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Article

Redesign of accounting education to meet the challenges of artificial intelligence: A literature review

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REDESIGN OF ACCOUNTING EDUCATION TO MEET THE CHALLENGES OF ARTIFICIAL INTELLIGENCE – A LITERATURE REVIEW

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Abstract

The development of emerging technologies, including artificial intelligence (AI), has a direct impact on the accounting profession in the sense of redefining the role and place that accounting specialists occupy within economic entities. This paper is a systematic literature review and aims to emphasise and synthesise the main challenges regarding the impact that artificial intelligence and other related technologies exert on accounting professionals and the competencies they need to develop or acquire. At the same time, the outline of specific solutions was envisaged, through which accounting professionals can be supported in their efforts to adapt to the new requirements of the labour market imposed by the evolution of disruptive technologies. To achieve the proposed objectives, Web of Science (WoS) was used as an academic database and specific tools for bibliometric analyses, including the VOSviewer application. The results identify universities as the main pillar in the process of the redesign of accounting education, and update of the curriculum in the field as the main measure to be undertaken. The originality of the paper resides in the identification of specific solutions for curriculum reconfiguration in the field of accounting education, the highlighting and overcoming of possible challenges for the redesign of the education process in the field of accounting, under the impact of AI.

Keywords: accounting profession, artificial intelligence, digitalization, professional competencies, accounting curriculum, accounting education

JEL Classification: I20, J24, M40, N30, O33

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Introduction

The remarkable evolution of technology requires a comprehensive understanding of its impact not only in the context of industry, education, and society, but also in terms of labour relations and professions, an impact that comes with a set of difficulties, which must be overcome, and opportunities, which must be capitalised (Tavares et al., 2023). Among the factors behind these difficulties or opportunities we mention the transition to a digitalised and resource-efficient economy, the development of robotics and artificial intelligence, as well as demographic factors (Asonitou, 2022).

The global digital revolution has significantly and irrevocably transformed human society and the activities carried out, and in this context the accounting profession is expected to experience a major change in the near future as a result of technological developments. Practices will be automated and related positions will become obsolete, so that accounting graduates as well as practitioners in the field should be educated for newly and different tasks and positions (Al-Htaybat, von Alberti-Alhtaybat and Alhatabat, 2018). Also, the rapid evolution of technology and the important changes induced by this process in the business world, have a direct impact on accounting professionals, with advances in the fields of automation and machine learning, artificial intelligence, data analysis and blockchain. At the same time, these are being considered disruptive technological elements in the accounting domain (Aldredge, Rogers and Smith, 2021). These disruptive technologies, being extremely dynamic, are significantly reshaping business processes (Moore and Felo, 2022) with direct implications on the status and on the role played by the accounting professionals.

In the context of the effects produced by technological developments, accounting education and the qualification of accounting students for the current and especially future requirements of the labour market is considered one of the notable issues that seem to have been overlooked in many of the education programs of the majority universities (Al-Hattami, 2021). This issue is raised as the ongoing digital revolution demands the accounting profession to adapt and bring forward new accounting services, that involve a wider set of competencies than commonly recognised (Banasik and Jubb, 2021).

Against this background, we have identified a research opportunity, in that there is still a lack of holistic understanding of how the adoption of AI forces accounting professionals to redefine, adapt or develop previously acquired competencies, or even acquire new competencies. Therefore, we propose three research questions (RQ), which we aim to answer:

- RQ1: In the context of the development of artificial intelligence systems, which are the competencies that the professional accountants must acquire or develop, to adapt to the new requirements of the labour market?
- RQ2: Which are the mechanisms to support the accounting professionals in their effort to reconfigure these competencies?
- RQ3: In the context of the expansion of artificial intelligence systems, which is the role of the educational system and what are the directions aimed by the curriculum development process, to support the students or the accounting professionals in the process of adaptation or development of their competencies?

We consider it appropriate to choose this topic, because, as other authors have pointed out (Leitner-Hanetseder et al., 2021; Tavares et al., 2023; Yigitbasioglu, Green and Cheung, 2023; Jackson, Michelson and Munir, 2023), in the literature there are relatively few studies investigating the influence and future consequences of new technologies on the accounting profession. Based on a systematic literature review, the purpose of our study is twofold:

- to identify, group, and systematise knowledge regarding the impact that artificial intelligence and other related technologies have on accounting professionals and the competencies they need to develop or acquire;
- to outline specific solutions through which accounting professionals might be supported in their efforts to adapt to the new requirements of the labour market imposed by the evolution of these disruptive technologies.

The results of our study identify the competencies needed by the accounting professionals in the context of implementing AI-based solutions, the stakeholders involved in obtaining these competencies, and the role of the educational system in this endeavour. Analysing the impact of AI on accounting education, this paper makes significant contributions to both theory and practice: theoretically, we propose a new perspective on the impact of AI on accounting education, by integrating dissipated research in a new analysis framework, while from a practical perspective, we identify a series of challenges and specific actionable measures to overcome these challenges. Our paper is structured as follows: the first section is dedicated to the rigorous review of the scientific literature and allows us to highlight the general context determined by the development of artificial intelligence systems, with direct reference to the impact on the accounting profession; in the second section we explain in detail the research methodology we used; in the third part of the paper we analyse the results obtained; in the fourth part we critically discuss the results; in the fifth section we make proposals for new research directions; finally, we present the conclusions of the research and its limits.

1. Literature review

Rapid technological progress directly influences the way businesses are organised and run (Almufadda and Almezeini, 2022; Birt, Safari and de Castro, 2023), and dramatically transform economic activity (Bonzanini et al., 2020). The development and implementation of artificial intelligence were defining elements for triggering the fourth industrial revolution, which intensified technological changes with impact in almost all sectors of life (Cunha et al., 2022).

The accounting profession is also undergoing through an important change and transformation due, in particular, to technological developments, among which digitalisation and artificial intelligence have a significant impact (Almeida and Carvalho, 2022). In this context, the accounting professionals must adapt to the new technological alternatives on the market, which prove to be superior to the traditional accounting system (Ciurea and Man, 2020). Moreover, Guşe and Mangiuc (2022, p. 264) state that “digitalisation will rewrite the social contract between people and the business environment, the largest gap occurring not between developed and emerging economies, but between generations born and educated in the analogue age and those from the digital age”.

It is considered that all these changes demand an adaptation or even a significant transformation of the competencies required to accounting professionals, so that they can successfully fulfil their new tasks (Damasiotis et al., 2015) and effectively use the technologies, found in a continuous evolution, to provide further valuable support to all interested parties (Banța et al., 2022).

Against the background of these profound transformations, both those who are preparing to become professional accountants and those who are already being active in this field feel the need for support to facilitate their approach aimed to redefine, to adapt or to develop the competencies required by the new conditions existing on the labour market, in the context of the development of systems based on artificial intelligence.

The solutions identified by researchers in the scientific literature bring into discussion different actors and diverse ways to support both accounting students and practitioners in their efforts to adapt to the new context of the labour market.

Jackson, Michelson and Munir (2023) assign roles in this process to universities, professional organisations and employers, considering that it is necessary to have a partnership between all these interested parties, which aims to rethink the curriculum, ensure programs relevant continuous professional development, provide part-time jobs, coaching, mentoring and on-the-job training, etc. On the same line of cooperation between several actors, Bonzanini et al. (2020) appreciate that higher education institutions, businesses, professional associations and public authorities will have to cooperate in the next framework of Industry 4.0. Fredo et al. (2023) also sustain the idea of collaboration between academia and professional organisations and argue in favour of the need to diversify digital, communication and social knowledge and skills. Kokina and Davenport (2017) argue that academia needs to reconceptualise the accounting curriculum, regulators need to formulate revolutionary policies, while professional bodies need to redesign the professional development process.

Gonçalves, da Silva and Ferreira (2022) consider that the main role in the process of education and continuous professional development must be given to higher education, which must keep pace with technological development to provide specialists with the necessary competencies so that they remain relevant in relation to the dynamic requirements of the labour market. However, national and international professional associations are also involved in this process and they must play a significant role in defining the competencies sets that are necessary for the training of professionals in the current and future context. Also, Kroon, Alves and Martins (2021) state that regulators also have an important role, considering that they must be careful to adjust standards according to the current digital state, while Birt, Safari and de Castro (2023) argue that the roles must be divided between educational institutions, standardisation bodies, and professional ones.

There are points of view that shed light on the accounting professionals, as they have a direct responsibility, given that it is appreciated that the rapid and unpredictable changes of the profession bring forward the need for continuous learning, flexibility and permanent adaptation to new circumstances (Li and Zheng, 2018; Grabińska, Andrzejewski and Grabiński, 2021; Cunha et al., 2022).

Even if the researchers identify several actors that must play a role in the process of adaptation of accounting professionals to the new requirements of the labour market, nevertheless, the study of the specialised literature reveals the primary importance of educational institutions. The majority of the opinions expressed, and in agreement with our

views, converge towards the need to adapt the curriculum in order to ensure the competencies required by the current and especially the future technological context (Al-Htaybat, von Alberti-Alhtaybat and Alhatabat, 2018; Al-Hattami, 2021; Banasik and Jubb, 2021; Cong, 2021; Junger da Silva et. al., 2021; De Villiers, 2021; Kroon, Alves and Martins, 2021; Almeida and Carvalho, 2022; Gonçalves, da Silva and Ferreira, 2022; Bunea and Guinea, 2023; Elo et al., 2023; Karciglu and Binici, 2023; Landsberg and van den Berg, 2023; Tavares et al., 2023).

Researchers express heterogeneous opinions regarding the set of competencies that the accountants of the future should possess, so that they will continue to fulfil a strategic role within economic entities:

- Yigitbasioglu, Green and Cheung (2023) consider that professional accountants will play a significant role in the assessment and assurance of new technologies, and this requires them to master competencies that will allow their involvement in activities aimed at monitoring and interpreting big data generated by the use of artificial intelligence, in order to ensure compliance with legal and ethical requirements;
- Tsiligiris and Bowyer (2021) state that the skills needed by future accountants could be classified into four categories: ethical skills, digital skills, business skills, and soft skills;
- Pargmann et al. (2023) highlight the need to combine technical and professional competencies in the different areas of accounting, as well as the growing importance of meta-competencies such as proactive thinking, self-control, creativity, and interdisciplinary action;
- Pasewark (2021) claims that, at the present, the accountants must master unprecedented analytical and technological competencies, have practical experience in using business intelligence software, interact with robots, develop skills in leadership, human resources, global awareness, diversity awareness, and collaboration;
- Kroon, Alves and Martins (2021) write about additional training in business strategy and business models; understanding the basics of programming and developing the skills needed to keep up with the latest technologies; development of business analysis capabilities; acquiring soft skills such as intuition, creativity and communication;
- Li and Zheng (2018) emphasise interdisciplinary skills that allow accountants to use the advantages of artificial intelligence. They consider it important for accountants to acquire skills to analyse financial data, to master relevant knowledge about the business, but also to combine big data with artificial intelligence in the tasks they perform.

Considering the context presented and the divergent opinions that the specialised literature highlights, our scientific approach will be directed to identify and to synthesise the main challenges regarding the impact of AI on accounting education, which will allow us to answer the research questions.

2. Research methodology

Our study is based on a systematic review of the specialised literature, including specific tools of bibliometric analyses considered popular and rigorous methods for exploring and analysing large volumes of data (Donthu et al., 2021). The specific stages of the research methodology that we applied to carry out our scientific approach are summarised in figure

no. 1. The data collection stage was very important for the relevance of the obtained results, which is why we paid considerable attention to it. In our research we chose the Web of Science (WoS) as an academic database because it is considered one of the most important research databases in the world (Kamble, Gunasekaran and Gawankar, 2018).

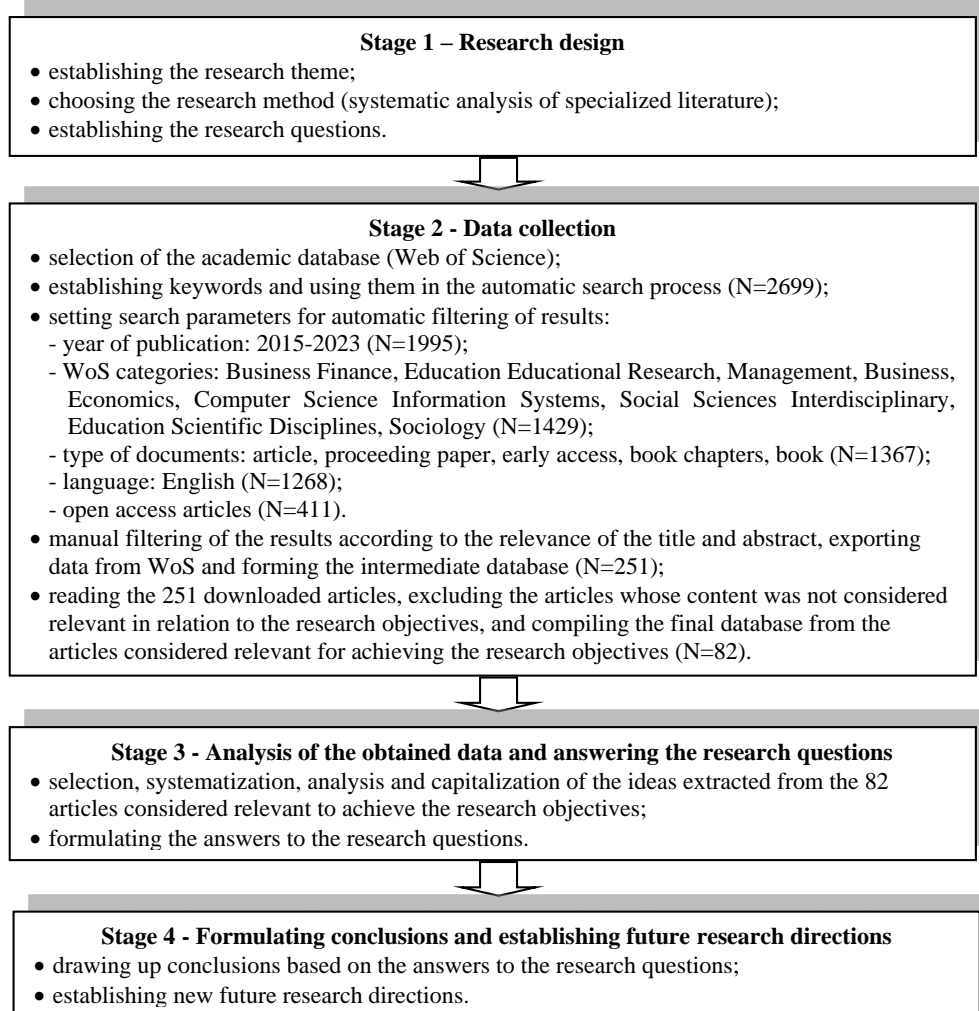


Figure no. 1. Stages of the research methodology

For the query of the scientific database, a set of keywords was used, linked by the Boolean operators “AND” and “OR”, which targeted the topic, allowing the query to follow the title of the papers, their summary and the keywords. The keywords used to query the database are presented in table no. 1.

Table no. 1. The structure of the keywords used for the query

WoS query criteria
TS = (“accounting” AND “artificial intelligence”) OR TS = (“accounting” AND “digitalization”) OR TS = (“accounting” AND “accounting profession”) OR TS = (“accounting” AND “competences”) OR TS = (“accounting” AND “curriculum”)

The interval set for the query concerned the period 2015-2023, considering that starting from 2015/2016, publications about the influence of artificial intelligence on industry, education, or other aspects of society began to appear in the literature (Tavares et al., 2023). An important search parameter was also represented by WoS scientific categories. We selected nine categories considered relevant to the field in which the research carried out is framed. The distribution of the 82 articles in the final sample among the nine categories is as follows: Business - 10, Business Finance - 35, Computer Science Information Systems - 10, Economics - 5, Education Educational Research - 9, Education Scientific Disciplines - 6, Management - 3, Sociology - 2, Social Sciences Interdisciplinary - 2. At the same time, the automatic filtering also had as a reference element the type of documents queried, the following types being selected: article, proceeding paper, early access, book chapters, book. Out of the 82 articles that make up the final sample, 66, representing 80.49%, are represented by articles published in journals, and 16, representing 19.51%, are articles published in the volumes of international conferences.

To emphasise the relevance of the final database, we also used VOSviewer, an IT software product created by van Eck and Waltman (2010), which allowed us to develop some suggestive bibliometric maps. In order to create the bibliometric maps with the help of VOSviewer, it was necessary to export the WoS database in tab-delimited file format. Using this software we were able to perform an analysis of the relevance of the keywords used in the WoS query process, as can be seen in figure no. 2.

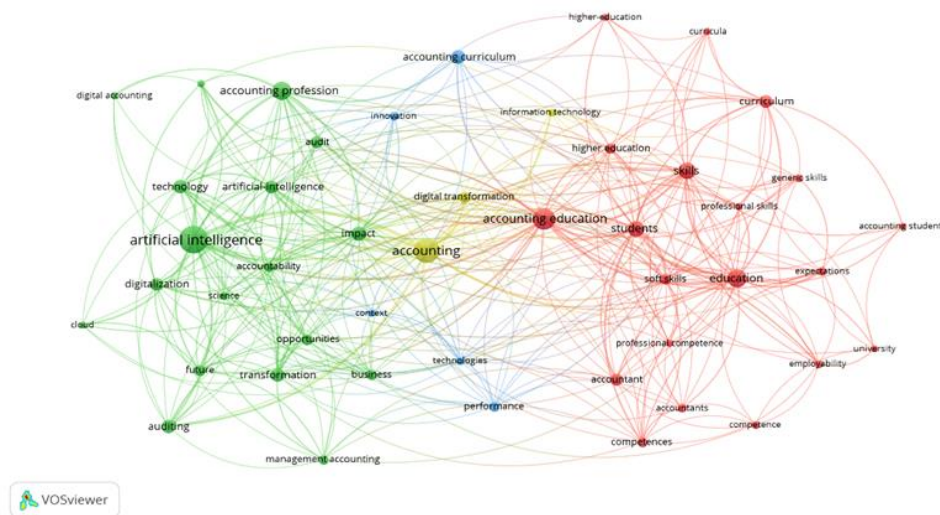


Figure no. 2. Occurrence frequency of keywords

The map generated by VOSviewer highlights the frequency of keywords used by the authors and, from its analysis, it can be seen that among the most used keywords are also those used

by us in the query process. Moreover, it can be observed that three of the keywords used by us, “artificial intelligence”, “accounting” and “accounting profession”, are in the top of the most frequently used ones by the authors of the articles included in the final sample, fact that highlights the relevance of the keywords used in the query process.

Another analysis we carried out through VOSviewer allowed us to highlight the scientific value of the articles included in our sample, through the journals in which these articles were cited. Figure no. 3 presents the co-citation network by cited source and indicates the journals in which are published the articles that most extensively cite the studies we selected. This emphasises the fact that our database was made up of valuable articles from the specialised literature, which were cited in prestigious journals. One can see the existence of a consistent network of co-citations, as well as the fact that journals from the main stream of publications are pointed out. The best positioned journals from this point of view are Accounting Education, Journal of Emerging Technologies in Accounting, Accounting Horizons, and Issues in Accounting Education.

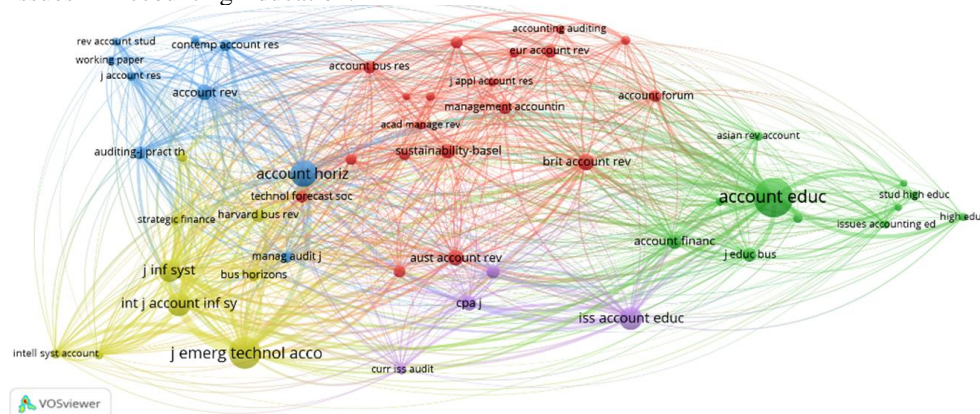


Figure no. 3. Co-citation of the journals included in the sample

The credibility of the articles included in the final analysis, is also underlined by their citation rate, as shown in Table no. 2.

Table no. 2. Citation rate of sample articles*

Citations (Web of Science)	Percent (%)	Papers	Citations (Google Scholar)	Percent (%)	Articles
0-9 citations	74,39	61	0-9 citations	47,56	39
10-30 citations	17,07	14	10-30 citations	29,27	24
31-60 citations	4,88	4	31-60 citations	6,10	5
> 60 citations	3,66	3	> 60 citations	17,07	14
Total	100	82	Total	100	82

Note: * Results valid on August 1st, 2023

The data in Table no. 2 highlight the fact that the analysed articles have a consistent impact in the specialised literature, taking into account the relatively short interval since their publication. Thus, more than 25% of the articles have more than 10 citations on WoS, a fact that proves the importance of the impact of AI in the field of accounting, as the results of our study also highlight.

3. Results, discussion and new research directions

In order to answer the first research question (RQ1) and to conclude what are the competencies that the accountants of the future must master, we considered the three main pillars on which their professional competencies must be based: technology, data and human interaction (Birt, Safari and de Castro, 2023; Tavares et al., 2023). Against this background, the study of the articles from our sample allowed us to group the identified competencies into four categories: digital competencies, data analysis competencies; transversal competencies, active participation in strategic management.

Regarding the digital competencies, knowledge of digital technologies generates one of the core skills needed by modern accounting and finance professionals (Banasik and Jubb, 2021). Concerning data analysis competencies, artificial intelligence will generate a large volume of data, and therefore it is necessary for the accounting professional to be able to operate in a versatile way with this data (Banasik and Jubb, 2021; Yigitbasioglu, Green and Cheung, 2023). Analytical thinking, the ability to identify, select, manipulate, analyse, and interpret data to aid decision-making is complemented by competencies in data governance, related to how data is collected, transferred, stored, accessed, and reported (Aldredge, Rogers and Smith, 2021; Leitner-Hanetseder et al., 2021; Pasewark, 2021). With regard to transversal competencies, our study identified four main types of social skills: teamwork skills, communication skills, leadership skills, and critical thinking skills (Tsiligiris and Bowyer, 2021; Almufadda and Almezeini, 2022; Tavares et al., 2023; Vanhove, Opdecam and Haerens, 2023). Active participation in strategic management requires the accounting professional to master advanced decision-making competencies. The accounting professional must become an adviser to top management in organisations, being able to create predictive analyses and to develop alternatives based on data analysis, which contribute to the value creation in organisation (Al-Htaybat, von Alberti-Alhtaybat and Alhatabat, 2018; Onyshchenko et al., 2022).

The second research question (RQ2) that we intend to answer is aimed at identifying the measures by which accountants can be helped in the process of acquiring the new skills induced by the evolution of disruptive technologies, including AI. The study of the reviewed articles allowed us to identify four main categories of stakeholders involved in this endeavour: higher education institutions, professional associations, regulatory bodies in the field of accounting, and the institutional environment in a broad sense.

From the analysis of the specialised literature, we identified several measures that can be undertaken by the four categories of interested parties. These measures can be synthesised as follows, in relation to:

- the university environment: adapting the curriculum to the new requirements of the labour market and improving the infrastructure in universities;
- professional associations: ensuring relevant continuous professional development programs and collaboration with the university environment in redesigning the curriculum;
- regulatory bodies: updating the regulatory framework to allow the implementation of new changes in accounting practice and education;
- the institutional environment: collaboration with the academic environment and professional associations for the redesign of the curriculum and the integration of employees in professional development programs.

The third research question (RQ3) addresses the role of the educational system and the directions that the curriculum development process must follow in the context of the development of artificial intelligence systems. Our analysis highlighted that researchers consider courses and academic staff as the main pillars of this approach.

First, we found that researchers frequently discuss the need to reconfigure the curriculum by introducing courses that deal with data analysis, big data, data mining, machine learning, information security, programming, robotics, expert systems, and data retrieval, machine learning, AI technology, blockchain, cloud computing. At the same time, most analysed papers discuss the need to include some disciplines dealing with data analysis. This is considered to be justified in the context of the implementation of AI-based technologies, because these technologies generate a large volume of data that must be analysed and interpreted.

Another direction is aimed at academics and considers that they must be proactive (Aldredge, Rogers and Smith, 2021) in the adaptation of the modern teaching methods, such as audio-video tools, specialised software, tutorial consultations, simulations, and enterprise games (De Villiers, 2021). Technical support is needed for academics to become versed in the new methods, to develop transversal and technological competencies (Almeida and Carvalho, 2022). Moreover, it is considered to be useful for academics and practitioners to cooperate for the creation of modern didactic materials, adapted to the current context (Asonitou, 2022).

We present the identified solutions to the research problems in a synthetic manner in Table no. 3.

Table no. 3. Synthesis of the results

Research questions	Results of the research			
Competencies needed by accounting professionals	Digital competencies	Data analysis competencies	Transversal competencies	Active participation in strategic management
Ways in which accounting professionals can be helped to reconfigure these competencies	Universities: adapting the curriculum to the new demands of the labour market and improving the infrastructure in universities.	Professional associations: ensuring relevant professional development programs and collaboration with the academic environment in curriculum redesign.	Regulatory bodies: updating the regulatory framework to enable the implementation of new changes in accounting practice and education.	Business environment: collaboration with academia and professional associations for curriculum redesign and employee integration into professional development programs.
The role of educational system in the context of implementing AI-based systems	Introducing new courses, adding learning units to already existing courses or the blended approach.	Professional development of teachers.	Adapting the teaching methods.	Collaboration with practitioners for the creation of didactic materials.

4. Discussion

4.1. Competencies needed by professional accountants

The importance of technology's knowledge is highlighted by the fact that it can support the formation of other competencies. The Internet of Things, big data, data analysis, cloud computing, electronic archives, artificial intelligence, business intelligence, RPA, next-generation ERP, electronic invoices, mobile payments, and blockchain are just some of the technologies that will need to be mastered (Cong, 2021; Almeida and Carvalho, 2022). Accountants need to have a systemic thinking and must understand the design principles of a cyber system powered by artificial intelligence (Sutton, Arnold and Holt, 2018). It is certainly that are not the accountants who will develop accounting systems based on AI, but it is necessary for them to have some knowledge in order to validate the data generated by AI systems, especially when the results may seem contradictory or further away from the reference benchmark (Pasewark, 2021). Accountants must learn to work with automation robots and supervise them. While accountants do not need to become data scientists or machine learning experts, basic knowledge and training in statistics, machine learning, data analysis, and programming are needed so that they can work with machine learning and AI professionals to design and adjust specific accounting systems (Sun, 2019). Knowledge of business management software is also important.

The accountant should be able to gather and interpret data and communicate conclusions rather than simply report them (Birt, Safari and de Castro, 2023). Data security competencies are also important (Al-Htaybat, von Alberti-Alhtaybat and Alhatabat, 2018; Kokina et al., 2019). Specifically, the AACSB 2022 standards require students to demonstrate the ability to master current technologies and adapt to emerging technologies, including statistical techniques, clustering, databases, modelling, analytics, text analytics, predictive analytics, learning systems, or data visualisation. The software packages that can help with data analysis include: business analytics, Alteryx, Power BI, machine learning, and data mining (Almeida and Carvalho, 2022). On the other hand, there is a large volume of unstructured data that artificial intelligence cannot yet process. Thus, accountants will have to develop their competencies in areas where artificial intelligence cannot yet manifest itself: creativity, understanding the context, tasks that require the use of experience and intuition (Shi, 2020).

Effective interpersonal communication, through various channels, is an essential competency, as accountants will be required to analyse and interpret large data sets, convey the story the data tells and facilitate good decision-making by management (De Villiers, 2021; Elo et al. al., 2023). The growing importance of meta-competencies such as: proactive thinking, self-control, creativity and interdisciplinary action is highlighted (Pargmann et al., 2023). A characteristic of these new technologies is the high speed of change. Therefore, the accounting professional must demonstrate flexibility, adaptability, responsiveness, and agility throughout its professional career (Pargmann et al., 2023; Zhang et al., 2023). This can be achieved through vocational training and lifelong learning (De Villiers, 2021; Jackson, Michelson and Munir, 2023; Landsberg and van den Berg, 2023). In an AI-based accounting environment, the accountant's understanding and knowledge of business ethics is required to assess whether AI-based suggestions comply with accounting standards and ethical principles (Leitner-Hanetseder et al., 2021). Disruptive technological advances will require interaction competencies, including those related to conflict management, team roles, norms, and ethics (De Villiers, 2021; Gonçalves, da Silva and Ferreira, 2022).

The accountant knows that anticipating the impact of technology and understanding business processes based on technology are essential to providing accounting services that contribute to added value (Ciurea and Man, 2020). The accountant must constantly evaluate the AI solutions on the market and propose to the management the selection of the best solutions for the organisation (Damasiotis et al., 2015). The development of real-time accounting, which has to cope with the presence of big data and the new dimension of intellectual capital, requires an accountant who is not only an expert in the field of accounting, but also has experience as a business professional (Onyshchenko et al., 2022; Landsberg and van den Berg, 2023). Accountants are the link between managers and AI applications used in accounting practice (Richardson and Shan, 2019).

4.2. Supporting the accounting professionals to reconfigure their competencies

Universities are indicated, by the bibliographic references consulted, as being the main actor involved in the training of accounting professionals in the field of new technologies. A number of 52 articles refer directly to the modalities to support the accounting professionals, and 26 of them point to universities as the sole responsible in this regard. Analysing the referenced papers, the conclusion emerged that adapting the curriculum to the new requirements of the labour market is indicated by the overwhelming majority of researchers as the main measure that must be adopted by the universities (Al-Hattami, 2021; Banasik and Jubb, 2021; Gonçalves, da Silva and Ferreira, 2022; Karcioğlu and Binici, 2023). In addition, we consider that it is worth mentioning the opinions of some authors, who discuss the need for professional development of teaching staff and the infrastructure development in universities, in relation with the new technological evolutions (Aldredge, Rogers and Smith, 2021; Birt, Safari and de Castro, 2023).

Professional associations and regulatory authorities are considered important actors in the process of adapting the skills associated with professional accountants. It starts from the idea that professional associations must provide relevant continuous professional development programs, the most effective being considered online courses and webinars (Jackson, Michelson and Munir, 2023), thus complementing the courses and skills provided by universities. It is also considered that a close relationship between universities and these bodies facilitates the adequate training of accountants in the field of new technologies through the effect of multiplying the effects obtained (Fredo et al., 2023). At the same time, we consider that it is worth mentioning the ideas which suggest the involvement of professional associations in curriculum design, alongside universities, and this can facilitate students' understanding of contemporary practices, including technological trends (Jackson, Michelson and Munir, 2023). In this extensive process, some authors (Stoica and Ionescu-Feleagă, 2021) also suggest the involvement of regulatory bodies, by updating the legislation.

The institutional environment, a concept in which we have framed the companies that hire accountants, including accounting firms, and other organisations that, together with universities and professional associations, work together to establish the requirements for the training and improvement of accounting professionals, must cooperate with the academic environment and professional associations in the matter of professional training and development. The forms of collaboration recommended by the literature (Osmani, Hindi and Weerakkody, 2020) are the joint development of training courses, job placement clubs, career counselling clubs, and apprenticeships, which would enhance the skills of graduates and prepare them for the labour market. We also retain the idea of co-designing a curriculum that

enables the development of necessary competencies for the graduates' future careers (Osmani, Hindi and Weerakkody, 2020).

4.3. The role of the educational system

Regarding the way in which graduates can acquire the knowledge and skills required in the age of digital technologies, we identified three optics: the introduction of new courses, the addition of learning units to already existing courses and the mixed (hybrid) approach (Banasik and Jubb, 2021). However, in most articles a clear orientation of the authors towards one of these possibilities was not explicitly delineated, although, where views were expressed, we identified as the predominant option the update of existing courses with IT elements and, in this way, the creation of interdisciplinary courses. There are also authors who support more than one variant of the three listed (Holmes and Douglass, 2022).

Incorporating new courses or learning units into accounting curriculum requires significant reconfiguration. The accounting education system must be flexible to keep up with changes in real life, and curriculum changes must be based on the demands of the labour market. It is also appreciated that the involvement of IT experts and labour market representatives is mandatory in the curriculum revision process (Al-Htaybat, von Alberti-Alhtaybat and Alhatabat, 2018).

In this context, the researchers also mention problems that could be generated by the introduction of new courses and learning units in an already crowded curriculum, out of which the predominant ones are those aimed, on one hand, at the competencies of the academic staff who have to teach the new courses or learning units (Aldredge, Rogers and Smith, 2021), and on the other hand, the materials that should be removed from old accounting courses to make way for IT knowledge (Pasewark, 2021). One of the proposals encountered was the development of new integrated study programs and the formation of academic instructors who have a professional competence exceeding the field of accounting (Butler et al., 2021). In relation to the issue of academic instructor's skills, when asked who should teach the newly introduced technology courses, accounting instructors or computer science instructors, supporters of interdisciplinary courses circulated the idea that computer science instructors could not teach such courses, because they do not understand the accounting principles (Cong, 2021), leaving accounting instructors to improve themselves in the technological field. In the long run, the need for academic staff to acquire new competencies in digital technologies (Cong, 2021) was noted, as many of the academic staff completed their studies long time ago, when the emphasis on technology was different.

5. Challenges and future research directions

The process to reconfigure education in the field of accounting is extremely complex. Upon this process act certain variables that the specialised literature did not provide enough space. In our opinion, among these variables we can include the accentuated dynamics of technological progress, the inertia of the normative framework in education, seen in relation to rapid technological developments, the volatile nature of regulations specific to the financial-accounting and fiscal field or even the ethical implications of using AI on the accounting profession.

These variables can trigger a series of chain reactions with direct implications for accounting professionals. For example, the rapid evolution of technologies combined with the repeated changes in legislation in the field of accounting and taxation require the acquisition of new

competencies or the updating of knowledge held by accountants. This objective implies the involvement of accounting professionals in a perpetual process of professional development. In their turn, the inertia of the normative framework in education and even the implications of an ethical nature generated by the implementation of new technologies can constitute brakes in the framework of professional development. In this context, we believe that the study of professional resilience or the study of the influence exercised by the emotional intelligence of accountants on their professional performance, under the conditions of implementing the disruptive technologies, can constitute new challenges for researchers in the field.

We consider that the study carried out allows us to conclude that researchers unanimously agree with the central idea that the implementation of disruptive technologies, such as AI, requires the reconfiguration of the competencies held by accounting specialists and the adoption of measures to support this approach. However, the specialised literature does not sufficiently investigate the aspects related to the difficulties that can be encountered within this extensive process. Therefore, we consider that these topics require further in-depth study, which might constitute future research directions, as it is important to identify viable solutions to the predicted problems to be encountered in the process of redesigning accounting education in the context of AI implementation.

Firstly, there are the collaboration forms between the academic environment and the other interested parties. A hot field such as the use of artificial intelligence in accounting practice calls for the involvement of both IT and accounting professionals. Firms developing AI-based applications can send their lecturers to organisations and universities to train specialists on how to use those applications. Firms developing AI-based applications may also partner with universities or other organisations involved in training or professional development to co-create courses, study programs or professional development programs. There are already successful models in this regard, such as the SAP University Alliances in the field of ERP applications. In this context, we consider useful that future research could answer questions such as: who will train the trainers in the field of AI-based applications? What are the specific ways in which the academic environment must collaborate with the other interested parties in the curriculum adaptation process? How should the collaboration between teaching staff and practitioners be realised for the creation of relevant teaching materials? What teaching methods are best suited to meet the challenges of implementing AI-based applications?

Secondly, another issue that the specialised literature has not clarified, concerns the costs that universities will have to bear when redesigning education in the field of accounting in order to train specialists to master the new competencies required by the market. We consider that future research must also answer the following questions: what are the costs of implementing AI-based solutions to support the educational process in universities? Can universities financially support the implementation of AI-based solutions in the educational process? Is there government support to sustain academia in implementing curriculum for AI-based competencies?

Thirdly, we appreciate that the adaptation of the legal framework in the field of education and accounting will constitute an element that will render difficult this broad effort, to redesign the education process in the field of accounting. It is important that future research also clarify issues related to: what legislative changes need to be made to make it possible to implement AI-based solutions in accounting education and practice? How will professional reasoning be influenced following the changes made in the regulatory framework in the field of accounting?

Fourthly, but not lastly, we consider that future studies should investigate the ethical implications, that the adoption of AI-based solutions could have in accounting education and practice.

Conclusions

The bibliometric analysis carried out enabled us to elaborate the answers to the three research questions, based on the dominant points of view expressed in the scientific literature, which addressed issues related to the impact on accounting professionals exerted by the implementation of AI-based technologies. In conclusion, we consider that our paper demonstrates a pertinent examination of this topic, which we consider to be important and timely.

We consider our study to be rigorously grounded, but also original. Based on a systematic literature review, this article proposes specific solutions for curriculum reconfiguration in the field of accounting education, it identifies possible difficulties in redesigning the education process in the field of accounting and outlines possible ways to overcome these difficulties.

Our study is based on WoS indexed research papers, which is a relevant scientific database. However, it should not be overlooked that our analysis excluded papers from the search query that could have been collected from other sources that are not indexed in the WoS and that could have provided us with possible relevant elements for the research undertaken. This is the reason why we consider this aspect a limitation of our research, which needs to be further investigated in future research projects in the field.

Our research highlights that the implementation of AI-based systems determines the transformation of the competencies' set which the accounting professionals must master, as well as the need to support these professionals in the process of reconfiguration the competencies required by the labour market. In this context, we have identified several actors that can play a role in this process, among them universities being considered the central pillar. The main measure to support accounting professionals, in order to update their skills, is represented by curriculum reconfiguration. This task is primarily assigned to academia, but active collaboration between universities, professional bodies, and business is required for this curriculum redesign process to be relevant.

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