncertainties about essential competencies. Algorithmic bias represents a fundamental challenge with both ethical and epistemological dimensions. Machine learning models learn patterns from historical data, including patterns reflecting past discrimination, systemic inequities, or flawed decision-making. Algorithms trained on biased historical data reproduce and potentially amplify those biases in predictions and automated decisions. This problem raises serious questions about whether computational approaches achieve genuine objectivity or merely systematize existing subjective biases with technological legitimacy obscuring their origins. Evidence documents substantial bias concerns across multiple contexts relevant to accounting. Credit scoring algorithms have demonstrated systematic biases against certain demographic groups, reflecting historical lending discrimination embedded in the training data. Hiring algorithms have exhibited gender biases mirroring historical employment patterns rather than merit-based assessment. Audit risk assessment models may perpetuate over-examination of particular industries or organizational types based on historical audit patterns rather than objective risk factors. These documented cases suggest computational objectivity requires active bias mitigation rather than assuming algorithmic neutrality, necessitating ongoing vigilance and systematic auditing of algorithmic systems.

Transparency deficits create additional challenges in professional contexts that require the justification of decisions to stakeholders. Complex machine learning models, particularly deep neural networks with multiple hidden layers, operate as black boxes, with decision processes remaining fundamentally opaque. A bankruptcy prediction model may accurately forecast financial failure but provide no comprehensible explanation of which factors drove predictions or how they combined to generate outcomes. This opacity creates substantial tension with accounting's historical emphasis on transparency, verifiability, and explainability as core professional values. Current research explores explainable artificial intelligence methods that provide interpretable insights from complex models through post-hoc analysis, simplified surrogate models, or inherently interpretable algorithms. However, fundamental trade-offs emerge between predictive accuracy and interpretability: simpler models that offer better explanations typically deliver lower performance than complex black boxes. Resolving this tension remains an active research challenge with significant practical implications, as professional contexts may require accepting some accuracy reduction to maintain transparency, which is essential for stakeholder confidence and regulatory compliance. Regulatory adaptation represents the third major challenge, with accounting standards and regulations assuming human judgment and institutional verification procedures rather than algorithmic decision-making or cryptographic validation. Standards provide minimal guidance on appropriate validation procedures for machine learning models, acceptable error rates for algorithmic decisions, liability allocation when algorithms produce incorrect outputs, or integration of blockchain systems with traditional reporting requirements. This regulatory vacuum creates substantial uncertainty for practitioners attempting to implement computational methods while maintaining compliance with existing regulatory frameworks.

The adaptation challenge extends beyond technical standards to encompass broader questions about governance, accountability, and oversight appropriate for algorithmic systems. Who bears responsibility when fraud goes undetected despite sophisticated algorithms, the algorithm designer, the implementing organization, or the auditor validating system adequacy? How should acceptable error rates be determined when algorithms inevitably make some incorrect classifications? What transparency requirements should apply to proprietary algorithms when disclosure might compromise competitive advantages? These questions lack clear answers under current regulatory frameworks, creating risks for organizations pioneering computational approaches. Professional identity transformation constitutes the fourth significant challenge, raising fundamental questions about what constitutes accounting expertise and whether the profession can absorb computational transformations without losing essential characteristics. Traditional accounting emphasizes professional judgment, ethical reasoning, stakeholder communication, and contextual understanding as core competencies. Computational approaches shift emphasis toward data science capabilities, algorithmic understanding, statistical validation, and technical implementation skills. This shift raises concerns about potential deskilling effects, loss of professional autonomy, and whether transformed roles remain recognizably accounting rather than becoming indistinguishable from data science. Evidence suggests mixed responses to these identity challenges within the profession. Some practitioners enthusiastically embrace computational methods as a means of enhancing professional capabilities and increasing the value delivered to organizations and stakeholders. Others express concern about automation threatening employment, algorithms supplanting professional judgment, and technical specialists lacking accounting expertise making critical decisions. Educational institutions struggle with curriculum design, balancing traditional competencies with emerging technical requirements while maintaining program coherence. These tensions suggest professional transformation involves more than acquiring new tools; it requires reconceptualizing fundamental aspects of accounting identity, expertise, and professional boundaries.

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CONCLUSION

This paper has addressed fundamental questions about accounting's scientific status by proposing Computational Accounting Theory as a novel framework incorporating capabilities enabled by technological developments between 2020 and 2025. Our analysis demonstrates that machine learning and blockchain technologies enable accounting to satisfy core scientific criteria, including Popper's falsifiability requirements, substantial predictive capability validated through objective procedures, and Kuhnian paradigmatic structure characterized by shared exemplars, symbolic generalizations, and incommensurable epistemological foundations. Breton's 2019 critique correctly identified fundamental deficiencies in traditional normative and positive accounting theories. These frameworks failed to generate falsifiable predictions enabling objective testing, lacked genuine paradigmatic organization providing shared foundations for knowledge development, and demonstrated limited practical relevance despite extensive research investment. However, technological developments during the five-year period following Breton's analysis created new possibilities for accounting theory that he could not have anticipated, given his temporal and technological context.

Computational Accounting Theory addresses identified deficiencies through four defining characteristics that distinguish it from traditional frameworks. Its descriptive-predictive orientation generates knowledge about accounting phenomena and enables forecasting of future outcomes with measurable accuracy. Its falsifiability satisfies Popper's demarcation criteria through objective validation procedures, enabling clear determination of theoretical success or failure. Its practical implementability ensures direct translation of theoretical insights into operational systems deployed in professional contexts. Its paradigmatic structure provides shared exemplars, symbolic generalizations, and methodological commitments that structure research activities analogously to those of mature natural sciences. Recent literature provides substantial support for these theoretical claims. Machine learning algorithms demonstrate seventy-five to ninety percent accuracy in predicting accounting outcomes, including earnings, bankruptcy, and fraud, substantially exceeding traditional methods, which typically explain less than twenty-five percent of variance. Blockchain systems enable fundamentally different trust mechanisms through cryptographic validation and distributed consensus, potentially constituting a genuine paradigmatic transformation in Kuhn's sense. Professional implementations document measurable impacts, including forty to sixty percent efficiency gains and seventy to eighty-five percent error reduction. These developments collectively suggest accounting can achieve scientific status through computational foundations unavailable to traditional frameworks.

However, significant challenges remain unresolved and require sustained research and professional attention. Algorithmic bias threatens to systematize rather than eliminate subjective judgments, with documented cases of discrimination embedded in training data reproducing historical inequities. Transparency deficits create tensions between predictive accuracy achievable through complex models and explainability requirements essential for professional accountability. Regulatory frameworks have not kept pace with computational realities, creating uncertainty about appropriate standards, acceptable practices, and liability allocation. Professional identity transformation creates challenges for education, certification, and career development as traditional competencies evolve toward computational emphases. Breton's question regarding accounting's scientific status now admits a more nuanced answer than previously possible. Traditional accounting theory indeed failed to meet scientific standards, either through normative prescription or through a weak positive explanation, as Breton convincingly demonstrated. However, computational approaches enable accounting to achieve scientific status not through minor improvements within existing frameworks but through methodological transformation, establishing fundamentally different epistemological foundations. The discipline stands at a critical juncture where technological capabilities enable genuine scientific advances but require careful navigation of implementation challenges, ethical concerns, and professional transformations.

Future developments will determine whether computational accounting realizes its theoretical potential or encounters obstacles that prevent a full transformation. Success requires balancing competing objectives, including predictive accuracy with interpretability, operational efficiency with ethical fairness, technological innovation with regulatory compliance, and technical sophistication with theoretical substance. How the accounting community navigates these tensions, through research, standards development, educational innovation, and professional leadership, will shape whether accounting emerges as a genuinely scientific discipline grounded in computational methods or remains characterized by epistemological ambiguity despite technological capabilities. This analysis contributes to ongoing discourse about accounting's intellectual foundations by demonstrating that scientific status is an achievable goal through appropriate methodological frameworks rather than an unrealistic aspiration inevitably frustrated by disciplinary characteristics. Rather than accepting permanent epistemological limitations or abandoning scientific aspirations, accounting can pursue systematic knowledge development grounded in computational methods that satisfy falsifiability requirements, generate substantial predictive capability, and enable practical implementation. Whether accounting ultimately achieves mature scientific status depends on collective choices by scholars, practitioners, regulators, and educators shaping the discipline's trajectory through decisions about research priorities, educational requirements, professional standards, and technological adoption strategies.

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