NEED FOR ADVANCED IT SKILLS FOR ACCOUNTANTS – WHAT DOES ACCOUNTING EDUCATION LITERATURE TELL US?

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ABSTRACT

In the digital age, technology has a significant impact on the professional field of accountants. The constantly evolving digital technologies lead to changing tasks and require new skills. This has been the subject of accounting (education) literature for a long time. Using a structured literature review (SLR), we explore what IT skills have been required the last decade and conclude whether these skills meet the requirements of an advanced (semi-autonomous) accounting organization. Our study shows that the accounting education literature identifies the need to integrate advanced IT skills into educational programs. We conclude with a discussion of the drivers and obstacles for implementing IT skills in accounting education curricula. Our findings and derived recommendations should be of interest to accounting educators and professional bodies and highlight the need for further research related to IT skills for accountants in the digital age.

INTRODUCTION

The ongoing digitalization of accounting creates new opportunities to automate accounting processes (Leitner-Hanetseder, Lehner, Eisl, & Forstenlechner, 2021) as well as increases the amount of data used in financial and managerial accounting (in the following accounting) (Oesterreich & Teuteberg, 2019; Vasarhelyi, Kogan, & Tuttle, 2015). The increasing digitalization is often associated with the massive loss of jobs in accounting (Agyemang, O'Dwyer, & Unerman, 2019; Frey & Osborne, 2017). This might be caused by the fact that accounting traditionally includes repetitive and rule-based tasks, which can easily be automated with digital technology. However, digitalization does not lead to a disappearance of the accounting department but rather to an upgrading of the accounting profession or new possibilities for the accounting department and the accountants themselves (Leitner-Hanetseder et al., 2021).

In particular, the possibilities of big data analytics could lead to an accounting establishing itself as a high-quality data provider of structured historical financial and unstructured non-financial data and internal advisers (Bhimani & Willcocks, 2014; Leitner-Hanetseder et al., 2021; Moll & Yigitbasioglu, 2019). However, this development requires a change in the tasks of accountants (Knudsen, 2020; Leitner-Hanetseder et al., 2021). We see that humans will no longer execute especially manual, repetitive and rule-based tasks. Tasks in accounting such as data collecting, recording and preparation of data will be taken over by integrated software solutions or software bots. A fundamental change in recording and reconciliation could be triggered by blockchain technology, which might enable triple-entry accounting.

Furthermore, BI-Tools based on AI-technology might lead to data-driven decision making (Leitner-Hanetseder et al., 2021). According to Lehner, Leitner-Hanetseder, & Eisl, 2019 advanced AI-algorithm might lead to the final level of digital development the fully autonomous accounting (FAAS), which is defined as follows:

"A FAAS is a firm-wide, fully autonomous, self-aware and self-improving accounting system. The centre of an FAAS is a state-based, multi-functional, deep-learning network as artificial intelligence (AI) that is able to holistically simulate and potentially outpace human-cognition and decision-making processes. This AI manages structured and unstructured data and regulations from various sources and delivers timely and apt information to the right audience in the right format."

On the way to a fully autonomous accounting defined by Lehner et al., 2019many stones have to be pushed away. Although a lack of IT skills is a significant hurdle to overcome, we are aware that IT skills are not the only competences that employees have to face in the course of digitalization. For example, understanding the key concepts and rules of accounting is necessary more than ever (Vasarhelyi, Teeter, Ryan, A., & Krahel JP, 2010). However, in the last decade, IT skills are nevertheless a competence that is brought up again and again in the accounting education literature (Howcroft, 2017; Leitner-Hanetseder et al., 2021; Moll & Yigitbasioglu, 2019; Tan & Laswad, 2018; van Laar, van Deursen, van Dijk, & Haan, 2017). To identify which IT skills have been discussed in the accounting (education) literature, we conduct a structured literature review (SLR). In an ongoing evolution of digital technology, IT skills depend on the level of digitalization in accounting. Therefore, we assign whether the discussed IT skills meet the requirements of a semi-autonomous accounting in the model of Lehner, Forstenlechner, Leitner-Hanetseder, & Eisl, 2021, which might be a scenario for many companies in the near future or might be existing in some companies. Consequently, we define the following research questions (RQ):

RQ1: What IT skills have been discussed in the accounting education literature in the last decade?

RQ2: Do these skills meet the requirements of an advanced (semi-autonomous) accounting?

This paper is structured as follows: In section two, we highlight the theoretical background and concepts of digital accounting. In section three, we describe the research process, including the method, steps and activities of the SLR to answer RQ1. In section four, we focus on the presentation of the results in responding to the RQ1. In section five, we answer RQ2 and provide insights into further research.

BACKGROUND

Digitalization is considered one of the most significant and most lasting challenges in today's society and affects many areas of our lives, including gainful employment. What exactly digitization means is complex and not clearly defined (Vial, 2019). Digitalization is often used synonymously with the term "digitization", "digital transformation". It will be associated with "technological disruption" (Cong, Du, & Vasarhelyi, 2018), "digital disruption" (Marrone & Hazelton, 2019) and at least a "technological (digital) revolution (Ackert, Church, & Zhang, 2018; Pan & Seow, 2016). It often refers to the reorientation of companies or even disruption of markets and existing goods and services (Vial, 2019). Digitalization is generally associated with increased efficiency, cost reduction and increased customer satisfaction through individualized products with the shortest possible delivery times (see business models such as Netflix) (Bhimani & Willcocks, 2014). Obviously, digitalization also has a major impact on accounting, and automation is not new to accounting and happened over the last decades. In an ongoing evolution of digital technology, the aforementioned FAAS provides a glimpse into a utopian future of accounting (Lehner et al., 2019). However, to close the skill gap in the near future, it is necessary to identify the IT that will be used in the near future or currently. As a framework, we refer to the semi-autonomous accounting proposed by Lehner et al., 2021. Within a semi-autonomous accounting, accountants focus on the interpretation of

system-generated information and take on a stronger internal advisory role supported by a fully-integrated accounting information system (AIS) for financial and management accounting. The AIS is characterized by high levels of automatization and is sourced from other sub-systems, and provides a much larger data pool. Within level two, automated document processing within a fully-automated workflow is employed, specialized (smart) software robots are used (see also Cooper, Holderness Jr, Sorensen, & Wood, 2018; Rozario & Vasarhelyi, 2018), digital reporting in XBRL-based and overall reporting-cycles enable near-time reporting (see also Cai, 2021; Clarkson, Li, Richardson, & Tsang, 2019). The AIS uses blockchain-based distributed ledgers (see also Cai, 2021; Dai & Vasarhelyi, 2017) and is connected with external data sources such as social media platforms for financial disclosures and non-financial insights (see also Arnaboldi, Busco, & Cuganesan, 2017; Hales, Moon, & Swenson, 2018).

Process-mining technology help to control and document all accounting processes (see also Chiu & Jans, 2019). Accountants include external and unstructured data in their enhanced Business Intelligence (BI)-solutions, which use InMemory-database (DB) technologies and use data science algorithms to tackle big data analytics, predictive analytics and fraud detection. Early-stage AI-powered applications provide human decision-makers with high-quality base for decision-making. Managers can retrieve ad-hoc information via corporate social media (Bellucci & Manetti, 2017) and chatbots (Blankespoor, 2018) and use cutting-edge technologies-based devices and BI digital boardrooms (smart meeting rooms) with multi-display environment for their meetings and video conferences (Rubart et al., 2017). Regarding the IT skills, data preparation is automated, accountants need an understanding of software robots, integrated ERP-Systems and blockchain technology. Furthermore, we expect that accountants need IT skills to handle (BI-)tools to check adequate types of data sources and data quality, analyze trends and patterns within data and visualize reports for end-users.
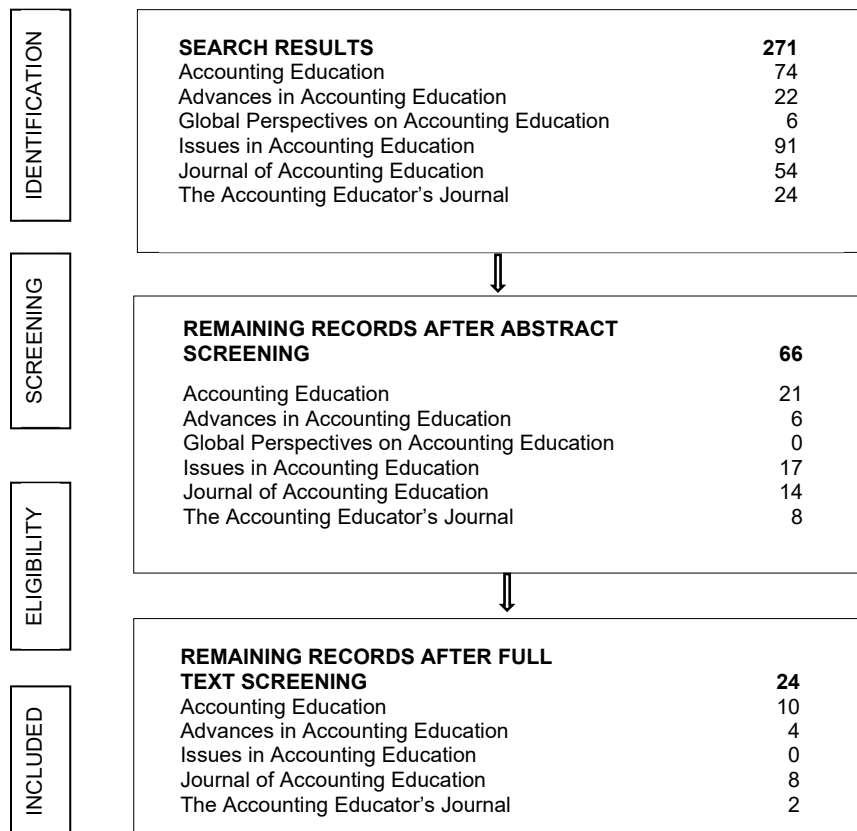
The semi-autonomous accounting proposed by Lehner et al., 2021 indicates that the implementation of the digital technologies in the digital accounting impacts tasks and therefore IT skills of accountants. However, we are aware that IT skills are not the only competences that employees have to face in a highly digitalized business environment. We see that accounting practices become a crucial role in providing financial as well as non-financial reporting. However, in a highly digitalized work environment, accountants need different or additional skills in order to be able to deal with various information and communication technologies in a way that does not create a burden, but rather increases productivity and efficiency. The need of IT skills in the digital era is brought up again and again, especially in the accounting (education) literature (Howcroft, 2017; Tan & Laswad, 2018). Accounting educators and researchers are aware of the importance of technological development and that graduates need to be better prepared for the working environment to fill the skill gap (Kotb, Abdel-Kader, Allam, Halabi, & Franklin, 2019). Therefore, accounting educators suggest adaptions of the accounting curriculum (Al-Htaybat & Alberti-Alhtaybat, 2018). In this paper, we provide insights in the IT skills discussed in accounting education literature and assess whether they meet the requirements of a semi-autonomous accounting proposed by Lehner et al., 2021.

DATA AND METHODOLOGY

We started the research process with three meetings in which we discussed current literature relevant to the field and agreed on our specific research goals after clearly defining the research gap and the aim of our research. In order to answer the aforementioned RQ1, "What IT skills have been discussed in the accounting education literature in the last decade?, we found a structured literature review (SLR) suggested by (Massaro, Dumay, & Guthrie, 2016) the most appropriate approach. Analyzing existing literature in detail allows to gain insights into prior research and summarize and compare the results within a specific field. We conducted a keyword search in six popular and major Accounting Education journals, namely in Accounting Education, Advances in Accounting Education, Global Perspectives on Accounting Education, Issues in Accounting Education, Journal of Accounting Education and The Accounting Educators' Journal. Four of the six journals are listed in der Academic Journal Guide (2018) by Charted ABS and the VHB-

JOURQUAL3. The search process was organized as follows. We performed the keyword search within the full text of the articles using the publishers' websites and, in case the publishers' websites did not provide an advanced search option, Google Scholar. Several search criteria have been defined to select the relevant articles. The search was limited to articles in English language published between 2010 and 2020, as it is assumed that IT skills as an emerging research field gained relevance in the last ten years. The search action included terms related to digitalization and information technology, as well as terms related to skills and competences. We used a broad search scope. Therefore, we used synonyms for the keywords to ensure that all relevant articles were included and reduce the likelihood of overlooking relevant articles. The search action was performed with the following keywords, their respective multiples, and Boolean operators: ("information technology" OR "digital" OR "digitalization") AND ("skill" OR "skillset" OR "competence" OR "competency" OR "qualification" OR "fluency" OR "literacy"). To ensure the quality and reproducibility of the literature search, a spreadsheet was created to document the search process and the search results in detail. This search resulted in a set of 271 articles. The next step was to review this set of articles to determine which articles are relevant for further examination. By analyzing the abstracts of the articles, we identified 205 that were out of the scope of the research question. After excluding these articles, we were left with 66 relevant articles. In the next step, the full texts of the remaining 66 articles were screened for eligibility. 24 articles either deal with the empirical investigation of IT skills and competences or the conceptualization of these or highlight certain IT skills and competences' relevance, thus constituting the final sample for our structured literature review. The selection process is summarised in Figure 1.

Figure 1: Results of the Research Process

IDENTIFICATION	**SEARCH RESULTS**	**271**
	Accounting Education	74
	Advances in Accounting Education	22
	Global Perspectives on Accounting Education	6
	Issues in Accounting Education	91
	Journal of Accounting Education	54
	The Accounting Educator's Journal	24

SCREENING	**REMAINING RECORDS AFTER ABSTRACT SCREENING**	**66**
	Accounting Education	21
	Advances in Accounting Education	6
	Global Perspectives on Accounting Education	0
	Issues in Accounting Education	17
	Journal of Accounting Education	14
	The Accounting Educator's Journal	8

ELIGIBILITY / INCLUDED	**REMAINING RECORDS AFTER FULL TEXT SCREENING**	**24**
	Accounting Education	10
	Advances in Accounting Education	4
	Issues in Accounting Education	0
	Journal of Accounting Education	8
	The Accounting Educator's Journal	2

The figure includes detailed information about the results of the keyword research in the main accounting education journals and indicates the 24 articles left for further analyses.

RESULTS

Based on the SLR, results indicate that digital technologies are seen as a driving force and game changer for the accounting profession in the accounting education literature (Pincus, Stout, Sorensen, Stocks, & Lawson, 2017). Al-Htaybat, Alberti-Alhtaybat, & Alhatabat, 2018 conclude that "the accounting profession is predicted to experience a significant change in the future, due to technological developments.", which lead to a transformative effect on accounting practice because of automated and integrated workflows. Therefore, accounting education should include more contemporary technological features, especially IT skills, to meet the demands of employers in the digital era (Al-Htaybat, von Alberti-Alhtaybat, and Alhatabat (2018). The study of Tan & Laswad, 2018, which provides an analysis of job advertisements, highlights the need for accountants to use IT and close the IT skills gap between accounting education and professional needs. Having a look at the discussed IT skills in more detail, intermediate proficiency requires the ability to process transactions in an Enterprise Resource Planning (ERP)-system, to understand the structure and to be able to navigate within ERP-System (Sledgianowski, Gomaa, & Tan, 2017; Spraakman, O'Grady, Askarany, & Akroyd, 2015). The automation of processes means integrated processes within one system and/or data model but is also connected with RPA tools. RPA tools allow accountants to automate processes by themselves (Leitner-Hanetseder et al., 2021) and reduce human labour in accounting (Herbert, Rothwell, Glover, & Lambert, 2021). In times of rare IT staff, employees without special IT training can create applications according to the modular principle in a very simple way.

Therefore, in the future, the accountant himself will not only identify the process to automate, but also implement it. Professional software developers are often lacking, but the digital transformation can still gain momentum through citizen developers. According to Brink & Stoel, RPA enables transactions to be captured and analytics to be performed instantly. This finding may suggest making efforts to incorporate RPA into the classroom. Additionally, an understanding of blockchain technology with its potential to transform and reshape accounting (triple-entry accounting or identify use cases) is seen as relevant in accounting education (Felski & Empey, 2020). In the last years, spreadsheet packages such as Excel (Ragland & Ramachandran, 2014; Ramachandran Rackliffe & Ragland, 2016) are seen as necessary IT skills for accountants. In accounting education literature, there are some teaching cases that highlight the need to encourage students to handle Excel (see, for example, Willis, 2016).

Excel skills seem particularly important in accounting to prepare, analyze, manipulate, and report financial data. Advanced Excel features are considered the most important IT skills regarding applications (Brink & Stoel; Ragland & Ramachandran, 2014). To close the skill gap, excel is used in accounting courses for which students need a significant amount of data analytic skills (Ramachandran Rackliffe & Ragland, 2016). Thus, we conclude that Excel skills and data analytic skills often go hand in hand. Results show that data analytic skills are gaining importance in accounting practice (Ballou, Heitger, & Stoel, 2018). Therefore, Richardson and Shan (2019) propose introducing data analytics courses for accounting at both undergraduate and graduate levels.

Even if Excel skills are considered to close the skill gap in the last years, accounting education literature points out that due to the increasing amount and complexity of data in the digital era, the complexity of spreadsheets is expected to increase (Awayiga, Onumah, & Tsamenyi, 2010). Therefore, applications for business analytics are changing, and students need to be aware of the dangers of spreadsheet errors and need to know how to minimize them (Schneider, Becker, & Berg, 2017). Advanced BI-intelligence tools such as Power BI, QlikView and Tableau provide the ability to easily integrate data sources, provide greater flexibility and provide the ability to handle bigger datasets and enable traceability (Schoute, 2019). Self-service BI-tools connect structured data contained in the ERPs with non-transactional but unstructured and semi-structured information from the environment, such as social media sources and allow end-users insights into the data based on their special needs (Vasarhelyi et al., 2015). Accounting education literature sees the need to teach BI-tools (Brink & Stoel; Riggins & Klamm, 2017). Accountants as power users

should have the skills to create dashboards for end-users and have the skill to decide what information is available for which end-user (Riggins & Klamm, 2017). Additionally, accountants are seen as the ones who create awareness of the appropriate use of self-service BI-tools (Riggins & Klamm, 2017). Additionally, to handle BI-Tools, Schoute, 2019 highlights the need for a basic understanding of programming languages. Coding might be necessary to adapt BI-tools to individual needs or gain insights into the data base without using specific BI-tools. Furthermore, BI-tools enable accountants to detect trends and anomalies by using machine learning algorithms or visualizing (Cunningham & Stein, 2018). Using these BI-tools requires an understanding of machine learning and visualizing techniques (Leitner-Hanetseder et al., 2021).

In times of Big Data analytics, there is also evidence that it is valuable for accountants to have skills for working with cloud services and cloud-based systems (Wells, 2018) as well as relational database management systems (RDMS) or even NoSQL databases (Awayiga et al., 2010; Brink & Stoel; Richardson & Shan). Another topic related to working with (big) data is data quality as well as data and cyber security (Brink & Stoel). This means that students know quality criteria and are able to update and retrieve the data source using structured query language (SQL) (Lawson & Street, 2021). Similarly, recent cybersecurity incidents highlight the need to complement accounting curricula, sensitize students for cybersecurity and teach them how to recognize, assess and mitigate cybersecurity risks (Roohani & Zheng, 2019).

CONCLUSION AND DISCUSSION

The ongoing digitalization of accounting has far-reaching implications for the skills and competencies needed by accountants. Literature identified a rising skill gap between education and professional needs caused by the digitalized economy (Jackson & Meek, 2021; Oesterreich & Teuteberg, 2019). This paper takes a closer look at this gap and is therefore timely and highly relevant both for accounting education literature and practice. It answers the questions of which IT skills have been discussed in the accounting education literature in the last decade and if these skills meet the requirements of an advanced semi-autonomous accounting presented by Lehner et al. (2021). For this purpose, a structured literature review (Massaro, 2016) was conducted. The first keyword search resulted in 271 hits, and after several screenings, the final sample contained 24 articles from the accounting education literature that deal with IT skills in times of digitalization. In the following Figure 2, we summarize the key IT skills discussed in the last decade in accounting education literature. What we see is that accounting education literature discusses IT skills in the context of transaction automation (software robots, integrated ERP-Systems, blockchain technology) as well as gaining insights into internal and external data with software applications (spreadsheet packages such as Excel, BI tools) as well as an understanding of cloud services and cloud-based systems, RDMS & NoSQL database, programming languages (such as SQL, R+, Python, SAS) and AI-based algorithms. Finally, there is a need to know how to provide data and cybersecurity. According to the results of the SLR, accounting education literature discusses IT skills that go hand in hand with the tasks and digital technologies used in a semi-autonomous accounting proposed by Lehner et al., 2021. This means that the discussed IT skills enable accountants to become data analysts and internal advisors.

Figure 2: Information Technology Skills in Accounting Education Literature
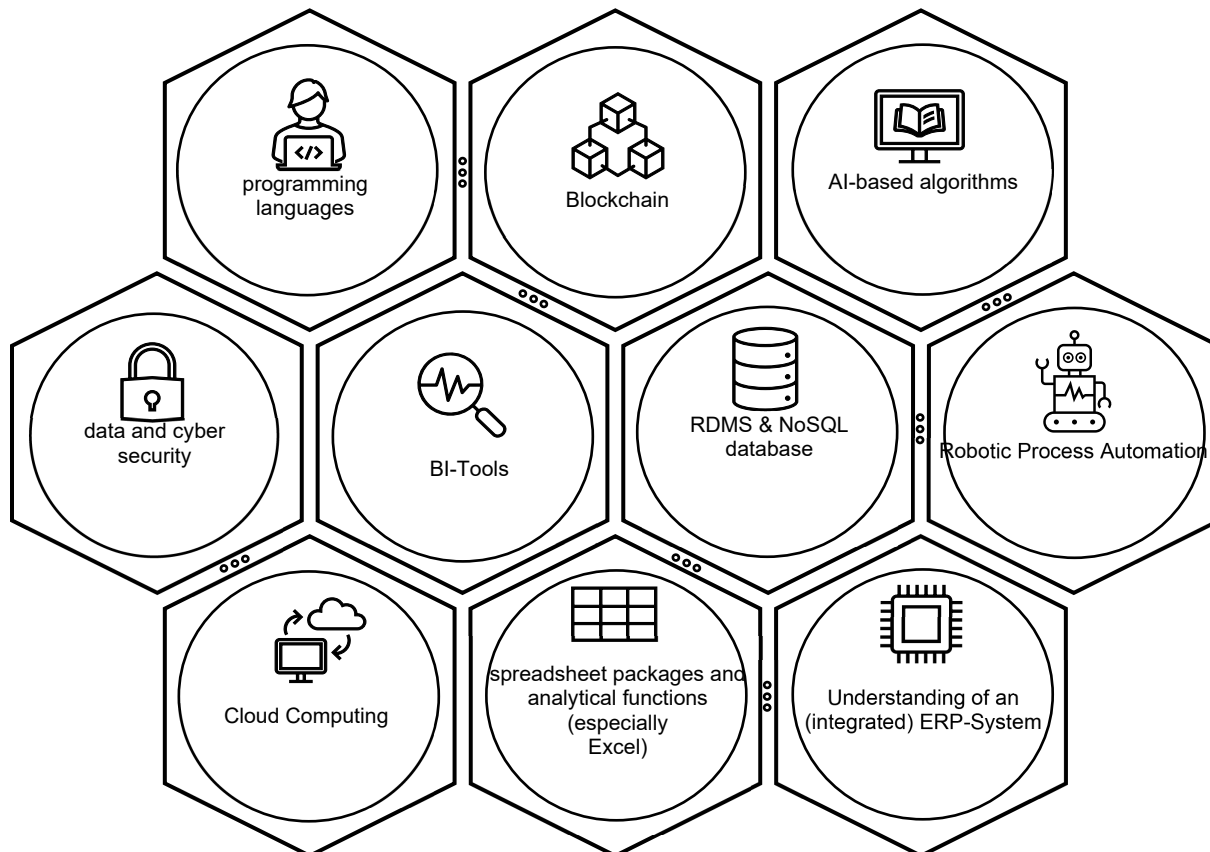

Figure 2 indicates the discussed IT skills within accounting education literature in the last decade, which meet the information technology in a semi-autonomous accounting proposed by Lehner et al., 2021

From these IT skills identified from the literature, we believe that some are more important than others or should be given special attention in accounting education because of their relevance in a digitalized economy and their contribution to the field of accounting. As efficient processes and near time reporting is essential to be competitive in an highly volatile environment. We see that it is necessary that accountants have deep understanding of integrated ERP-Systems and tools to automatize processes and reduce manual interfaces. In the next decade, process automation within ERP-Systems or by using Robotic Process Automation-Technology will be an essential IT skill to automatize recognition, closing and reporting. Accountants might be able to identify potentials for automation and based on a citizen developer concept should be able to automatize procceses. There are also indiciations, that blockchain technology could have a revolutionary impact on the efficiency as well as transparency. For example using blockchain technology for intercompany reconciliation might increase efficiency in reporting and allow transparency within the group and for external auditors. In contrast to ERP-Systems and RPA, user skills are not relevant. For accountants, it might be necessary to identify and assess use cases for blockchain technology. We believe that technologies such as ERP-Systems, RPA and blockchain technology should be included in accounting curricula, for example in a process automation course.

Besides skills to automatize processes, we think that data analytical skills are important more than ever. Because of big data, it is essential that accountants know about ways to hold data in a relational database management system (RDBMS) and how to retrieve data from it by using programming languages such as SQL or Python. Additionally, we see that the use of BI-Tools enables accountants to create individualized dash boards for decision makers. In times of Big Data, Excel and Power Point skills won't be as relevant

as in the last 20 years and due to our experience are seen as tools that are taught during school time. We also see that a basic understanding of logic-based machine learning algorithm (so called AI) used for predictive and in the long run prescriptive analytics will be essential. We do not believe that accountants generate or decide which algorithm is used for which use case but we see that accountants need to be able to understand and interpret the results generated by advanced IT-Tools for decision making. Therefore, we recommend to implement basic data analytical course in the accounting curriculum. Finally, we see that to students need to know about concepts to provide data and cyber security. This course might enable students to be able to know about data storaging, get an understanding of AI based descision making, know how to retrieve and analyse data with one specific programming language and use BI-tools to create reports. Table 1 summarizes those IT skills required in a process automation course and business data analytical course that the authors consider particularly important and the related level or recommendations for accounting education.

Table 1: Summary of Important Courses and IT Skills and Recommendations for Education

Process Automation course	
IT skills	Level and/or recommendation
ERP-Systems	Understanding of integreated ERP-Systems
	User knowledge to handle processes within a system and identify automation potential
RPA-Tools	User knowledge to automatize processes
Blockchain Technology	Basic understanding to be able to identify and assess use cases
Business data analytical course	
IT skills	Level and/or recommendation
Understanding of data basis	basic knowledge
Programming languages	include a basic user knowledge in SQL, Python or R in data
BI-tools	advanced user skills
AI-based algorithms	basic knowledge to understand decisison making
Data and cyber security	sensitize students for cyber crime and cyber attacks and provide preventive measures

Table 1 summarizes those IT skills that the authors consider particularly important and the related recommendations for accounting education

In order to provide students with these competences it is necessary to integrate IT skills into accounting curricula. As mentioned above, we suggest two courses. However, we identified that IT skills are still seen as a "peripheral component in an accounting degree" (Kotb et al., 2019). For these reasons, it is not or not sufficiently integrated into accounting courses, and training "on the job" is seen as sufficient (Kotb, Abdel-Kader et al. 2019). In a dynamic and volatile environment, IT-tools and data sources might come and go. This uncertainty about technological developments is seen as a main driver, which boosts or delays the implementation of IT skills in the accounting curriculum. In the last century, there was the agreement that Excel is a useful spreadsheet to meet the professional skills. This led to the fact that in many accounting curricula Excel is implemented. For the next years, we see that the above mentioned IT skills are required or have a potentital to be required. However, a steady analysis of the needs is an essential key factor for successful education. We also see four main driving forces, which might boost or delay implementing IT skills in the accounting curriculum.

First, uncertainty about technological developments and related skills to be taught. Second, the financial resources of the faculty impede or delay the implementation of technologies in accounting curricula (Andiola, Masters, & Norman, 2020). Third, missing training concepts, which facilitate the accounting students to handle accounting concepts in a digital economy with Big Data and automation in the field of accounting. Fourth, in order to create a learning environment in which accounting concepts but also IT skills are taught, an interdisciplinary faculty staff is necessary, that might handle the challenges of developing and teaching the accounting concepts with IT tools (Andiola et al., 2020). In business practice, teamwork and interdisciplinary is becoming more and more important in the course of digital transformation, and the same must apply to accounting faculties.

The structured literature review was limited by focusing on articles published in six relevant accounting education journals from the years 2010 to 2020. Consequently, articles published early or in non-accounting education journals, books or conference papers are excluded from the analysis but might have also provided valuable findings. Furthermore, although we have taken great care to ensure validity, the choice of the keywords and the screening process are based on subjective valuations. Therefore, it cannot be guaranteed that all relevant publications are included in the analysis. We see that future research to understand the impact of the transformation of accounting could go in many directions. With this paper, we would like to highlight the need for further research concerning the boundary of the transformation of accounting and the impact on accounting education to avoid a rising IT skill gap.

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