AI-based Automated Production of Learning Content – A Means to Bridging the Digital Divide in Workplace Learning?

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Abstract—This article examines the digital divide in workplace learning, highlighting disparities in the distribution and adoption of advanced learning technologies across workplace types. Through a rapid literature review, the study finds a concentration of advanced learning technologies use in the education, health, and medical sectors, with limited use in other sectors, particularly non-technical and smaller organizations. The findings underscore the inequitable access to technology-enabled learning opportunities, highlighting a significant gap between professional and non-technical sectors. The article proposes the use of AI-driven content creation as a strategic approach to democratize workplace learning and reduce the resource barriers associated with implementing advanced learning technologies. This research establishes a foundation for understanding and addressing the digital learning divide, and suggests future directions for more equitable technology integration in workplace learning.

Keywords—technology-enhanced learning; digital divide; workplace learning; generative AI; automated content generation

I. Introduction

Measuring and combatting the digital divide in workplace learning is of crucial importance [1]. If we fail to address this issue, the gap between those who have access to advanced learning technologies (ALT) and those who do not will widen, leading to significant disparities in skills and opportunities. This threat results from the fact that a large share of lifelong learning occurs during and alongside work and often has a rather informal character [2], [3]. In this context, much is foreseen from ALT. ALT are characterized by careful instructional design, a high degree of interactivity, and a holistic approach to the assessment of learning outcomes [4]. Some examples of ALT are adaptive learning systems, mobile micro-learning, augmented or virtual reality applications, and even digitally supported types of collaborative ("social") learning.

When designed well, these technologies can make self-regulated learning-on-the-go at the workplace easier, allowing individuals to take control of their learning and regulate it according to their needs [4]-[6]. However, if the digital divide in workplace learning is allowed to persist or even increase, those without access to these technologies will be at a severe disadvantage. They may struggle to keep up with the rapid pace of technological advancements and evolving job requirements, ultimately hindering their professional growth and career prospects. Therefore, it is essential to ensure

equitable access to ALT to boost lifelong learning for all employees, thereby fostering a more inclusive and skilled workforce.

Against this background, the first objective of our research is to gain insights into the relative distribution of opportunities to benefit from ALT for workplace reskilling and upskilling, i.e., the digital divide in workplace learning. In the second step of our research, we examine the underlying causes of the digital divide in workplace learning. Our analysis suggests that while barriers to technology adoption may play a role, they are not the sole factor contributing to the digital divide in workplace learning. In contrast, it can be observed that the substantial financial investment required to develop effective digital learning content for the workplace may represent a significant obstacle for organizations seeking to provide digital learning opportunities to their employees. It is therefore reasonable to consider whether generative AI could provide a solution to this problem, potentially reducing the time required to produce digital learning content.

In conclusion, we argue that a deeper understanding of the digital divide in workplace learning, and how AI-based content creation could mitigate it, could be an important step towards more equitable access to ALT, facilitating personal and professional growth, employability, and thus the advancement of social justice and inclusion. The following section outlines the structure of the paper. Section II presents a rapid literature review on the digital divide in workplace learning. Section III evaluates the extent to which the digital divide may be attributed to barriers related to the production of learning content at the workplace, and how AI could facilitate the generation of learning content at the workplace, thus narrowing the digital divide in workplace learning. Section IV concludes and provides some directions for further research.

II. The Digital Divide in Workplace Learning

A. State-of-the-Art

In the past, inequalities in access and use of Information Technology (IT) have been discussed against the backdrop of the concept of the "digital divide", i.e., "digital inequalities between individuals, households, businesses or geographic areas" that arise from disparities in physical access to IT infrastructures, digital competency of users but also in unequal capabilities, engagement, and use outcomes [8]. So far, the digital divide has been, for example, discussed at the individual (i.e., age, income, educational level, digital

competencies, language barriers) level and the regional level (country, remote areas vs. rural areas) [9]. During the COVID-19 pandemic, we have experienced firsthand that the digital divide can severely limit access to education for those who are digitally left behind [9]-[12], leading to reduced education equity [14]. To our knowledge however, there is no systematic analysis yet that sheds light on the digital divide in *workplace* learning, i.e., processes related to learning and training activities at various levels of an organization, thus *at* work [14][15].

For this paper, and drawing on the general definition of the digital divide provided by [8], we define the digital divide in workplace learning by the variations in the utilization and adoption of adult learning practices across different types of workplaces. More concretely, we hypothesize that whether one works in a small or a large company, whether one works in the public or the private sector, and what job field (e.g., blue vs. white collar) one is working in severely affects one's opportunities for technology-enhanced learning. From a workplace ethics and sustainable development perspective, access to opportunities for re- and upskilling From the perspective of workplace ethics and sustainable development, access to lifelong learning opportunities should not depend on job characteristics, but should be inclusive and equitable, as required by the United Nations Sustainable Development Goals [17]. Furthermore, barriers in the access to ALT at the workplace create disparities for individual workers and puts the up- and reskilling of our workforce at risk, which is urgently needed for future employability.

Earlier studies show that the use of ALT is heavily skewed towards the educational sector [17][18], as well as towards academic professions, in particular health and medical care (ibid.) and information technology [19][20]. To give an example, in the review study by Granić [18], about 80 percent of the studies covered came from the educational field. Similarly, in the review by Yu et al. on information technology in workplace learning [21], 18 out of the 60 studies analyzed were from the medical field. There is also some evidence that ALT is less used in public services (3 out of 60 studies in the review of Yu et al. [21]) than in business enterprises [20][21] – 3 as compared to 34 in the review by Yu et al. [21] – and that smaller and medium-sized enterprises lag behind in the adoption of ALT [23].

However, even if the studies mentioned above provide informative starting points, we argue that a reliable and more granular picture of the digital divide in workplace learning is missing: Most studies rely primarily on evidence predating 2020, before the digitization boost caused by the COVID-19 pandemic. Therefore, they can be considered somewhat outdated. Two of the three studies covering very recent evidence do not [19] or not fully [23] qualify as *systematic* reviews. Recent systematic reviews cover rather specific topics such as instructional planning in e-learning [24] or the effect of technology-enhanced learning and training on organizational-level learning outcomes [20], or they focus on specific occupations and sectors, in particular those such health professionals [25] or teachers [26] where the use of ALT is frequent. The most recent systematic review by Yu et al. [21] found that only 19 out of the 60 studies analyzed (ibid,

p. 4912) focused on individual employee learning processes within enterprises. The remaining studies investigate the interplay of meta-constructs, such as technology acceptance of ALT in general or satisfaction with online forms of learning at the workplace rather than focusing on individual-level workplace learning processes. However, the review does not provide a detailed analysis of institutional characteristics or delve deeply into ALT. The current literature highlights how little we know about the varied utilization of ALT across industries, occupations, and diverse institutional settings (e.g., large vs. small, public vs. private).

To address the described gap in the literature, we propose an alternative approach to analyzing the literature on technology-enhanced workplace learning. We advocate for a shift towards examining *specific examples* of technology-enhanced workplace learning *implementations* aimed at *individual* learning processes within *distinct workplace contexts* to obtain a more nuanced understanding of the disparities in technology-enhanced workplace learning depending on the type of workplace. This approach allows us to shed light on the research question how access to digital learning opportunities is affected by the type of institution and the professional field.

B. Research Design

We conducted a rapid review [27] to evaluate the digital divide in workplace learning. Rapid reviews, which fall within the framework of Cochrane review methods [28, p. 5], are a streamlined approach to gathering evidence through synthesis and have a shorter turnaround time compared to traditional systematic reviews. In what follows, we explain the search and selection strategy that we derived from the objectives of this study – to describe the digital divide in workplace learning. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses [28][29] (PRISMA) approach was adopted to guide the screening process (see Figure 1).

The search strategy was as follows: We identified peer-reviewed journal publications published in the English language, and focused on technology-enhanced learning at the workplace. We used the Web of Science (WoS) online database to search for relevant publications, as this database matched best our search strategy and promised an efficient identification of relevant publications (contains peer-reviewed journal publications). Only publications published in 2020 or later were included. This is because we assume that the implementation of ALT in the workplace has undergone structural changes as a result of the COVID-19 pandemic. Review articles were excluded, as we are interested in institutional-level implementations of technology-enhanced learning.

Our search string (see also Table 1) refers to different synonyms of e-learning, and made reference to real-life ALT applications in a workplace setting. The search terms underwent further refinement and revised by an information specialist at the Brandenburg University of Applied Sciences. The final search string included restrictions (e.g., students at higher education institutions, pupils at schools, machine-

learning applications) for settings that do not classify as workplace learning.

Searches were conducted from February 16, 2024, to February 26, 2024, and yielded a total of 561 records (no duplicates). To account for the skewed distribution of publications on ALT towards the educational and health sectors, we conducted three separate searches for technology-enhanced learning (ibid.). These searches were conducted for educational institutions (N=130; 23% of records), for the health and medical sector (N=238; 42%) and for all other fields (N=193; 35%).

We recognize that this first step is merely an approximation, as we had not yet screened out records based on titles, keywords, and abstracts that may not be related to the use of ALT at the workplace. However, considering the high frequency of articles related to education and health and medical fields, and recognizing that most institutions in these fields are likely to be large and public sector-based, we believe that this approximation falls within the efficiency required by the chosen methodology (rapid reviews) while still retaining substantial validity for assessing the digital divide in workplace learning.

The screening strategy for the 193 records resulting from the search for other sectors was as follows: Titles, keywords, and abstracts were screened for each record. Records that did not mention 'online' in connection with 'learning' (N=24), were not related to workplace learning or did not contain detailed information about a specific implementation at the workplace (N=81), excluding, e.g., studies focusing on organizational learning processes rather than individual learners' competency building, and studies that discuss abstract concepts or the interplay of general constructs in technology-enhanced workplace learning. Furthermore, we excluded studies without information about sector or professional field (N=27). This meant, e.g., that we exclude cross-sectional studies covering a large number of different institutions.

Furthermore, we identified additional review studies that have not been excluded in the initial WoS search routine (N=3). Similarly, we excluded further studies that refer to education (N=16) or to the health and medical field (N=10) that still ended up in the search results for "other sectors".

The remaining N=22 publications were included in full text screening. We excluded two additional studies because they were implemented and/or tested in a higher education context. Another was focused on knowledge management with MS Office and social media tools rather than with technology-enhanced learning. Moreover, we found two studies using the same ALT implementation example that we treated as duplicates and excluded one of them.

The 18 final full-text records underwent detailed analysis to gain systematic evidence on the digital divide in workplace learning. The screening was conducted with respect to the characteristics of the institution and the workplace, such as size, sector, and type of job.
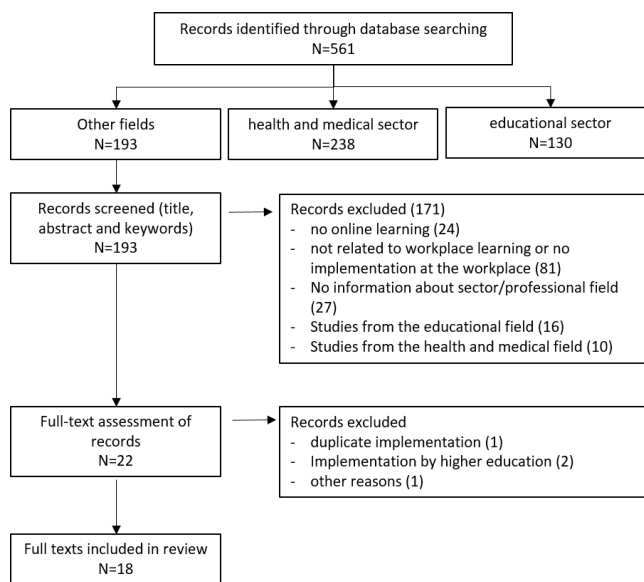
Table 1: Construction of the search string

Explanation	Components of the WoS seach string		
online learning or synonymous term in title referring to the use of ALT	(((TI= ("digital" OR "virtual" OR "online" OR "hybrid" OR "remote" OR "blended" OR "distance" OR "web-based") AND TI=("learning*" OR "training*" OR "course*")) OR TI=("e-learning" OR "elearning" OR "e-training" OR "entraining" OR "microlearning" OR "micro-learning" OR "mobile learning" OR "mobile-learning" OR "learning app"))		
	AND		
concrete implementations...	(AB=("case stud*" OR "company case*" OR "field stud*" OR "field experiment*" OR "questionnaire*" OR "survey*") OR TI=("case stud*" OR "company case*" OR "field stud*" OR "field experiment*" OR "questionnaire*" OR "survey*"))		
	AND		
... at the workplace	(AB=("workplace*" OR "business*" OR "industry" OR "industries" OR "enterprise*" OR "compan*" OR "public service*" OR "public sector*" OR "civil serv*" OR "corporat*" OR "professional*" OR "SME*" OR "governm*" OR "continuing education") OR TI=("employee*" OR "worker*"))		
exclude ALT applications aimed at students or pupils as well as machine learning applications	**NOT**		
	AB=("student" OR "students" OR "pupil*"OR "machine learning" OR "deep learning" OR "reinforcement learning")		
	NOT		
	TI=("student" OR "students" OR "pupil*"OR "machine learning" OR "deep learning" OR "reinforcement learning")		
relate to one of the three fields	**AND**	**AND**	**NOT**
	education	health and medical field	other fields
	AND	**AND**	**NOT**
	(TI=(teacher* OR faculty* OR lecturer*) OR AB=(teacher* OR faculty* OR lecturer*))	(AB=("health*" OR "care" OR "medic*" OR "surg*" OR "radiol*" OR "dementia*" OR "clinic*" OR "nurse*") TI=("health*" OR "care" OR "medic*" OR "surg*" OR "radiol*" OR "dementia*" OR "clinic*" OR "nurse*"))	TI=(teacher* OR faculty* OR lecturer*) NOT AB=(teacher* OR faculty* OR lecturer*)) NOT AB=("health*" OR "care" OR "medic*" OR "surg*" OR "radiol*" OR "dementia*" OR "clinic*" OR "nurse*") NOT TI=("health*" OR "care" OR "medic*" OR "surg*" OR "radiol*" OR "dementia*" OR "clinic*" OR "nurse*")

Figure 1: PRISMA-Chart

C. Results

Initially, the scarcity of studies on advanced learning technologies for workplace learning beyond higher education and healthcare is noteworthy. This scarcity suggests that – at least evidence-based and scientifically evaluated – implementation of ALT in the workplace is not yet that widespread, as we would expect given the generally acknowledged importance of reaping the benefits of ALT for workplace learning. Full-text screening of the 17 relevant studies identified yields the following picture (see also Table 2): The great majority of examples of ALT use at the workplace refers to large organizations or to cross-institutional implementations with participants from several institutions (e.g., engineers or agricultural workers employed in different companies or being self-employed). Our sample only contains one example at a medium-sized enterprise, and none at a small organization. Moreover, most applications are from technical sectors, such as energy, engineering, or automotive rather than from the service sector. Immersive virtual reality training (single or multi-player) is the most frequently found ALT, followed by mobile and micro-learning implementations. The picture becomes even clearer when we look at the occupational fields targeted by ALT in the records studied: it is mainly blue-collar workers who have access to ALT, especially VR-based immersive training, while service sector companies rather tend to use less technically sophisticated learning technologies, such as mobile and micro-learning. This discrepancy could be attributed to a generally lower level of digital literacy required to implement digitally supported learning in many service companies compared to technical, manufacturing companies where production processes have been increasingly automated with the help of digital technologies over the years. However, this hypothesis is challenged by the absence of companies from highly automated and digitized service sectors (e.g., finance, banking) in our literature review.

Table 2: Distribution of ALT-Use at the Workplace

Study	Institution	Sector	Profession	ALT	COLL
[31]	N/A	retail	diverse	MicroL	no
[32]	large	public	diverse	MobileL	yes
[33]	several	engineering	engineers	other	yes
[34]	large	business services	white-collar	other	yes
[35]	large	automotive	blue-collar	VR	no
[36]	large	public	white-collar	MicroL	no
[37]	several	IT	IT specialists	MicroL	no
[38]	large	public	both	other	no
[39]	medium	industrial services	blue-collar	VR	yes
[40]	N/A	food	N/A	other	no
[14]	large	energy	blue-collar	VR	no
[41]	N/A	energy	blue-collar	VR	no
[42]	large	steel	blue-collar	VR	no
[43]	several	electronics	blue-collar	VR	no
[44]	several	education	other	other	no
[45]	several	public	blue-collar	VR	yes
[46]	several	agriculture	blue-collar	MobileL	yes
[47]	large	chemical	diverse	other	N/A

Notes: ALT = advanced learning technologies, COL = collaborative learning, MicoL = micro-learning, MobileL = mobile learning, VR = Immersive virtual reality training

A third of the records analyzed cover ALT that fosters networked learning, i.e., collaboration between learners. Here, we cannot find differences in the use of ALT between white-collar and blue-collar professions.

D. Discussion

As a conclusion, our screening of the literature has revealed that there is a lack of ALT implementation at the workplace in other sectors, at least in terms of implementations that have been scientifically evaluated and the results have been published in peer-reviewed journal articles. Our results show that technology-enhanced learning opportunities are less frequent in smaller organizations, non-technical sectors (including the public sector) and for white-collar workers.

A major limitation of our analysis is publication bias. We may assume that the likelihood of writing an academic publication and publishing it in a peer-reviewed journal is higher in academic fields, such as health and education, which may partly explain the great number of results on the use of ALT for workplace learning we found.

Still despite these methodological limitations, our results indicate that there seems to be a digital divide in workplace learning, in particular along employer size and technological sector. Given that for example in Europe, almost two thirds of the employed workforce is working in small or medium-sized enterprises [48], and similarly, almost three quarters are employed in the service sector [49, p. 48], this poses a threat to workforce up- and reskilling and may severely hamper learning opportunities and individual development and growth for employees at such workplaces.

III.   AI-BASED CONTENT CREATION AS A SOLUTION

A. The challenge of creating content for digital learning

To reduce the digital divide in workplace learning, it is essential to identify the obstacles preventing enterprises, particularly SMEs and service sector enterprises, from adopting digital learning technologies for the continuous up-skilling and re-skilling of their workforces. Previous studies have primarily focused on the lack of adequate technological infrastructure or general resistance to the introduction of e-learning for workplace learning [50].

A further explanation, which has not been fully investigated in previous studies of the adoption of advanced learning technologies, is that the burden on organizations of creating content specifically for an organization's needs may be a significant obstacle to the implementing digital learning in the workplace.

The creation of high-quality digital learning materials requires a combination of specialized skills in instructional design, multimedia production [51][52], and subject matter expertise [53]. Furthermore, the process of designing, developing and iterating digital content is time-consuming. It is estimated that between 40 and several hundred (!) hours may be required to develop one hour of e-learning content,

depending on the complexity of the material and the technologies used [54]-[56].

In summary, 'breathing life' into workplace ALT by creating high-quality learning content tailored to the organization's is a significant investment in human and financial resources. These non-technical barriers may slow down the adoption and implementation of digital learning solutions, limiting their potential benefits in improving workplace learning and development. A more detailed examination of the challenges of learning content creation also provides further insights into the propensity of organizations to adopt ALT for workplace learning, as discussed in our rapid literature review in Section II:

- Training content in companies varies significantly between the service and manufacturing sectors. A recent, cross-European study conducted by the OECD [57] found that the adoption of online delivery strongly depends on the content of training: Online delivery is most common for health, safety and security requirements as well as IT skills, but less so for technical, practical or job-specific skills such as machine or product training, sales training or customer handling, as well as soft skills such as communication, leadership, teamwork or conflict management. The creation of digital learning content for service sector topics may present greater challenges due to the need for interactive and scenario-based training that simulates real-life customer interactions and communication skills, which are inherently dynamic and context-specific. In contrast, manufacturing sector training may often involve more standardized and procedural content, such as safety protocols and technical skills, which are easier to codify and deliver as digital learning content. This could explain why service sector companies have been found to be less active in the provision of ALT at the workplace.

- SMEs are particularly reliant on informal learning [50][57]-[59], and make less use of classical training activities in classroom-like settings. Reasons for this preference may include limited resources for providing formal training to employees. Another explanation is that SMEs often offer jobs with a high task variety and excellent learning opportunities [59]. In addition, physical and social proximity is greater in smaller organizations, which provides particularly good conditions for informal learning [60] through feedback, trial and error, and observation of colleagues. However, the learning content conveyed by such informal learning activities is highly specific to the work process and activity concerned, and thus qualifies as highly contextualized material, characterized by above-average production times and costs. This may be an additional explanation for the lower propensity of SMEs to use digital learning approaches for their employees.

In conclusion, addressing the complexity and resource requirements for the creation of high quality, context-specific digital learning materials is crucial to fostering greater adoption of advanced learning technologies in different organizational settings. By overcoming these barriers, SMEs and service sector companies, in particular, could benefit significantly, leading to a reduction in the digital divide in workplace learning.

B. AI-based creation of workplace learning content

Recently, the development and adoption of large language models (LLMs), such as OpenAI's ChatGPT, have attracted considerable interest for their ability to generate human-like conversational text content. These advances in generative AI can help automate the creation of high-quality, contextualized learning content [60]-[63]. There are promising applications for the automated generation of comprehensive learning content such as curricula [64][65], learning paths or course outlines, narrative educational elements [66], and interactive activities such as quizzes and reflection questions [67]. Significant potential is also attributed to the creation of personalized learning experiences [62][68], which tailor the pedagogical approach the specific abilities, interests, requirements and even learning styles of each student. Some of these approaches work based on a zero-shot basis, i.e., without the need to pre-train the AI model [69].

A number of commercial LLM-based content creation tools have emerged, enabling the creation of educational materials and comprehensive courses (for an overview of tools mainly aimed at school and academic use, see [70]. In addition to tools designed for education in schools and academia, there are more general-purpose AI-based course builders, such as Coursera's AI-based Course Builder [70], EdApp's AI Create [71], H5P's smart import [72], nolej.io [73], mindsmith.ai [74], and many others [75], which provide adequate functionality for designing digital learning for lifelong and workplace learning. The promise of these tools is to significantly reduce the time and cost needed of creating engaging, customized learning content [76].

However, AI-based automated content generation has primarily been used by educational institutions. Holmes and Littlejohn [77] note that, for this reason, AI in professional learning is primarily used to automate content creation in formal training courses with predefined content and outcomes, and is not yet widely used in informal workplace learning.

This paper outlines the significant potential of AI in creating digital learning content tailored to the specific needs of the workplace. As we will demonstrate, it is critical to capitalize on this potential, particularly in light of the observations made in Section II. These indicate that smaller organizations and service sector companies are lagging behind in the adoption of digital learning in the workplace. There are three main drivers for the adoption of digital learning in the workplace are as follows:

1. *Democratization through the reduced resource intensity of using AI support.* The use of AI to support the creation of digital learning content has the potential to democratize the design and delivery of digital learning activities. There is no need for subject matter experts or experienced staff to

have expertise in complex authoring software or to meet prerequisites in instructional design and pedagogical strategies. Furthermore, when sharing knowledge for AI-based content creation, language expression and formal correctness play only a minor role in the final quality of the material. This reduces the barriers for employees with limited language skills or little experience in formulating texts, enabling them to become AI-powered digital learning authors. AI-powered digital learning content creation can reduce production time and costs to a fraction of what they are today. AI-based automation also enables individuals and organizations to share their knowledge when time, financial resources, and e-learning skills are limited.

2. *Resource-efficient creation of company-specific learning content.* Significantly improved ability to leverage and frequently update customized, company-specific knowledge as often as needed with minimal effort. AI provides a vastly improved ability to leverage and frequently update customized, company-specific knowledge with minimal effort. Many AI course authoring tools allow uploading of a variety of formats, including text, video, and audio [66]. This flexibility means that existing corporate materials, such as product descriptions, technical descriptions, safety instructions, or anonymized customer complaint records, can be easily transformed into company-specific learning content that closely reflects organizational specifics and real-world work processes. Using such custom source material as a baseline produces learning content that is not only tailored to the specific needs of the prospective learners, but also improves the accuracy of the learning material because the AI is less prone to "hallucinations."

3. *The power of generative AI tools to create human-like conversational content.* Another advantage of using generative AI tools to create digital learning content is their human-like conversational style. Generative AI's strengths in simulating human interactions [78] offer significant potential for creating high-quality materials such as interactive scenarios and digital role-plays, especially in soft skills and sales training. For example, AI-based role-plays could be developed using difficult customer scenarios based on common complaints or recorded audio from support calls.

In addition to these three main areas, AI exhibits considerable potential in the automated generation of learning content across a number of dimensions. These include multilingual learning units, which are becoming increasingly important given the international nature of many workforces. Content can also be tailored both didactically and contextually to different groups of learners (e.g., trainees, experienced learners, career changers) and different learning styles (e.g., experimental, visual). Adapting the instructional approach to each learner's individual learning style, progress, or skill level can be a valuable approach for workplace learning.

C. Discussion

In Section III.A, we examined the barriers to the creation of high-quality, context-specific digital learning materials for SMEs and service sector firms, highlighting that this may contribute to the digital divide in workplace learning, particularly with respect to the lower propensity to use ALT in smaller organizations and service sector firms. In Section III.B, we then explored how AI-based automated content generation can address these challenges by democratizing content creation, reducing the effort required to create and update customized learning content from unstructured sources, and leveraging human-like conversational styles to enhance interactive digital training for non-technical topics.

Our analysis suggests that AI has the potential to reduce the time and cost of producing digital learning content, while also supporting with the digitization of informal learning processes to some extent. AI's ability to transform unstructured materials, observations, and feedback, as well as process-specific content, into structured digital materials and maintain them at a relatively low cost and in a short time. This is particularly promising for small and medium-sized enterprises (SMEs), companies operating in highly dynamic environments, and companies in the service sector. This could narrow the size- and sector-dependent part of the digital divide in workplace learning identified in our rapid literature review in Section II.

Nevertheless, it is imperative to undertake a comprehensive assessment of the potential impediments to the narrowing of the digital divide in the context of workplace learning, with a particular focus on the burden of creating learning content. AI tools for automated content creation need to meet high standards: they should source custom material from flexible resources, generate human-like conversational output, adhere to strict data privacy standards when processing sensitive corporate information, be user-friendly for content creators, and be reasonably priced. Ideally, they should also use evidence-based instructional strategies relevant for effective digital (workplace) learning [24][79]. Some researchers call for "pedagogical intelligence" to work hand-in-hand with artificial intelligence in education, criticizing the lack of pedagogical foundations guiding current AI research in schools [80].

After testing some of the existing AI tools mentioned above, it is clear that no current tool meets all these requirements (for privacy concerns, see [69]). Many tools are promising in their functionalities. Even if adequate tools were readily available and accessible, quality concerns could still be an issue. A common solution is to use a human-in-the-loop approach [76][81], where human experts manually review learning content at critical processing stages.

IV. CONCLUSION

In summary, the digital workplace divide remains a significant issue, particularly for smaller organizations with limited resources and those requiring highly specific, non-technical training content. The high demands on time, money, and human capital to produce company-specific learning

content have been identified as a major cause of this divide. Automating content creation using generative AI offers a promising solution to narrow this gap.

It is of the utmost importance that policymakers, society, and industry work in collaboration to prevent the potential exacerbation of existing inequalities through the creation of an "AI divide" in the workplace. Consequently, it is imperative that AI-based learning content creation evolve into an inclusive technology. This would enable a broader range of workers to act as subject matter experts and share knowledge through self-created digital learning materials, thereby promoting widespread workplace learning opportunities for all workers and narrowing the digital divide in workplace learning.

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