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Mapping digital competencies in the business domain – an empirical workplace analysis using job advertisements

Abstract

The rapid development of digital technologies has revolutionized the way companies operate and conduct business. Organizations now require higher attention paid to digital competencies to leverage the usage of digital tools and platforms effectively, optimize processes, reach customers and stay ahead of competition. This study examines how digital competencies have changed in the field of business administration to identify essential skills and knowledge required in today's corporational landscape. Text mining is used to extract digital skills from a vast dataset of 25,000 job advertisements in the business administration field. The resulting empirical data is analysed to derive profiles outlining the development of digital competencies in the business administration field. The study reveals two specific digital competencies in high demand: analytical evaluation utilizing various software tools and communication via social media. Competence requirements from the labour market can indicate the design of study programmes and the adaptation of teaching methods.

Keywords

digital literacy, digital competence, business administration, job advertisements

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Abbildung digitaler Kompetenzen in betriebswirtschaftlichen Berufsbildern - eine empirische Arbeitsplatzanalyse anhand von Stellenanzeigen.

Zusammenfassung

Die rasante Entwicklung digitaler Technologien hat die Art und Weise, wie Unternehmen arbeiten und wirtschaften, revolutioniert. Unternehmen müssen nun verstärkt auf digitale Kompetenzen setzen, um die Nutzung digitaler Technologien und Plattformen effektiv zu nutzen, Prozesse zu optimieren, Kunden zu erreichen und der Konkurrenz voraus zu sein. In dieser Studie wird untersucht, wie sich die digitalen Kompetenzen im Bereich der Betriebswirtschaft verändert haben, um die wesentlichen Fähigkeiten und Kenntnisse zu ermitteln, die in der heutigen Unternehmenslandschaft benötigt werden. Mit Hilfe von Text Mining werden digitale Kompetenzen aus einem Datensatz von 25.000 Stellenanzeigen für betriebswirtschaftliche Berufe extrahiert. Die daraus resultierenden empirischen Daten werden analysiert, um Profile abzuleiten, die die Beschaffenheit digitaler Kompetenzen skizzieren. Die Studie zeigt, dass zwei spezifische digitale Kompetenzen besonders gefragt sind: die analytische Auswertung mit verschiedenen Softwaretools und die Kommunikation über soziale Medien. Die Kompetenzanforderungen des Arbeitsmarktes können Hinweise für die Gestaltung von Studiengängen und die Anpassung von Lehrmethoden geben.

Schlüsselwörter

Digitale Literalität, Digitale Kompetenzen, Betriebswirtschaft, Stellenanzeigen

1 Introduction

The almost unlimited availability of processing capabilities is ushering in a new era: it represents a significant shift from analogue and physical realms to virtual spaces, decentralized networks and digital frameworks. While the potential for technology use in value creation is emerging, quantifying these opportunities remains a challenging endeavour (Hirsch-Kreinsen, Ittermnn & Niehaus, 2018). Modern tools, such as ChatGPT or artificial intelligence (AI) in general, either replace or reshape human roles across a wide range of contexts within the professional and vocational sectors (Picot, Hopf & Sedlmeir, 2017).

The shifts in the lives of professionals and others in the economic system, catalyzed by the digital transformation, demand careful consideration. These changes extend beyond alterations in social dynamics and corporate value creation mechanisms. Consequently, they are reshaping labour market demands and give rise to new work processes. The notion of digital literacy offers initial, primarily heuristic, foundations for modelling human workflows in a digitally influenced world (Spante et al., 2018). While all approaches target the management of digital technologies and their consequences, distinguished domain-specific prerequisites are absent, thus, hindering the modelling of digital competence from a professional perspective (Botturi, 2019).

This highlights that current research mainly emphasizes general concepts but lacks a clear connection to business administration inquiries and the associated development of digital literacy. Concepts such as digital marketing (Key, Czaplewski & Ferguson, 2019), process mining (Van der Aalst, 2016), automated accounting and the management of digital business models are underrepresented in the documentation of operational activity profiles. Consequently, this article focuses explicitly on the field of business administration and its evolving landscape due to digital transformation, particularly concerning the characterization of employee competencies. Competence expectations from the private sector as the foundational framework are used to enhance understanding. The objective hinges on the significance of strategically shaping specialized training to align with the job market, equipping individuals

with the skills required for seamless workforce integration. Competence requirements from the labour market can indicate the design of study programmes and the adaptation of teaching methods. This approach opens fresh avenues for the enhancement of higher education curricula by aligning to the principles of the Bologna process.

2 State of Research and Theoretical Grounding

2.1 Changes in workplace requirements

Observations within the context of Industry 4.0 (Kagermann, 2015) signify a shift towards the digital realm and the use of virtual technologies. Concerns regarding the potential replacement of human labour by machines are commonly associated with this phenomenon. However, prior research suggests that technological changes in work processes do not lead predominantly to the substitution of job profiles and tasks but instead result in their realignment and redesign (Arntz et al., 2016).

The altered demands arising from digital transformation are characterized in employment research by concepts such as the task-based approach (Acemoglu & Restrepo, 2019), which focuses on specific workplace activities. The approach's key premise is that digital technologies are particularly adept at substituting routine activities. The shift in job activities necessitates the acquisition of new skills, knowledge and attitudes, all closely tied to technology and its application. Consequently, it is widely acknowledged that evolving job demands coincide with alterations in the importance of specific occupational prerequisites. Moreover, the evident repercussions extend to swiftly evolving labour market requirements. The World Economic Forum (2020) approximates that 50 % of the existing workforce will require retraining to align to labour market dynamics by 2025. Additionally, forecasts suggest that 85 million jobs may vanish due to the evolving division of labour between humans and machines.

However, this shift could potentially lead to the creation of up to 97 million new roles through enhanced collaboration with emerging technologies and algorithms.

This evolution leads to the current advances in the use of AI as a disruptive and society-shaping digital technology. Early empirical results show impressive results: The impact of generative AI technologies on the online labour market is evident in the 21 % higher drop in the demand for freelance platform jobs after the introduction of ChatGPT. Similarly, there is a 21 % higher drop in the demand for jobs that are prone to automation compared to manual labour-intensive jobs. Furthermore, imaging AI technologies have led to a 17 % higher drop in graphic design demand (Demirci, Hannane & Zhu, 2023).

Formerly required competencies must now give way to digital aptitudes, prompting a necessary adjustment of existing task profiles and associated qualification prerequisites to align with the demands of digitization. This transition underscores the growing importance of IT knowledge and cognitive skills (Arntz et al., 2016).

It is generally evident that existing job profiles and the tasks associated are undeniably evolving. This transformation is underscored by the emergence of new professions, such as influencer managers and data analysts.

2.2 Digital competencies and digital literacy

The swift progress of society and emerging technologies has caused the concept of literacy to broaden across various disciplines and research domains. Hence, an increasing audience is showing a keen interest in defining digital literacy. In a broad sense, it encompasses a spectrum of skills linked to using computers and information technology (ICT) adeptly (Leaning, 2019).

The concept of digital competence or digital literacy is now extensively documented, along with connections to various disciplines evident in numerous publications Spante et al. (2018) demonstrate that specific application contexts establish distinct frames of reference. The prevailing term in teacher education is "digital competencies", as also noted by Seufert et al. (2019). Notable models, such as DigCompEdu

(Redecker, 2017), are designed specifically for teachers. This pertains primarily to the utilization of digital resources, including data, communication tools and collaborative platforms, within learning environments. The DigComp 2.1 framework has gained universal acceptance and spans across domains. It systematically categorizes virtual actions into different competence levels. A new version of DigComp, DigComp 2.2, was introduced in 2022 (Vuorikari et al., 2022).

Certain authors argue that the terms "digital literacy" and "digital competence" are used interchangeably, leading to digital literacy being linked with ICT and computer literacy (Mattar, Cassio & Cuque, 2022). This article is based on the concept of literacy. Digital literacy now extends beyond ICT and computer proficiency involving tools, software and hardware. It encompasses other essential literacy skills, such as media literacy (comprehending different media forms), information literacy (searching and assessing information), and the capacity to communicate effectively using various software and tools. Achieving digital literacy in this technosocial context requires a combination of technical and critical thinking skills (Bravo, Chalezquer & Serrano-Puche, 2021).

All definitions and models share the emphasis on the utilization of digital tools and technologies and their impact on behavioural processes. The establishment of a domain reference becomes imperative to employ competence modelling for subsequent diagnostics within specific groups. Consequently, distinguishing domain-specific requisites and the subsequent work grounded in the modelling of digital competencies from a specific subject-oriented standpoint is crucial.

2.3   Business Digital Literacy

The goal of the Business Digital Literacy Model (see Fig. 1) is to comprehensively encompass the activities of business managers, structuring them at the convergence of domain-specific knowledge and digital literacy. This model has emerged from a systematic literature review which examined the current state of research on digital literacy models in higher education (in detail, Schlottmann, Gerholz & Winther, 2021). This initiative is anchored in the most commonly cited dimensions of digital

literacy. Hence, digital literacy is structured around key dimensions, including information and data, digital content creation, digital communication, basic functional and technical knowledge, and metacognitive knowledge. Continuing from this point, business areas are divided into eight structured fields, encompassing accounting, finance and investment, human resources (HR), marketing, organization, production and logistics, taxation, and corporate management. These eight business areas comprise the economic content of the domain and serve as subdomains of business knowledge. A heuristic model for business digital literacy is conceived by combining domain-specific scientific content with the dimensions of digital literacy.

Figure 1: Business Digital Literacy Model (Schlottmann, Gerholz & Winther, 2021)

The model differentiates domain-specific competencies at the intersection of business administration and information technology. Business Digital Literacy describes the sum of skills, attitudes and cognitive dispositions required to meet business needs related to digital technologies.

It facilitates the use of this competence structure for curriculum and instructional improvements, addressing the demands that emerge at the interface of digital technology and business management decision-making. This model adeptly charts the impact of digital technologies and the ensuing prerequisites across various sub-areas of business administration. Yet, the specific evolution of skills expected from employees in business areas remains undefined.

3 Aim of the Study

Previous research has left unanswered questions regarding how business areas, along with their work processes and associated competency requirements, will evolve in response to digital transformation. This study explicitly addresses this gap. The study's objective is to analyse the skills, knowledge and attitudes outlined in job advertisements (job ads) and their connection to the utilization of digital technologies. Specifically, this results in two research questions:

(RQ 1): Which digital competency expectations for employees can be observed in the context of the use of digital technologies in the labour market for business occupational profiles?

(RQ 2): How can the requirements described from the job ads be summarized as a domain-specific profile for specific business areas?

The aim is to delineate the domains where digital technology plays a pertinent role in business processes, necessitating corresponding competencies.

4   Method

The analysis adopts a job-analytical-empirical approach (Schütz, Köppe & Andresen, 2020) to structure competence requirements and meet the expectations of present labour market demands. It subsequently elucidates various business areas (e.g. controlling, HR, marketing) at the nexus of digital literacy. Job ads serve as a robust foundation for this analysis, as shown by previous research findings (cf. Bensberg, 2013).

4.1   Data collection and processing

Job ads from business areas were selected based on the Business Digital Literacy Model to construct a valid representation of the population (see Fig. 1). For this purpose, publicly advertised jobs on the three largest job boards were used. This approach guarantees a comprehensive view of the prevailing demand in the labour market. A web crawler, developed with Python's Scrapy library, was used to automate the search for job ads during the period from January to February 2023. In terms of data structure, particular importance was placed on extracting the job title and job description, as highlighted by Stock-Homburg & Groß (2019). Consequently, the components "job title", "job description" and "location" were extracted, thus, collecting a range of 1,000 to 2,000 job ads per platform and keyword combination. Only job ads from companies based in Germany were selected. The job ads in the evaluation focus on graduates for direct entry into a profession. The selection occasionally includes vacancies aimed at professionals with at least five years' experience, but which do not require a university degree. The keyword combination used for the search in the domain of controlling included terms such as "controller", "controlling specialist" or "controlling assistant". The database underwent cleaning and deduplication processes based on the job descriptions. Consequently, a database comprising n = 25,000 documents was generated.

4.2 Data analysis

A qualitative content analysis (Mayring & Fenzl, 2019) was used for the evaluation of the study. The analysis involved examining the intersections between the business areas and the various dimensions of digital literacy. For this purpose, the dimensions of digital literacy were used as the main categories (see Fig. 1, right part). These areas were then elaborated upon and refined by establishing additional inductive sub-categories.

This process involved two primary phases:

1. Job ads were initially manually reviewed to establish a codification scheme for various text sections. This scheme was created through a prestudy conducted in 2021, where a total of n = 1000 job ads were manually examined and coded. The identification of the use of reporting tools, for instance, was categorized as a subcategory under "information & data", encompassing all text sections referring to different reporting techniques and applications.
2. In the subsequent phase, the code system developed was automated to manage the substantial volume of data. The analysis was then executed using a text mining algorithm enabling the evaluation of 100 % of the data material.

5 Results

5.1 Research question one – descriptive findings

Looking at each of the business areas, a varying number of references to digital competence requirements could be found across all job ads. Most of the latter with at least one requirement were found in controlling, with a total of 22.5 % of findings. Logistics shows the lowest proportion of job ads with just 5.3 % of coded documents. Table 1 shows the relative distribution of categories across different segments in the dataset.

Table 1

Relative distribution of the main categories

Main category	Distribution in percent
information & data	43.90
content creation	2330
basic functional & technical knowledge	19.30
communication and collaboration	9.60
metacognition & strategy	3.90

The total number of coded job ads that give an indication of the respective category are listed there. This shows how often the respective facet is requested in the cross-section. Hereinafter, a brief overview of the content criteria of the categories is given.

Information and data

On this basis, it can be stated that the handling and processing of (this) data in corporate processes is mentioned most frequently (43.90 %). This category includes for example, *maintaining databases, finding information via search algorithms or SQL queries*, *and analysis with Power-Bi* or spreadsheet tools.

Content creation

The second most codes were awarded in the content creation category. Overall, 23.30 % of the categories are covered by segments relating to the creation or modification of digital content. They are required to create *digital reports* with *appropriate visualization* or to *prepare presentations*. Furthermore, the maintenance of various *CMS, such as websites, blogs and the intranet of the company* is mentioned. Programming (in python or R) and creating small scripts for automation are also part of this category.

Basic functional and technical knowledge

This category describes not only a basic knowledge of digital technologies but also the ability to integrate technical innovations into business operations. Therefore, statements on *"MS Office"* as a basic precondition as well as requirements for the development and *digitalization of business processes* were coded.

Communication and collaboration

Surprisingly, there are only a few references to digital communication or digital collaboration. References to *influencer management, social media, customer journey* and *video communication* are made at times, but they only represent 9.60 % of this category. Furthermore, application possibilities for digital collaboration, for example, *Slack, Trello or Confluence* fall into this area.

The capabilities of all categories and segments *per document* were counted and compared to determine the intensity of digitization of individual occupational profiles. In comparison to the previous statistics, this shows the range of digital skills required *per job ad*. Boxplots, with their distinctive statistical position measures, were used to contrast the areas of specialization. Figure 2 shows all the documents grouped in job profiles. It illustrates that the individual occupational profiles with a specialization in business administration are characterized to varying degrees by digital skills and knowledge.

Metacognition and strategy

Regarding this category, only a few codes could be assigned. This includes statements on *recognizing new trends, affinity for technology* and *assessing the benefits of technologies*.
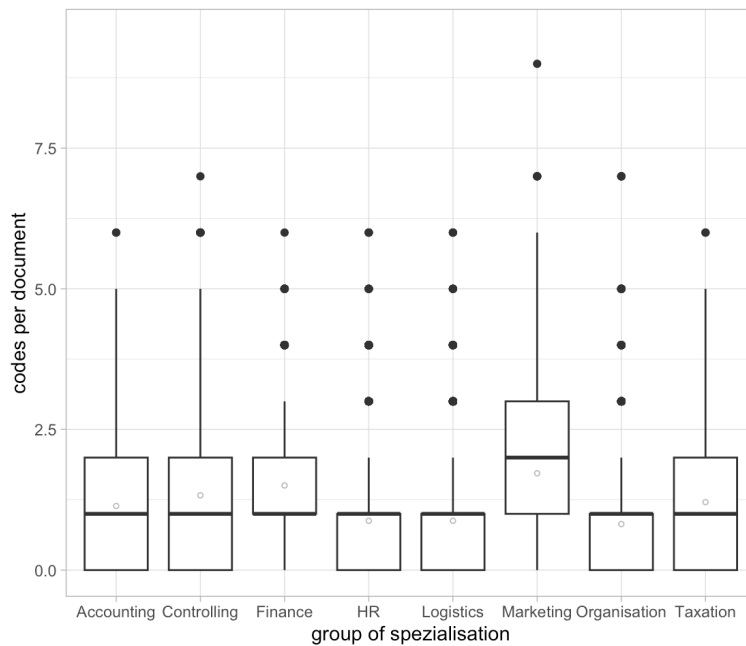
Figure 2: Boxplots codings per document

The distribution of finance, accounting, controlling and taxation is very similar. The same applies to the HR, logistics and organization groups. More requirements for digital competencies were found per document for the specialization marketing than in the other areas. A median between two and three requirements for digital competencies can be identified per job ad. However, there are also documents with considerably more requirements, as the outliers show. The statistics presented can provide some initial insight to answer research question one: The job descriptions and competence requirements are characterized to varying degrees by digital technologies. In the first line, marketing activities are more strongly determined by digital technologies than others. In addition, the handling of data and digital content creation is crucial across all areas of business administration, so that these are in great demand

in the job ads. Basic functional and technical knowledge remains largely formed using basic software, such as Microsoft office suit.

5.2   Research question two – profiling

The second research interest inquires how the individual profiles of business activities differ according to the characteristics of digital skills. In order to answer this question, profile lines were formed based on the relative distribution of the main categories (Fig. 3). A higher heterogeneity between the requirement areas is visible, which is also confirmed by a Chi^2 test ($p < 0.05$). This confirms a more than random distribution of the proficiencies by the codings.

One can see that competence requirements in the field of marketing are focused more on communication than the field of taxation. Although the previous analysis showed that there are fewer requirements in HR in comparison, they are much broader and distributed across all areas of digital literacy. The category "metacognition and strategy" is particularly pronounced in contrast to all the others.
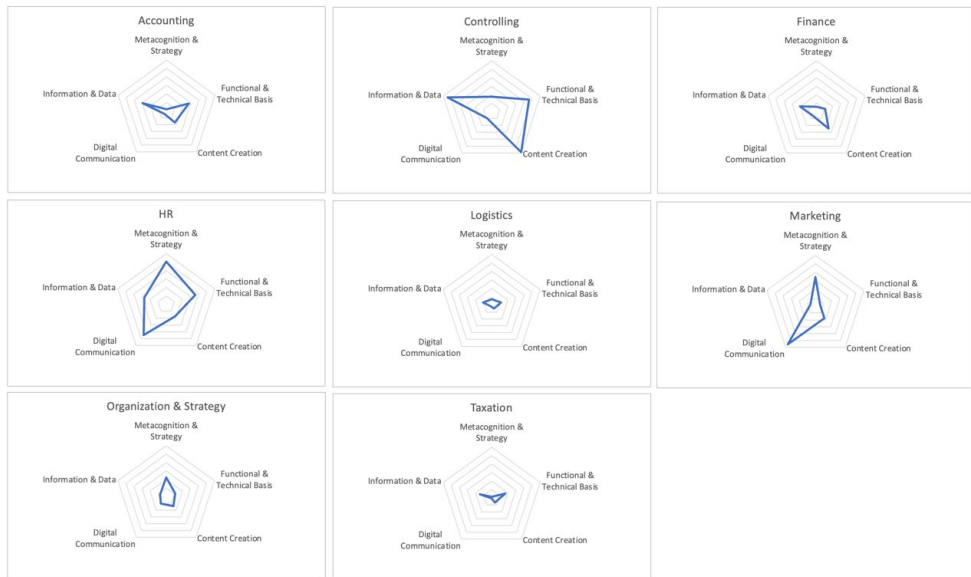
Figure 3: Digital profiles per business area

The profiles show highly different characteristics for the individual facets of digital literacy. Thus, depending on the business area, different emphases are also recognizable as far as the application of digital technologies is concerned. This should be considered as a first starting point to further develop detailed profiles, thus, creating suitable curricular development opportunities.

6 Discussion

The analysis shows that various professional business areas are characterized by varying degrees of digital literacy requirements. The results are comparable with findings from other areas: activities in accounting are mostly digital. Technologies such as robotic process automation and AI are already being used today to automate activities such as document scanning (Pargmann et al., 2023). It is, therefore, plausible that many of the digital skill requirements lie in this area.

The procurement and evaluation of information plays a major role overall. Experience with different tools is required depending on the business area. Other research results show that information literacy as part of digital skills is growing rapidly and is necessary in the 21st century (Cloots, 2020). The findings on the relevance of information and data analysis are in line with the current state of research. It is noticeable that digital communication is hardly mentioned empirically in comparison to the other categories. In contrast to the results, the literature attaches great importance to digital communication and collaboration (Fonseca & Picoto, 2020). It can be assumed that communication via various channels is seen as a basic requirement for professional activity and, therefore, not explicitly outlined. However, as there is no explicit evidence of this to date, it would need to be investigated in further research. It may be beneficial to incorporate the employee perspective as a source for identifying changing digital requirements in the workplace to enhance future research projects (Cedefop, 2018; Rathke, Krempkow & Janson, 2023).

It is also worth noting the statistics for the logistics sector, which is currently the subject of extensive research into process automation, intelligent control and autonomous systems (cf. Papert & Pflaum, 2017). Discovering only a few clues in the job advertisements is unexpected.

Nevertheless, comparatively few requirements for digital skills are mentioned in the job ads analysed. This contradicts the general trend of digital transformation and the change in job profiles (cf. World Economic Forum, 2020) as well as other studies indicating that almost all professional activities, including in HR, are now supported

using digital technologies (cf. Mihova & Ivanova, 2020). Job ads often contain specific requirements, such as the need for specific software solutions to handle business processes. Some examples of this are Power-BI for managing and analysing data, Instagram in social media and Confluence in project management.

7   Conclusion

In summary, job ads can serve as a starting point for identifying and mapping digital competences in commercial occupational fields. The handling and analysis of data is particularly relevant for later activities. Additionally, the findings of this study reveal that expertise in creating target group-oriented presentations for content creation are becoming increasingly crucial. However, it is essential to delve deeper into the profiles at a content level in subsequent research to conduct a more comprehensive evaluation of the requirements for specialist training at higher education.

This study shows some limitations, mainly in terms of data quality and evaluation. Relying solely on the analysis of job ads presents challenges in generating a complete and precise representation of the labour market's demand (Stohr, 2019). Analysing and coding job ads may be unpredictable and variable because they often reflect the recruiters' communication skills rather than the actual job itself (Ahmed, 2005). Furthermore, the results of the analysis are influenced by sample selection. As the number of job ads containing digital competency requirements varies among business areas.

Despite these limitations, the findings of this study provide relevant insights for the curricular development required in higher education. The ever-evolving business landscape demands comprehensive digital skills and knowledge, making it imperative that higher education institutions integrate the matching of learning opportunities as an essential part of their curricula.

Educational institutions must integrate relevant learning environments for comprehensive digital skills and knowledge into their curricula to train skilled workers ad-

equately (Ehlers, 2020). Regarding business administration, this means that specialist training should include suitable tools for data analysis, marketing automation and social media communication (Paul, Bhuimali & Aithal, 2018), as well as programming language learning. Developing digital skills or, at least, a digital mindset (Hildebrandt, Valta & Beimborn, 2022) can help educational institutions prepare for the digital labour landscape and increase the supply of digital experts in the long term. By imparting these digital competencies, higher education institutions can prepare students thoroughly for a successful career in today's fast-paced digital landscape.

In order to cultivate these digital competencies, higher education institutions can utilize pedagogical concepts that combine commercial requirements with information technology issues. Implementing robotic process automation and process mining in small Industry 4.0 simulations, for example, can facilitate active learning while also instilling critical digital competencies among students (Becker, Dobhan & Bozem, 2022).

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