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Artificial Intelligence in Accounting: Implications for Practices and Education

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Abstract

We conduct a semi-structured literature review on the benefits and concerns that artificial intelligence (AI) brings to the accounting practice and the profession. Our analysis highlights AI's current applications, particularly in auditing in which it boosts productivity and enhances audit quality and financial reporting quality. These advancements enable accountants to transition from traditional roles to strategic advisory positions. Despite such benefits, we also acknowledge the potential risks concerning AI adoption. Furthermore, we discuss the implications of the widespread adoption of AI for future accountants and the accounting education. Future accountants need to possess interdisciplinary skills to perform higher-value-added services. Hence, we call for collaborative efforts of faculties to develop accounting curricula to adapt to the change. Our study provides an up-to-date review of recent AI research in accounting and stresses the importance of curriculum adaptation to prepare future professionals. However, our reliance on theoretical frameworks and secondary data may not fully capture AI's practical impacts, and rapid AI advancements may quickly render our findings outdated, necessitating ongoing research.

Keywords: accounting; accounting education; artificial intelligence (AI)
JEL Code: M41, O33, M48.

INTRODUCTION

Artificial intelligence (AI) has become topical in recent years. For instance, ChatGPT, an AI chatbot launched in late 2022, was soon among the top three rising Google searches in 2023 (Webb, 2024). The innovations and advancements in AI are said to have fuelled the Fourth Industrial Revolution (Schwab, 2017; McKinsey, 2022; Wang, 2023). In the field of accounting, the market size of AI is estimated at USD 1.56 billion in 2024 and expected to increase to USD 6.62 billion in 2029 on a compound annual growth rate of 33.5% (Mordor Intelligence, 2024).

Facing the potential of AI applications in accounting, researchers have identified accounting jobs as one of the areas that are most exposed to AI-powered software, where exposure refers to the ability of technologies to save a significant amount of time completing a large portion of the worker's tasks (Eloundou et al., 2023). With the exciting progress in technologies, questions are to be asked. What is AI? How have AI technologies been used in the accounting field? What does research say about AI in accounting? And what are the implications for accounting professionals and accounting educators? These questions motivate our study.

The objectives of our study are twofold. First, we conduct a semi-systematic review of the research on AI in accounting to provide insights on the benefits and risks that AI could bring to the accounting field. Second, we discuss AI's implications for accounting education. We target audience who have background knowledge in accounting and share similar interests in those questions about AI.

Our study contributes to the literature in the following ways. First, we present a timely review of the research on AI in accounting by including publications and working papers up to early 2024. Our inclusion of the latest studies complements previous literature reviews that covered earlier publication dates. For example, Agustí and Orta-Pérez's (2023) bibliometric analysis of the accounting AI research includes studies up until 2020. Second, to the extent that ChatGPT raises general awareness of AI, our review is arguably more pertinent to the AI topic because we also cover research on ChatGPT. Before ChatGPT, the accounting AI research often focused on the machine learning technology to recognize patterns and make forecasts, which are different application domains of AI technologies (see Kureljusic and Karger, 2024). Third, our study highlights the implications of AI adoption for the future of accounting education and practice. By examining how AI can transform traditional accounting roles and the necessary skills for future professionals, we provide insights into the evolving landscape of the accounting profession. Furthermore, our findings contribute to the potential inclusion of changes in curriculum due to AI adoption, underscoring the need to integrate AI-related topics such as data analytics, machine learning, and AI-driven decision support systems into accounting education.

The remainder of our study is organized as follows. Section 2 explains the research method. Section 3 reviews AI and its current applications in accounting. Section 4 highlights the research on the benefits and risks of AI applications in accounting. Section 5 discusses the implications for accounting professionals and educators. Section 6 concludes.

RESEARCH METHOD

We conducted a semi-structured review of the literature on AI and accounting. Using the keywords "AI" and "accounting", we review the search results on Google Scholar and Social Science Research Network (SSRN). The keyword search returned millions of results on Google Scholar as of April 2024. To carry out our task, we limited our review to the top 200 results, sorted by the default relevance by Google Scholar. Our keyword search returned about 150 results on SSRN, which are included in our review.

Our first impression of the studies found on Google Scholar is that they are recently published and have a relatively good number of citations. Based on our records, the top 150 results on Google Scholar have an average publication year of 2019 (median publication year = 2021) and an average citation number of 45 (median citation number = 22).

Second, many of the top 200 articles on Google Scholar are published in non-top tier journals (i.e., not a Financial Times Top 50 (FT50) journal). Regarding the two in FT50 journals, one was published in Journal of Accounting Research (see Commerford et al. 2022) and the other in Review of Accounting Studies (see Fedyk et al., 2022). There are also studies published in reputable journals that are not included in the FT50 journal list, see Ranta et al. (2022) in European Accounting Review (ABDC A*), Moll and Yigitbasioglu (2019) in the British Accounting Review (ABDC A*), and a few in Meditari Accountancy Research, Accounting Horizons, and Accounting Education (all ABDC A). In addition, studies of AI and accounting are more often seen in specialized journals, which suit the scope of the journals. We found 10 studies in Journal of Emerging Technologies in Accounting and 4 in Journal of Applied Accounting Research (both ABDC B).

Third, we note that a consideration portion of the articles is published in non-business disciplines, for instance, by the publisher Institute of Electrical and Electronics Engineers (IEEE) (see Zhang et al., 2020) or as conference proceedings. This is consistent with the interdisciplinary nature of AI (Ng and Alarcon, 2021). However, due to the authors' limited knowledge, assessing the quality of these journals and conferences is currently beyond our capabilities. Hence, we encourage other researchers to explore this literature and share their findings.

In our semi-structure literature review, the question we are keen to know is: what are the benefits and concerns that AI brings to accounting? This question also leads to the question many may have been wondering, that is, will human accountants be replaced by AI algorithms in the future? These questions steer our review.

AI AND ITS CURRENT APPLICATIONS IN ACCOUNTING

Accounting researchers have adopted various definitions of AI. One common definition specifies AI as the "intelligence that is demonstrated by software or machinery that imitates the workings of the human mind" (Fisher et al., 2016, p. 157). Another common definition defines AI as "a system's ability to interpret external data correctly, to learn from such data, and use these learnings to achieve specific goals and tasks through flexible adaptation" (Kaplan and Haenlein, 2019, p. 17; Agustí and Orta-Pérez, 2023). Sometimes, the term AI can include theoretical advancements in computer systems too (Petkov, 2020). Our study adopts the definition that defines AI as "a computer program or software application that can imitate or simulate human behavior", which is a definition close to the first example (Ng and Alarcon, 2021, p. 1).

Under the adopted definition, AI can be divided into sub-fields including machine reasoning (MR), machine learning (ML), natural language processing (NLP), etc. Expert systems, an early form of AI in the 1970s and 1980s, are applications of MR that draws conclusions using stored knowledge and automated inference techniques that imitate or simulate human decision-making. ML uses algorithms to analyze data to perform tasks such as recognizing patterns and making predictions. It is used by Netflix and Amazon to provide users with customized recommendations and promotions. Siri and ChatGPT are applications of NLP technologies that focus on the interaction of computers and people using human languages (Ng and Alarcon, 2021).

In accounting practice, accountants have utilized various applications of the above AI technologies. For example, rules-based expert systems have been used in auditing and tax; fuzzy-based expert systems are used to detect frauds in settled insurance claims; ML-enabled expert systems are used for cash and account reconciliations to save manual hours in processing time (Yang and Vasarhelyi, 1993; Pathak et al., 2005; Ng and Alarcon, 2021).

ML algorithms help Big 4 auditors to review, identify, and extract key accounting information from sheer volumes of documents. The KPMG Contract Abstraction Tool extracts information from lease contracts and analyzes the data for compliance with the lease standard IFRS 16 (KPMG, 2018; Ng and Alarcon, 2021). Deloitte's Argus analyzes documents and extracts information to identify possible trends, risks, and anomalies in contracts (Almufadda and Almezeini, 2022). EY's deep learning technology, a sub-field of ML, can reconstruct documents that were poorly scanned using

optical recognition software (Wong, 2019; Ng and Alarcon, 2021). PwC, a multiple-year winner of the Audit Innovation of the Year award from International Accounting Bulletin, deploys a bot called GL.ai to detect anomalies in the general ledger (Pwc, 2018; Almufadda and Almezeini, 2022).

NLP technologies have great potential in accounting. Some of the above-mentioned ML tools, such as Deloitte's Argus, also leverage on the NLP technology to review and extract information (Ng and Alarcon, 2021). Moreover, Deloitte uses NLP tools to provide targeted financial advice in tax practice (Nickerson, 2019). In addition, NLP can be used in text mining to extract meaning from textual data and in analyzing textual documents to assess the compliance with accounting standards and regulations (Fisher et al., 2016; Ng and Alarcon, 2021).

Overall, the growth of data acts as the main force driving the growing adoption of AI technologies in the accounting field, especially in auditing. Researchers have identified areas for the potential future applications of AI in accounting, for instance, in assurance of non-financial information such as environmental, social and governance and cybersecurity and in regulation (Boritz and Stratopoulos, 2023; Kommunuri, 2022).

BENEFITS AND RISKS OF AI ADOPTION

In the previous section, we discussed applications of AI technologies in accounting, especially in auditing. Those applications benefit accountants and accounting firms by saving manual hours and improving the efficiency and accuracy of repetitive tasks that are now automated by AI (Ng and Alarcon, 2021). We refer to these as the productivity benefits.

Besides the productivity boost, research shows that AI improves audit quality and financial reporting quality. Using data covering the 36 largest accounting firms in the US between 2010 and 2019, Fedyk et al. (2022) find that AI investments improve audit quality by lowering the incidence of various restatements. More specifically, a one-standard-deviation change in accounting firms' recent AI investments is associated with a 5% reduction in the likelihood of an audit restatement. This effect is present in both Big 4 and non-Big 4 firms and stronger for audits of older firms, on auditors' new clients, in the retail industry, and in more recent years of their sample period. Moreover, AI investments reduce audit fees while increasing fees earned per employee. Follow-up interviews with audit partners confirm that (1) AI is widely used in audit; (2) adoption of AI is centralized at the firm-level (national) and top-down; (3) the primary focus of AI is better audit quality; and (4) the main driver of audit quality is auditors' use of AI rather than clients' use of AI.

Anatharaman et al. (2023) investigates whether the adoption of AI in business operations improves firms' financial reporting quality. Using data for US public firms between 2014 and 2018, they find that AI adoption improves accruals quality. More specifically, firms' AI adoption lowers the absolute value of discretionary accruals, the standard deviation and the average absolute values of Dechow and Dichev (2002) residuals. The causality of these findings is confirmed via dynamic analysis, fix effects analysis, and the Heckman's (1979) approach to correct for self-selection. Regarding the channel through which accruals quality is affected, the researchers find that AI adoption improves the extent to which accounting estimates predict future cash flows.

With the rise of ChatGPT and large language models (LLMs) in recent years, researchers start to explore the capabilities of LLM applications. With enhancements, ChatGPT 4 can pass major certification exams including the CPA, CMA, CIA, and EA (Eulerich et al., 2024). Lo and Ross (2024) explore the application of ChatGPT in financial advisory (e.g., retirement planning); Li et al. (2024) and de Kok (2024) explore cases where ChatGPT can assist researchers and financial analysts in analyzing corporate culture and in detecting non-answers in earnings conference calls, respectively.

Despite of all these benefits of AI technologies, human perception of AI can be different. The tendency to discount computer-based advice more heavily than human advice when the advice is identical is known as algorithm aversion. Commerford et al.'s (2022) experiment demonstrates algorithm aversion in auditor judgements when auditors propose adjustments to management's

complex estimates. In court, jurors are more likely to render a negligence verdict when AI, rather than human, performs an audit procedure (Cui et al., 2024).

Common risks and concerns of AI adoption in accounting include ethical considerations, such as privacy accountability, safety, security, transparency, explainability, fairness, human control of technology, professional responsibility, and promotion of human values (Fjeld et al., 2020; Boritz and Stratopoulos, 2023). Due to the black-box nature of and the potential model biases in complex algorithms, explainable AI is greatly desired by practitioners and academics (Fritz-Morgenthal et al., 2022; Zhang et al., 2022; Boritz and Stratopoulos, 2023). There is also a two-way interaction between human and AI. Along with the wide adoption of AI technology, human behavior is increasingly shaped and used by technology (Boritz and Stratopoulos, 2023). For instance, in the age of AI where the audience of financial reporting has shifted to machine readers, the publication of Loughran and McDonald (2011) has prompted firms to reduce the use of negative words identified in the authors' keyword list in corporate filings because the machine algorithms were largely rule-based (Cao et al., 2024).

On the labor market outcomes, researchers have different views about whether AI adoption would increase or decrease the number of accounting jobs (see Greenman, 2017; Almufadda and Almezeini, 2022; Fedyk et al., 2022). The current consensus among practitioners and academics is accountants with AI will replace accountants (Boritz and Stratopoulos, 2023). Professor Ray Ball expressed a similar view that AI will increase the role of accounting and add more capacity to accountants (Andon, 2023). Hence, AI may help the profession fix the pipeline issue facing hiring managers who are reportedly struggling to find accounting talents (Boritz and Stratopoulos, 2023).

IMPLICATIONS OF AI ADOPTION TO THE FUTURE OF ACCOUNTING FIELD AND EDUCATIONAL PRACTICES

In recent years, the rapid advancement and adoption of artificial intelligence have ushered in transformative changes across industries, and the field of accounting is no exception. As AI technologies continue to evolve and permeate various aspects of accounting practices, it is imperative to consider the profound implications this adoption holds for the future of the accounting profession and educational practices.

Redefining the role of accountants

With the emergence of AI in business practices, the role of accountants is undergoing a significant transformation. Traditionally, accountants were primarily responsible for tasks such as bookkeeping, data entry, and financial reporting, which involved repetitive and manual processes (Walker, 2016). However, as AI technologies are increasingly integrated into accounting systems, these routine tasks are becoming automated, freeing up accountants' time for more strategic and analytical work (Khaled Alkoheji & Al Sartawi, 2022).

Redefining the role of accountants entails shifting their focus from mundane data processing tasks to higher-value-added activities such as data analysis, interpretation, and strategic decision-making (Ferreira & Pedrosa, 2024). AI enables accountants to leverage advanced analytics and predictive modelling techniques to extract actionable insights from vast amounts of financial data. This evolution in the role of accountants positions them as strategic advisors who contribute to business growth and performance optimization through data-driven recommendations and proactive financial management.

Moreover, as AI systems become more sophisticated, accountants are expected to collaborate closely with data scientists, IT professionals, and business leaders to harness the full potential of AI-driven technologies. This collaborative approach emphasizes the importance of interdisciplinary skills and a deep understanding of both financial principles and technological advancements in shaping the future role of accountants.

Table 1. The Roles of Accountants Before and After the Emergence of AI

Role aspects	Before the emergence of AI	After the emergence of AI
Focus	Manual data entry, bookkeeping, financial reporting.	Strategic and analytical tasks.
Responsibilities	Ensuring compliance with accounting standards, conducting audits, preparing financial statements.	Automating routine tasks, data analysis, pattern recognition, predictive modelling, communicating with key stakeholders.
Tools used	Spreadsheet software, manual calculations.	AI-powered tools and algorithms.
Decision-making	Relied on historical data, intuition.	Utilize predictive analytics and scenario analysis.
Collaboration	Limited collaboration with other professionals.	Collaborate closely with data scientists, IT professionals, and business leaders.
Skill set required	Financial expertise, basic computer skills.	Financial expertise, proficiency in data analytics, technology and critical thinking, interpersonal and communication skills.
Contribution to business	Provided retrospective insights into past financial performance.	Offer proactive strategic advice, support strategic decision-making processes.

Incorporating AI related topics to accounting curriculum

The idea of incorporating AI into accounting curriculum is not a recent development. As far back as 1995, Baldwin-Morgan proposed the idea of incorporating AI into the accounting curriculum. The intention behind this proposal was to ensure that students were equipped with knowledge about AI technologies before encountering them in professional settings (Baldwin-Morgan, 1995). Given the widespread adoption of AI across various industries today, it has become imperative to integrate AI seamlessly into accounting education.

The extant to incorporate AI into the accounting curriculum is well documented in the literature. Different scholars advocate different approaches to incorporating AI into the accounting curriculum, namely (i) integrating AI into existing courses, (ii) creating standalone courses dedicated to AI, (iii) hybrid approach. The first approach, AI related concepts and practices are incorporated into the traditional accounting subjects, allowing students to learn about AI in the context of their broader accounting courses. For example, Qasim and Kharbat (2020) suggest the addition of a foundational course in business technologies into the accounting curriculum, which includes topics such as data analytics and application of AI in accounting practices. Integrating AI into the accounting curriculum can also be done through adding introductory course in technology (Kotb et al., 2013).

The second approach involves developing independent courses dedicated exclusively to emerging technologies like data analytics and AI utilization (Tapis & Priya, 2020). These courses offer students targeted instruction and practical engagement with AI applications pertinent to accounting. For example, offering standalone courses focusing on data analytics (Clayton & Clapton, 2019).

The third approach is a hybrid model that integrates standalone courses with integrative methods. One benefit of the hybrid approach is that it does not require the incorporation of additional credit hours into the overall accounting curriculum (Dzuranin et al., 2018).

Table 2. Pros and Cons of Various Approaches to Integrating AI into Accounting Education

Integrating AI into existing curriculum	
Pros	Cons
Contextualization Providing students with a contextual understanding of AI within the broader context of accounting.	Integration challenges Requiring significant curriculum redesign and faculty training.
Efficiency Minimizing the need for additional resources for course development.	Depth of coverage Limiting the depth of coverage on AI, potentially overlooking more advanced AI concepts and applications.
Integrative learning Facilitating a more integrative understanding of the intersection between AI and accounting.	
Creating standalone AI courses	
Pros	Cons
Focused instruction Providing focused instruction allowing students to develop specialized skills in AI relevant to the accounting profession.	Resource intensive Requiring additional resources, including faculty expertise, course development time and infrastructure.
Comprehensive coverage Providing students with a comprehensive understanding of AI concepts and applications.	Curriculum fragmentation Standalone courses may lead to fragmentation of the accounting curriculum
Hybrid approach	
Pros	Cons
Flexibility Combine the strength of both integrative and standalone approaches	Complexity Designing hybrid curriculum requires careful planning and coordination, including faculty training.
Resource efficiency Leveraging existing infrastructure and courses	Potential for duplication Overlapping between standalone and integrated content.

Nonetheless, we contend that every method of integrating AI into the accounting curriculum comes with its distinct advantages and drawbacks. Educators and academic institutions ought to exhibit flexibility when crafting programs tailored to meet the requirements of their students and the changing landscape of the profession. Below, we present a matrix outlining the benefits and drawbacks of each approach.

The development of interdisciplinary skills

The integration of AI into the accounting sector introduces substantial shifts in both the nature of accountants' work and the skill set demanded of them. A notable outcome of AI adoption is the development of interdisciplinary skills among accountants. Historically, accountants have concentrated largely on financial and numerical proficiencies. However, with AI now assuming routine duties such as data entry and reconciliation, accountants must diversify their skill set to maintain relevance in a profession that is swiftly evolving. With AI transforming accountant roles, it also drives the demand for interdisciplinary skills.

The call for interdisciplinary skills is reinforced by accreditation standards like AACSB, which advocate for a comprehensive curriculum integrating statistics, data management, analytics, and big data tools (Marques, 2023). Employers, including the Big 4 accounting firms (PwC, EY, Deloitte,

KPMG), are also driving the demand for interdisciplinary skills. They seek candidates proficient in identifying data trends, data mining, statistical modeling, data analysis, and effective verbal and written communications.

PwC emphasizes the necessity of integrating analytical components into accounting curricula to enhance foundational accounting skills (PwC, 2015). Their report suggests implementing courses like statistical analysis, computational analytics, and a data analytics practicum to equip students with essential new skills (PwC, 2015). Additionally, PwC underscores the importance of developing leaders who possess not only technical proficiency but also comprehensive leadership abilities.

EY has developed a model outlining the essential talents their professionals should possess, emphasizing proficiency in data analysis using statistical and quantitative methods, creating explanatory and predictive models, and making decisions based on factual evidence (EY, 2015). This framework underscores EY's commitment to equipping their workforce with advanced analytical skills necessary for effective problem-solving and decision-making in business contexts.

Deloitte has also enhanced its auditing processes by incorporating advanced analytics capabilities. This transformation enables audit professionals to conduct data mining on large datasets and deliver detailed insights. As a result, auditors now require enhanced data analytic skills to enhance audit quality and decision-making (Deloitte, 2019). Deloitte emphasizes (i) technical skills, which include design thinking, visualization and storytelling, and (ii) general skills such as critical thinking, collaboration and communication (Deloitte, 2015).

In response to the advancing capabilities of AI, KPMG has also strategically integrated analytics into their business operations. This integration spans critical areas such as Big Data utilization, business intelligence strategies, enterprise analytics frameworks, and efficient information management practices (KPMG, 2016). By leveraging these analytics-driven approaches, KPMG aims to enhance decision-making processes, optimize operational efficiencies, and unlock valuable insights from vast amounts of data. This initiative not only aligns with the evolving landscape of AI technologies but also underscores KPMG's commitment to staying at the forefront of innovation in the digital era.

Table 3 provides a summary of the interdisciplinary skill set required in response to the increasing adoption of AI. It delineates the diverse range of skills essential for professionals to effectively navigate and capitalize on the opportunities presented by AI technologies.

Table 3. Interdisciplinary Accounting Skills

Category	Skills
Technical	Budgeting, tax planning, financial analysis, auditing techniques, managerial accounting.
Analytical and quantitative	Big data, business intelligence tools, information management, machine learning, explanatory and predictive analytics, data visualization techniques, statistical analysis.
Information technology and computing	Microsoft office suite, XBRL reporting, enterprise resource planning (ERP), programming language (R, Python, Java), database management (Access, SQL), statistical software (R-Studio, SPSS).
Complementary and general	Leadership skills including emotional and social skills, fact-based management practices, proficient communication skills, collaborative teamwork, ethical decision making, and critical thinking.

CONCLUSION

The widespread adoption of AI in accounting carries several implications for the future of the profession. Firstly, it is expected to redefine the role of accountants from mere number crunchers

to strategic advisors. With routine tasks automated, accountants can focus more on analyzing complex financial data, identifying trends, and providing valuable insights to support decision-making processes. This shift toward higher-value-added services emphasizes the importance of developing advanced analytical and critical thinking skills among accounting professionals.

The potential integration of AI also has profound implications for accounting education. Traditional accounting curricula must evolve to incorporate AI-related topics such as data analytics, machine learning, and AI-driven decision support systems. Future accountants need to acquire not only technical proficiency in using AI tools but also a deeper understanding of their implications for business operations and financial reporting.

Furthermore, accounting education should emphasize the development of interdisciplinary skills. As AI blurs the boundaries between accounting, data science, and technology, accountants of the future must possess a holistic skill set that encompasses quantitative analysis, programming, and business acumen. Collaborative projects and interdisciplinary courses can help students cultivate these skills and prepare them for the dynamic nature of the modern accounting profession.

Our study has the following limitations. First, while our literature review summarizes some of the most recent and pertinent research on AI in accounting, we do not provide critical evaluation of the research method and alternative explanations to the empirical findings in these studies. Second, we omit studies published in non-business disciplines due to our limited knowledge in these areas. Third, our analysis predominantly focuses on the potential benefits of AI integration in accounting, potentially underrepresenting the risks associated with its adoption. Moreover, the rapid technological advancements in AI applications may render our findings obsolete swiftly. As AI evolves, new opportunities and challenges will arise, necessitating ongoing research and reevaluation in this field. Finally, our study predominantly relies on theoretical frameworks and secondary data, which might not fully encompass the practical realities and subtle impacts of AI on accounting practices.

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