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Artificial intelligence in accounting and auditing: bibliometric analysis in Scopus 2020-2023

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ABSTRACT

The purpose of the study was to present the results of a bibliometric analysis and literature review on the scientific production related to artificial intelligence (AI) applied to accounting and auditing, contained in the Scopus database between 2020 and 2023. The PRISMA model was used to identify the studies, due to its transparency in the process of obtaining relevant literature. For the first part, a descriptive and quantitative bibliometric analysis with keyword search in the Scopus database was used. For the second part, a subjective approach was followed based on a qualitative analysis based on the author's interpretation. Both approaches were considered for their complementarity. The main quantitative characteristics of journals, authors, articles, conceptual structure, and social structure were identified. Also, the ethical implications of AI applied to accounting and auditing, and the way it impacts on accounting, tax auditing, financial strategy and decision making that contribute to the creation of value for their organization. Change the aversion to AI for adaptability and understanding that their auditing and forensic accounting were extracted. The accountant-auditor's work will be increasingly computerized. They should focus more on analysis; professional profile must be transformed synergistically with AI. The study is intended to serve as a theoretical basis for future research.

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1. INTRODUCTION

In Peru, artificial intelligence (AI) has taken preponderance even at the regulatory level, as evidenced by the publication of Law 31814 dated June 13, 2023. The regulation establishes the promotion of the use of AI within the framework of the national process of digital transformation, giving priority to the individual and respect for human rights to promote the economic and social development of the country, in a safe environment that guarantees its ethical, sustainable, transparent, replicable, and responsible use. This, added to the fact that the ethical behavior of public accountants represents a great concern in Peru [1], [2].

At the local guild level in Peru, the different journals of the Peruvian Public Accountants' Associations are beginning to address issues related to blockchain and AI applied to accounting, but at the level of scientific or academic literature there is still no evidence of literary production. Both at the level of university theses, academic books or accounting software production, there is no research available. Therefore, a bibliometric review is necessary to examine the advances of AI in the fields of accounting and

auditing. This provides a research path for accounting researchers. In other parts of the world, however, the question of what the accounting of the future should be like is being addressed.

The accounting of the future is characterized by the quality of scientific production, the adoption of innovative technologies, the integration of sustainability in accounting practice and the need to keep up to date with changes in frameworks and regulations [3]. We live in the times of the fourth industrial revolution Industry, the so-called Industry 4.0. Its basic components are the Internet of Things, real-time data collection and predictive analytics through big data analysis, AI, and cloud manufacturing [4].

AI has been installed in the present and is developing as a technological asset in constant evolution and a reason for research [5]. According to a report by the consulting firm McKinsey and Company published in Forbes, generative AI could add between $2.6 and $4.4 trillion in annual productivity worldwide, and analytical AI could contribute between $11 and $17.7 trillion annually to the global economy [6]. The growth of robotics, AI, machine learning (ML) and other advanced analytics tools are providing opportunities to optimize business models in the financial sector, both in commercial banking and Fintech companies [7]. Mathematical, computational, and algorithmic research is developing exponentially and seeking ever more sophisticated solutions to complex problems [8]-[10]. Studies show that accounting-related occupations have a high degree of computerization: 99%, tax preparers; 98%, bookkeeping, accounting, and auditing clerks; 97%, payroll and timekeeping clerks; 94%, accountants and auditors; 93%, tax inspectors and collectors, and tax agents [11].

Expectations in the global economy regarding AI have spread to the different accountants' guilds around the world. The International Federation of Accountants (IFAC) global accountants' guild expresses its concerns regarding AI and accounting, and wonders whether it is opportunity, threat, both or neither [12]. Interest in the subject is evidenced for example by the number of articles tagged with the keyword AI, as it has increased 9-fold, between 1966 to 2015, likewise, the number of students enrolled in introductory classes in AI at Stanford University has increased eleven-fold [13]. This irruption of this disruptive technology, the collective professional identity of auditors has explicitly incorporated technology, i.e., the auditor's identity is assumed by Goto [14].

However, accountants not only recognize the need for continuous improvement in relation to digital tools, but also associate the changes with the fear of losing their jobs when they are replaced by AI and perceive it as a vulnerability for the future of the profession [15]. In this new scenario, it is urgent to ask what will be the competencies of the accountant of the future and how will his role be defined as accountant, financial auditor, forensic accountant, and even in tax management? [16]. Lists five technologies set to redefine the work of accountants: cloud computing, integrations, digital currency, blockchain and ML [17]. He argues that these technologies will redefine jobs in a way that will reduce costs and increase demand rather than eliminate those jobs.

A. Artificial intelligence

AI works in the approach with human intelligence through computer programs that follow the rhythm of human behavior. These programs are characterized by intelligence, speed of electronic processing of operations and by providing users with the data and information they need in various decisions in a fast way. AI research brings knowledge to multiple disciplines, such as social sciences, engineering, computer science, and mathematics, in addition to the focus area, business, management, and accounting [18].

A focus on AI has a positive correlation with sales, return on sales, return on marketing-related investment and net operating efficiency. Similarly, we find that AI reduces advertising spend We also find that an AI approach can boost employment. This potentially increases costs for companies in terms of wages and salaries [19]. It is part of intelligent automation conceived as a transformative solution based on the integration of business process monitoring (BPM), AI, and robotic process automation (RPA) [20].

B. Accounting and auditing

Accounting in the 21st century is conceived as a social and interdisciplinary science to meet the multidimensionality of its challenges [21]. Its scope must not neglect environmental issues, technological innovations, and social conflict, which are the basis of the new social requirements [22]. With respect to the professional training of public accountants in the era of digitalization, it should be considered the learning of blockchain technology; adaptation to the new technological realities, unlearning tools that are digitally obsolete, specialist in data analytics, and adaptation to virtuality [23]. Recent studies present integrated accounting with intertwined approaches of environmental, social, and economic accounting models in such a way that it can contribute to sustainable development. Thus, accounting is not only based on an economic paradigm, but on a multiplicity of paradigms such as the net profit or utility paradigm [24].

C. Research objective

The objective of the paper is to present a brief bibliometric analysis and literature review based on AI research in the professional areas of accounting and auditing in the last four years. The bibliometric analysis will show results on journals (highest scientific production, Scopus coverage, and related quartile),

authors (highest scientific production, affiliations, and their countries), articles (most cited and keywords). By means of the literature review, the following research questions are proposed to be solved:

– What are the main journals, authors, articles on the proposed topic?
– What ethical aspects are being studied between the relationship, accountant, and algorithm?
– What is the impact of AI on accounting and auditing work?

2. METHOD

The bibliometric analysis was conducted in Scopus, being the database with greater scope in accounting research topics than Web of Science WOS. The following syntax was used as a search strategy (TITLE-ABS-KEY ("artificial intelligence") AND TITLE-ABS-KEY ("accounting") OR TITLE-ABS-KEY (audit) OR TITLE-ABS-KEY (auditing)) AND (LIMIT-TO (SUBJAREA, "BUSI")) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (PUBYEAR, 2020) OR LIMIT-TO (PUBYEAR, 2021) OR LIMIT-TO (PUBYEAR, 2022) OR LIMIT-TO (PUBYEAR, 2023)) AND (LIMIT-TO (PUBSTAGE, "final")). For the process of identifying studies on the research topic, the PRISMA model was followed, whose objective is to provide a transparent process for the search of relevant literature [25]. Thus, Figure 1 shows the process followed to obtain the 124 documents.

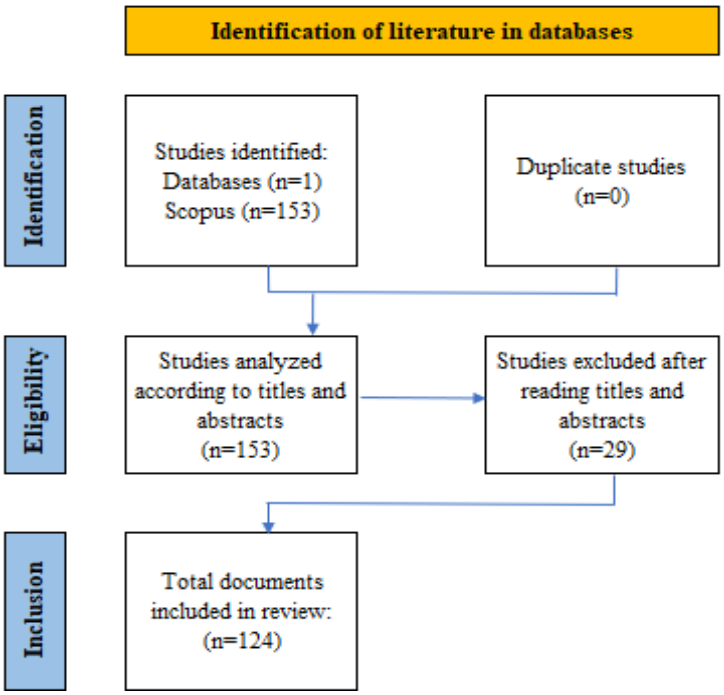

Figure 1. Identification of literature in database

The period under analysis covers the years from 2020 to 2023. Only documents from the area of "business, management, and accounting" were selected to obtain the results referring to the field of accounting and auditing. The data download was performed between June and July 2023. To answer question 1, bibliometric processing was performed using R studio software (Bibliometrix library) on the metadata file downloaded from Scopus in BibTex format. To answer questions 2 and 3, a compilation was made based on the interpretation of the author of this article.

3. RESULTS AND DISCUSSION

3.1. Bibliometric analysis

About the journals. The production of scientific articles for the period 2020, 2021, 2022, and mid 2023 were 27, 33, 35, and 28 articles. The main journals were identified; the following Table 1 shows those that have published more than two articles on the topics under investigation in this article, indicating the year of coverage in Scopus and the associated quartile according to Scimago.

Table 1. Scientific production of journals

Journal	Articles	Country	Coverage Scopus	Quartile
Journal of Emerging Technologies in Accounting	7	USA	from 2009 to present	Q2
Computer Law and Security Review	5	United Kingdom	from 1985 to present	Q1
Technological Forecasting and Social Change	4	USA	from 1970 to present	Q1
Technology in Society	4	United Kingdom	from 1979 to present	Q1
Academy of Accounting and Financial Studies Journal	3	USA	Discontinued 2021	---
Accounting, Auditing and Accountability Journal	3	United Kingdom	from 1988 to present	Q1
Financial and Credit Activity: Problems of Theory and Practice	3	Ukraine	from 2022 to present	---

As can be seen in Table 1, the main journals that publish on AI applied to accounting and auditing are catalogued as Q1 and Q2 quartile journals in Scopus. In some cases, they are journalling whose publications date back to the 1970s. The countries that have invested the most in research on the topics of study are the USA and the United Kingdom. Funding schemes could play a key role. Latin American universities could take note of the main journals in the world and plan accounting research activities that promote progress in the lines of research in the region. This could be complemented with agreements so that Peruvian accounting authors could have access to publication with differentiated APC costs to promote scientific dissemination. About the authors. The author with the most research papers on AI and accounting published in journals indexed in Scopus in the period under study is Othmar Lehner, from the University of Jyväskylä, a public university in Finland founded in 1934 as shown in Table 2.

Table 2. Principal authors

Author	Articles	Articles in Scopus	Institution	Country
Lehner, Othmar	5	62	University of Jyväskylä	Finland
Goto, Masashi	3	3	Sumitomo Dainippon Pharma Co., Ltd.	Japan
Al-Aroud, Shaher Falah	2	4	Isra University	Jordan
Hussainey, Khaled	2	182	University of Portsmouth,	United Kingdom
Leitner-Hanetseder, Susanne	2	6	University of Applied Sciences Upper Austria, School of Management,	Austria
Vasarhelyi, Miklos	2	138	Rutgers Business School-Newark and New Brunswick	USA

Chávez-Díaz [26] identified with the highest scientific production could be considered by Latin American universities or even by regional accounting associations for events such as congresses on accounting research with the use of AI. From the data obtained, the total production is distributed among few authors. With respect to the affiliations, Table 3 shows those with more than two published articles and additional information on the trajectory of each entity. This result shows us the top five universities in the world that consider the application of AI in accounting or auditing processes. In this regard, the agreements between educational institutions are a great opportunity to do joint research so that accounting researchers increase their scientific production. Exploratory studies show that only 2.9% of thesis advisors in Peru have published in journals indexed in Scopus and have obtained the qualification of research professor [26].

Table 3. Principal affiliations

Affiliation	Country	Articles	Articles on business, management, and accounting	articles in Scopus	Number of authors
Hanken School of Economics	Finland	5	1,772	2,813	399
Bandung Islamic University	Indonesia	3	56	506	427
Kobe University	Japan	3	686	68,960	14,958
State University of Trade and Economics	Ukraine	3	286	971	660
University of Applied Sciences Upper Austria	Austria	3	50	1,026	339

The countries with the highest scientific production according to the author's affiliation are the United Kingdom and the United States with nine articles each. About the articles. The article that has been most cited as of the evaluation date is the one corresponding to the author Gronsund with ninety-three citations. It is followed by Manita with eighty-eight citations. The Figure 2 shows the authors with more than ten citations globally. The most cited articles with at least fifty citations are identified as shown in Table 4.

These authors with the most cited papers could provide clues for applied research such as software production, fraud detection algorithms, or complementary robotic components that would add value to the accounting and auditing processes. The most frequent words associated with AI and the accounting and auditing domain are presented in Figure 3.

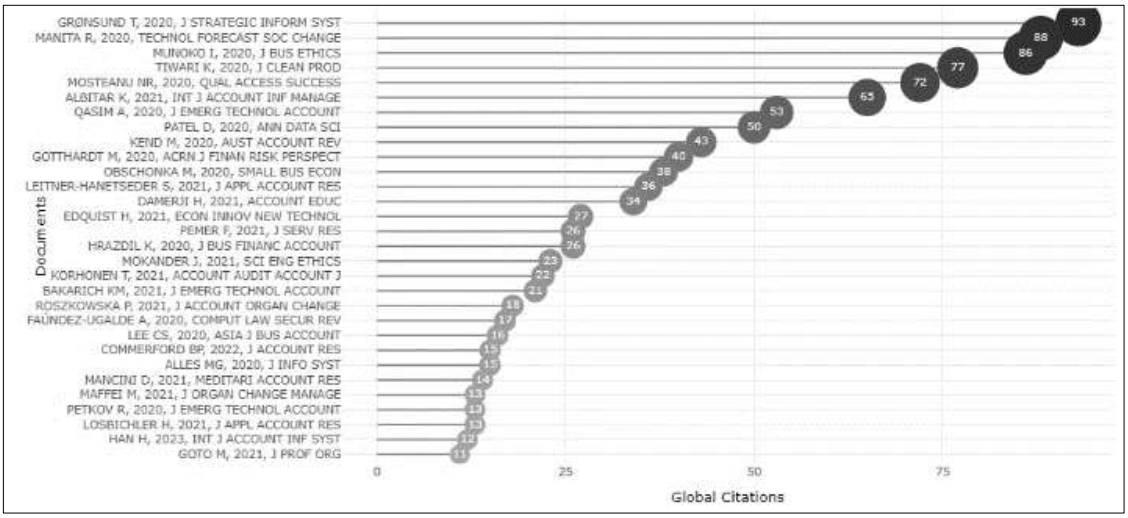

Figure 2. Authors with more than ten citations

Table 4. Most cited articles

Author	Doi	Total citations
Grønsund and Aanestad [27]	10.1016/j.jsis.2020.101614	93
Manita *et al.* [28]	10.1016/j.techfore.2019.119751	88
Munoko *et al.* [29]	10.1007/s10551-019-04407-1	86
Tiwari and Khan [4]	10.1016/j.jclepro.2020.120783	77
Mosteanu and Faccia [30]	NA	72
Albitar *et al.* [31]	10.1108/IJAIM-08-2020-0128	65
Qasim and Kharbat [32]	10.2308/jeta-52649	53
Patel *et al.* [33]	10.1007/s40745-019-00239-y	50

Figure 3. Cloud of words

Co-occurrence network. The present work was focused on the concept of AI and its effects on accounting and auditing. After obtaining the bibliography in Scopus, a co-occurrence analysis was performed, thus, it is possible to obtain concepts associated with AI in the proposed field of study. The concepts that stand out are “decision making”, “big data”, “data analysis”, “sustained development”, and “automation”, as shown in Figure 4. The information presented shows us clues for future research. For example, Figure 3 shows that decision making, big data management, sustainable development, technological development and corporate social responsibility are the sub-themes with the greatest emphasis and is corroborated by Figure 4.

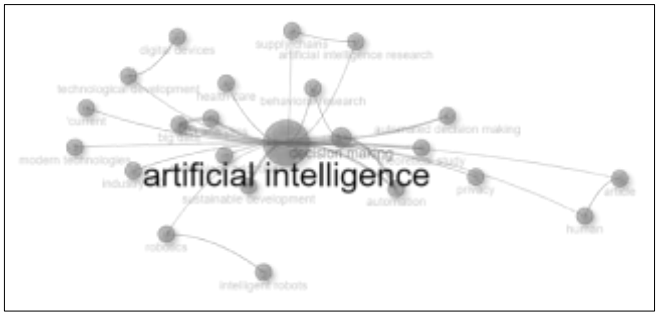

Figure 4. Co-occurrence network

3.2. Ethical aspects

One of the most talked-about ethical concerns relates to the possible discriminatory effects-ethnicity, religion, gender, or other attributes-that AI may consider in its execution [34]. To avoid biases in the algorithms that make up AI, [35], for example, introduces us to the performance model based on six algorithmic paths: ethical egoism, deontology, utilitarianism, relativism, virtue ethics and care ethics. In the same line of thought [36], argues that an effective AI approach must respond to the diverse needs of people of different sexes and genders. Asks How can humans make objective algorithms? Is the data that feeds the algorithms free of inherent biases? They argue that it is possible to train an AI system to ignore race, gender, and sexual orientation [37]. However, such a system can only be created with the help and moral awareness of human experts who create and train AI systems.

Research on human-algorithm interaction already shows the concept of "human-in-the-loop configuration" which emerges as a strategic capability, to ensure that the algorithm's performance meets the organization's requirements, as it provides a feedback loop that favors learning [27]. From the ethical point of view, it is key to create a scenario of human-AI collaboration in accounting, transparent, balanced, and auditable to achieve reliability; otherwise, ethical decision making cannot be guaranteed in the future [37], [38]. Therefore, the ethical design of emotional AI in society requires a thorough understanding of the risks and potential harms of the technology [39]. And, finally, appropriate ethical legislation by regulatory agencies is essential [40].

3.3. About AI in the different fields of accounting

The following lines present the conclusions on the interference of AI in various branches of accounting, such as management accounting, financial auditing and forensic accounting.

A. Accounting

An accounting information system relies heavily on its human and non-human stakeholders to form a coherent and united accounting information system network to promote AIS management strategies, therefore, there must be a balance between human and non-human stakeholders [41]. The accountant must overcome the possible inaccessibility of AI use, take responsibility for AI use, and overcome the increased social isolation due to AI use [42].

The use of AI in accounting had already generated tangible benefits by increasing the intelligence of accountants to analyze voluminous data and prevent intentional and unintentional fraud activities, however, a clear division of labor must be established between accountants and AI and the reasoning of AI must be transparent to ensure fairness and objectivity for all [43].

By automating repetitive work [44], error-prone and time-consuming, AI robots create more possibilities for human workers to do what human brains do best: create, connect, and analyze. Instead of lamenting the loss of mind-numbing data-processing tasks, the opportunity to advance human potential and organizational success is here with AI robot-human partnerships [13].

B. Financial audit

AI can be used to assist in auditing, and, at the same time, auditors can increase their technical skills regardless of the type of auditing firm they work for [45]. This also applies to state internal auditing [46]. However, it should be noted that much will depend on the quality and quantity of the data input to the AI systems [47].

The use of AI is performed from the stage of data information extraction even from unstructured data, being this process automation also known as cognitive automation [48]. Most internal auditors agreed that AI and ML play a significant role in improving audit quality, reliability, and overall efficiency. It also helps in detecting errors and misstatements, subsequently assisting auditors in professional skepticism and

best judgment [49]. As audit firms invest in AI, they can reduce the fees they charge while reducing their audit workforce and showing increased productivity [50]. With respect to Assisted and Augmented AI systems, auditors perceive them as easy to use in auditing, while they perceive Autonomous AI systems as complicated to use and not useful for auditing [51].

C. Forensic accounting

AI has enabled regulators around the world to crack down on stock market manipulations, money laundering and predictive policies adopted by financial institutions [52]. AI and ML-assisted professional skepticism and professional judgment have a positive correlation with error and misstatement detection because AI and ML ensure comprehensive data verification instead of manual audits. Compared to manual auditing, AI and ML-assisted auditing is highly dependable in detecting errors and fraud, unlike random data verification when performed manually [49], [53]. This does not mean that AI can eliminate fraud, but in an integration with other tools such as blockchain it will make it easier for organizations to control and track accounting information [54].

Although AI, RPA or ML are not yet used in many latitudes, they are not yet used in many countries [55] but, in more developed countries, the overwhelming presence of AI is noticeable; in these contexts, accountants can focus more on analysis, strategy and decision making that contribute to organizational success [56]. In times of Industry 4.0 or cyber era, the competencies that must accompany the accountant are soft skills, empathy, analysis, leadership, communication, emotional intelligence, integrity, flexibility, and the ability to manage work pressure and work in teams, as well as adding value to their profession through certification that demonstrates continuous professional development [57].

4. CONCLUSIONS

As indicated, and according to the results obtained in the bibliometric study, leading authors in the field of AI in accounting have been identified, who could be invited to accounting congresses or give online conferences. Similarly, the journals with the highest scientific production have been identified, to which periodic access is suggested for updating purposes. In the Peruvian context, agreements could be implemented with the most important journals so that accounting researchers can publish their first findings on the subject in the country. These agreements could include access to publications in these journals at differentiated costs. Finally, the educational entities with which national entities could make agreements or internships for the benefit of researchers are known.

Accountants not only need to adapt to the use of information technology, but also to adapt to the ever-changing business environment. Accountants must not only be familiar with the operations of the AI system, but also have a deep understanding of its algorithms and meanings of the results, as well as business operations. Accounting software manufacturers applied to Peru could consider as part of their solutions, not only robotic applications that simplify the recording of operations, but also integrations that facilitate fraud detection. In this way, accounting would aim at financial and business sustainability.

Looking to the future, we propose a multidisciplinary research agenda composed of five areas: organizational transformation, human-machine collaboration, regulation, technological innovation and ethical considerations for the Peruvian and even Latin American context. Likewise, audit firms are recommended to invest more in digital programs, such as AI, blockchain, network security and data function development.

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