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Are Graduates Digitally Unprepared?—A Digital Technology Gap Analysis From Alumni and Employer's Perspectives

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ABSTRACT

Background: The digital literacy landscape has undergone significant changes over the last 5 years, from the impact of the COVID-19 pandemic to the emergence of Artificial Intelligence (AI) technologies. The COVID-19 pandemic hastened the necessity for advanced digital skills for remote work and online collaboration, while the current AI era demands proficiency in new technologies and an understanding of their ethical implications. The digital deficit and the need to align university education with industry demands, especially in this era of fast-changing technology and the advancement of generative AI, are still subjects of ongoing debate and are the motivation for this paper. This study contributes to the ongoing discourse on digital literacy by providing actionable insights for enhancing digital competencies in higher education and bridging the digital gap.

Objectives: This study examines the digital literacy gaps among university graduates from the alumni and employers' perspectives. The study aims to understand the digital gap and how employers' and alumni expectations regarding employees' digital skills and literacy have evolved during COVID-19 and the current AI era.

Methods: The data were gathered through interviews with alumni and employers. Forty interviews were conducted to evaluate graduates' current readiness.

Results and Conclusions: Our data reveals digital deficiencies, particularly in areas such as digital identity and well-being, highlighting the need for targeted educational interventions. The study proposes strengthening strategies such as work-integrated learning and lifelong learning so universities can better equip graduates to meet the evolving demands of the digital economy.

1 | Introduction

In the rapidly evolving digital landscape, proficiency in digital literacy has become an essential competency for university graduates (Bacalja et al. 2022). However, the COVID-19 pandemic and the emergence of AI technologies have significantly altered the digital demands placed on graduates, exposing a potential digital deficit. In today's world, the success of students as engaged citizens and future employees is closely tied to their digital literacy (Tinmaz et al. 2022), and the absence of digital literacy has been argued to limit aspects of life, such as employment and social interaction (Pangrazio 2016). Students with digital literacy are said to use digital tools better and perform better in the workplace (Reddy et al. 2023). However, there is a widening digital competency (DC) gap with this transformation, particularly between those developed in business and management education and those required by industry (Lucas et al. 2022; Reddy et al. 2023).

Digital literacy is crucial for higher education graduates to gain employment and contribute to society (Morgan et al. 2022). It is also a skill required to carry out tasks in the workplace (Van Laar et al. 2020). However, evidence shows that the digital gap still exists (Colombari and Neirotti 2021; Lucas et al. 2022). Recent publications on digital literacy highlight a deficit in digital competencies among learners (Lucas et al. 2022; Morgan et al. 2022; Reddy et al. 2023). For instance, Morgan et al. (2022) and Lucas et al. (2022) argue that there is a digital deficit, with some areas of competencies having lower levels of proficiency. While business and management education exposes students to certain levels of digital skills, there is still a gap in the extent and depth of digital literacy exposure and preparation for the workplace (Zhou and Wolstencroft 2020).

Employees are now expected to integrate AI-driven solutions into their roles. For example, organisations such as Deloitte, McKinsey and World Economic Forum advocate for the need for organisations to invest in AI literacy programmes, ensuring that all employees, irrespective of their role, have a foundational understanding of AI's capabilities and implications (Deloitte 2023; McKinsey 2023; World Economic Forum 2024).

This study contributes to the existing literature on digital literacy and the competency gap by developing an approach to include practical elements and critical skills for digital literacy into the core curriculum to improve students' DC from foundational to intermediate proficiency levels in first and second-year undergraduate modules. The study's aim is twofold; the first aim is to understand the extent of the DC gap that exists in business and management alumni, and the second is to develop approaches within the core curriculum that include practical and critical elements to enable students to critically and responsibly use digital tools for employability. The paper poses the following key questions:

R1. How do employers and alumni view the expectations for employees' digital skills and literacy?

R2. To what extent does the knowledge and skill set acquired by university students align or diverge from the practical demands and expectations of business?

R3. What can universities do to bridge this gap in the future?

The paper is organised starting with a literature review covering the conceptualisation of digital literacy and the DC gaps. This is followed by the methodology, which is a qualitative study with data collected through interviews with alumni and employers. The findings are structured around the research questions.

2 | Literature Review

2.1 | Digital Literacy Versus Digital Competence: A Myriad Definitions

Digital literacy and digital competence are two terms, which are sometimes used interchangeably but have distinct meanings (Ilomäki et al. 2023). A review of existing literature reveals the changing definition and complexity of the term digital literacy, especially with the quick evolution of digital technologies and tools (Pangrazio 2016). The term digital literacy is complex and subject to debate, with authors taking different views in defining the term (Gallardo-Echenique et al. 2015; Marín and Castaneda 2023; Morgan et al. 2022; Nikou et al. 2022). Terms such as 'Information Literacy', 'Computer Literacy', 'Media Literacy', 'Communication Literacy', 'Visual Literacy' and 'Technological Literacy' have been associated with digital literacy (Falloon 2020; Marín and Castaneda 2023). Gilster (1997) introduced the term 'digital literacy', defining it as the proficiency to comprehend and utilise digitised information (Gilster 1997, 2). Authors such as Eshet (2004) and Tinmaz et al. (2022) define digital literacy as the skills and competencies necessary to navigate a complex and fragmented information ecosystem. Caverly et al. (2019) defined digital literacies as the use of multi-modal communication tools to digitally access, consume, and produce information to make meaning. Morgan et al. (2022) posits that digital literacy is more complex than operating devices and involves a variety of cognitive literacy, technical literacy and 'etiquette' literacy.

In terms of DC, Janssen et al. (2013) argue that DC is more than knowing how to use devices and applications; it involves ethical and responsible use (Janssen et al. 2013, 480). Lucas et al. (2022) posit digital competence as a set of skills, knowledge and attitudes that enable individuals to use digital technologies effectively. It goes beyond technical ability, encompassing the creation and sharing of digital content, communication, collaboration and problem-solving in various aspects of life, including education, work and social activities. Tzafilkou et al. (2022) define digital competence (DC) as the capacity to use digital technologies critically, collaboratively and creatively, alongside using Information and Communication Technologies (ICT)-based knowledge and skills for performing ICT-related tasks. Martzoukou (2021, 269–270) defines digital competencies as 'a complex umbrella concept that relates to the development of several competence areas, including information and data literacy, communication and collaboration, media literacy, creating online content, online safety and digital wellbeing as well as problem-solving, critical thinking and innovation with online tools and technologies'. As Morgan et al. (2022) mentioned, digital competencies encompass technical (operational literacy), cognitive (information literacy) and etiquette (legal, ethical and social literacy).

The paper sees digital literacy and DC as two related, but separate concepts. Digital literacy is the ability to understand and use digitised information and tools for a variety of purposes, while DC encompasses the disposition to critically use digital tools (Janssen et al. 2013). The paper adopts the definition of DC by Vuorikari et al. 2022, as the critical, confident and responsible use of and engagement with digital technologies for learning, the workplace and society.

2.2 | Evolution of Digital Literacy

The definition of digital literacy has evolved significantly over the decades, shaped by technological advancements (Reddy et al. 2020). From the 1960s, when the focus was on the concept of 'visual literacy', focusing on the ability to see,

Summary

- What is already known about this topic?
  - Definition of digital literacy: Digital literacy encompasses the skills required to effectively and critically navigate, evaluate and create information using digital technologies (Reddy et al. 2023). Its importance is well-documented, highlighting the necessity for individuals to be proficient in digital skills to thrive in modern society (Pangrazio 2016).
  - Widening digital competency gap: There is a recognised disparity between the digital skills developed through education and those demanded by industry, pointing to a significant digital competency gap (Lucas et al. 2022; Reddy et al. 2023).
  - Digital competency frameworks: Various frameworks categorise digital competencies, such as the JISC six elements of the individual capability framework (JISC 2024) and the tridimensional digital literacy framework proposed by Morgan et al. (2022). These frameworks offer structured approaches to understanding and developing digital literacy.
- What this paper adds?
  - Evolution of digital skills expectations: This study reveals how employers and alumni expectations regarding employees' digital skills and literacy have evolved due to the impact of COVID-19 and the rise of Generative Artificial Intelligence (GenAI).
  - Alignment of university education with industry demands: The research examines the extent to which university-acquired knowledge and skills align or diverge from the practical demands and expectations of the business industry. Notably, it identifies digital identity and well-being as the areas with the most significant digital gap.
  - The paper offers detailed insights into what universities can do to bridge the digital skills gap in the future. It provides actionable recommendations for integrating lifelong learning, digital etiquette and practical training into university curricula to better align educational outcomes with industry needs.
- Implications for practice and/or policy
  - Lifelong continuous learning and adaptability: Emphasising the importance of ongoing education and adaptability, this paper suggests integrating continuous learning opportunities into educational programs. This approach is crucial for ensuring that graduates remain competitive, can adapt to evolving industry needs, and reduce the training burden on companies.
  - Digital etiquette and professionalism: The study emphasises the need for training in digital etiquette and professionalism. By incorporating workshops on email etiquette, managing digital identities, and effective digital communication, universities can better prepare students for professional environments.
  - Enhancing practical training: To bridge the digital competency gap, the paper advocates for enhancing practical training through real-world applications and simulations. This includes partnerships with companies to provide internships, co-op programmes and project-based courses, which can help students gain hands-on experience and develop critical problem-solving skills.

interpret and communicate information visually, to 'computer literacy' in the 1980s, with the growing use of computer-based and media technologies (Buckingham 2015a, 2015b). The advent of personal computers, such as the Apple II in 1977 and IBM's first Personal Computer (PC) in 1981, necessitated further evolution. In recent years, the definition of digital literacy has expanded even further, particularly during the COVID-19 pandemic and the emergence of AI technologies. The pandemic highlighted the need for advanced digital skills as remote work and online collaboration became essential, requiring not only technical proficiency but also ethical, legal and social competencies (De et al. 2020; Murray et al. 2022). In the current AI era, digital literacy now includes the ability to integrate AI into problem solving. This ongoing evolution necessitates continuous learning and adaptation to keep pace with rapid technological advancement. Developing students' competencies in digital literacy poses significant challenges, primarily due to the rapid pace of technological change.

2.3 | The Level of Digital Competence Gaps in Students

A recent study has shown gaps in higher education students' digital competence (Lucas et al. 2022). Some of the key gaps include those in student's competency in different proficiency levels of digital competence (Lucas et al. 2022). Further, Lucas et al. (2022) highlighted that students' higher or lower abilities vary significantly. This links to arguments made by authors Kirschner and De Bruyckere (2017), Lucas et al. 2022 and Wolstencroft and Zhou (2020) debunk the myths of students being digitally native and multitaskers, arguing that students' DC is limited in proficiency and depth of knowledge. Further, students' level of DC regarding critical thinking is limited (Wolstencroft and Zhou 2020). Further, there is a disparity in perceived skills between employers and the skills students graduated with (Jackling and De Lange 2009; Jones and Abraham 2009; Saunders and Zuzel 2010). One of the reasons is linked to the failure of universities to adapt to the evolving digital skill sets that are increasingly crucial for business and society (Bremner and Laing 2019). While there is a diversity of opinions regarding the exact nature of these skills—the consensus is that there is a notable lack of these skills among graduates (Buckingham 2010; Denvir 2020). This disparity means that employers, when hiring graduates, are cognisant of the potential deficiencies in recent graduates' digital skill sets.

2.4 | Digital Competency Frameworks

Digital frameworks and categorisations abound in the literature to explain digital skills or competencies or students' gaps in attaining the competencies. Authors such as Van Deursen and van Dijk (2009), Van Deursen and van Dijk (2010) categorise digital skills under (a) operational skills, (b) formal Internet skills, (c) information Internet skills, (d) strategic Internet skills and (e) communication and content creation skills. Other authors, such as van Laar et al. (2017) categorise digital skills into seven core categories: technical, information management, communication, collaboration, creativity, critical thinking and problem

solving. In their paper, Van Laar et al. (2020) identified technical, information, communication, collaboration, critical thinking, creativity and problem-solving skills as the core digital skills. Claro et al. (2012) categorise it under four skills: information management, communication, content creation and problem solving.

Several authors have developed frameworks to provide a structured approach to assessing and developing digital literacy skills (Ilomäki et al. 2023; Lucas et al. 2022; Reddy et al. 2020, 2023). This paper adopts the JISC framework, which provides an overall map of digital capability development at both basic and advanced levels (Balyk et al. 2020). The reason for adopting this framework is that it offers a way of thinking about how individuals and organisations can successfully operate in a digitalised society. The framework is made up of six elements: (1) Digital proficiency and productivity; (2) Digital creation, problem solving and innovation; (3) Digital learning and development; (4) Information, data and media literacies; (5) Digital communication, collaboration and participation; (6) Digital identity and wellbeing (JISC 2024). Each of these elements is defined and explained in JISC (2024). Figure 1 below illustrates the six elements.

3 | Methodology

This study employed qualitative methods to explore the level of digital literacy and the existence of the digital gap from the perspective of alumni from UK universities and employers. Data were collected using interviews with both alumni and employers. A total of 40 interviewees participated, comprising 25 alumni and 15 employers. The demographic information of the interviewees (see Table 1) encompassed a diverse group of alumni and employers, providing a comprehensive perspective on digital literacy.

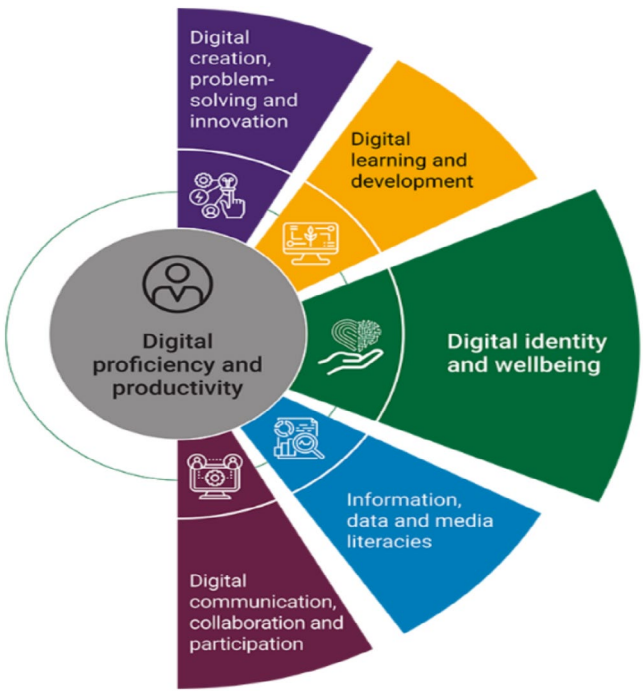

FIGURE 1 | JISC six elements of the individual capability framework (JISC 2024).

The 25 alumni interviewed are balanced in gender, with ages ranging from early 20s to late 30s. All alumni are UK graduates, holding at least an undergraduate degree, with many having pursued postgraduate education, and represented various fields of study such as Business, Engineering, Computer Science and Humanities. Their years since graduation ranged from 1 to 10 years, offering insights from both recent and moderately experienced graduates. These alumni were employed across multiple sectors, including technology, finance, education and healthcare (see Figure 2). In terms of geographical diversity, the alumni studied in various countries, with a significant number having studied in the UK, France, USA, Canada, Australia, China and India, and they currently work

TABLE 1 | Demographic characteristics of the interviewees.

		Alumni		Employers	
Variable	**Category**	**Count**	**%**	**Count**	**%**
Gender	Females	15	60%	7	47%
	Males	10	40%	8	53%
Age	20–25	6	24%	—	—
	26–30	10	40%	5	33%
	31–35	6	24%	7	47%
	36–40	3	12%	3	20%
Years of service	1–3 years	10	40%	—	—
	4–6 years	8	32%	4	27%
	7–10 years	5	20%	4	27%
	11+ years	2	8%	7	47%
Job roles	Entry-level	10	40%	—	—
	Mid-level	8	32%	5	33%
	Senior-level	5	20%	8	54%
	Executive	2	8%	2	13%
Country of work	UK	8	32%	4	27%
	USA	5	20%	3	20%
	Germany	3	12%	2	13%
	Singapore	2	8%	2	13%
	Others	7	28%	4	27%
Corporate size	Small (1–50 employees)	8	32%	3	20%
	Medium (51–250 employees)	9	36%	5	33%
	Large (251+ employees)	8	32%	7	47%

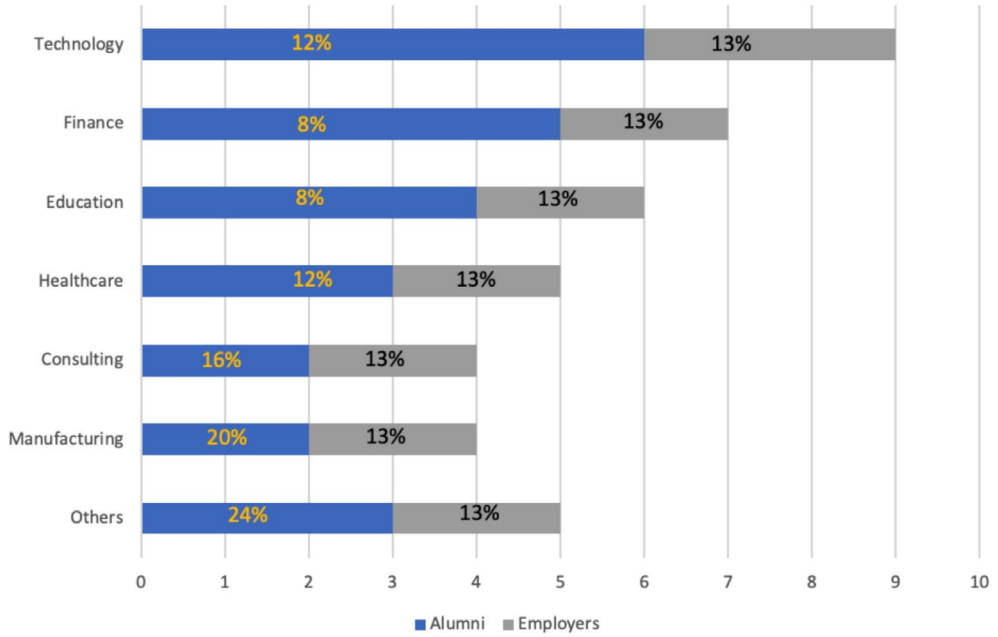

FIGURE 2 | Industries of interviewee employment.

in a variety of international locations, reflecting global perspectives on digital literacy.

In parallel, the 15 employers interviewed also had a balanced gender representation and came from a wide array of industries such as technology, finance, manufacturing and consulting (see Figure 2). All the employers had experience of recruiting UK graduates. These employers worked in organisations of varying sizes, from small enterprises to large multinational corporations, and held roles primarily in management, Human Resources (HR) and executive positions. The employers were based in several countries, including the UK, USA, Germany, China and Singapore, providing a broad view of industry expectations across different cultural and economic contexts.

Participants were asked open-ended questions about their experiences working with graduates or as graduates, as well as their perceptions of the graduates' digital competencies. The interviews were semi-structured, with durations ranging from 15 to 45 min. Participation in the study was voluntary, anonymous and obtained with informed consent. The qualitative data obtained from these interviews were analysed using thematic analysis methods.

Individual interviews provided detailed insights into the personal experiences and perceptions of each participant, allowing for a deeper understanding of individual viewpoints without group influence (Creswell and Poth 2018; Seidman 2006). This method was suitable for our research on learning the digital skills gap among graduates, as it enabled the collection of rich qualitative data that revealed the intricacies of digital literacy levels and skills gaps from the perspectives of both alumni and employers.

Thematic analysis was employed to systematically identify and analyse patterns within the data, uncovering recurring themes and unique insights (Cohen et al. 2018; Merriam and Tisdell 2016). By coding transcripts and categorising data, the analysis provided a comprehensive exploration of graduates' digital literacy, highlighting strengths and identifying critical gaps (Miles et al. 2014). This approach facilitated an in-depth understanding of participants' views on digital competencies, capturing diverse perspectives and contextualising findings within the broader digital literacy landscape (Guest et al. 2012). This method enabled us to pinpoint specific areas where graduates excelled and areas of deficiencies. It also allowed us to tailor the answers to the third research question on what universities can do to bridge the digital gap, ensuring that educational outcomes align more closely with industry expectations.

4 | Findings

The findings are structured using the research questions.

4.1 | RQ1: How Do Employers and Alumni View the Expectations for Employees' Digital Skills and Literacy?

During our interviews, we identified two major systemic events, COVID-19 (December 2019) and the rise of GenAI (November 2022, when OpenAI launched ChatGPT as a product and made it available to the public), which were mentioned by all interviewees for their significant impact on the evolution of expectations for employees' digital skills and literacy. These events have pushed changes in these expectations and often accelerated trends that had started some years previously, prompting us to divide the timeline into three phases: the pre-COVID era, the post-COVID and pre-GenAI era, and the post-GenAI era. Under the tridimensional framework of digital literacy proposed by Morgan et al. (2022), there have been significant upgrades in the expected digital skills and literacy across these three

phases. Drawing from our interview data, these changes are summarised in Figure 3, which illustrates the progression and impact observed during the study.

4.1.1 | The Pre-COVID Era

In the pre-COVID era, the expectations for employees' digital skills and literacy were basic and broadly centred around operational literacy. This primarily involved technical skills, with a strong emphasis on basic Information and Communication Technology (ICT) proficiencies, such as using Microsoft Word and Excel. Employers focused on ensuring that employees could perform essential digital tasks, which were considered sufficient for productivity and efficiency in most workplace settings. The digital landscape was stable, and the skill requirements did not extend far beyond these fundamental capabilities.

> Basic digital skills were enough before the pandemic. —Alum 23

4.1.2 | The Post-COVID and Pre-GenAI Era

The onset of the COVID-19 pandemic marked the first significant shift in these expectations, as remote work and virtual collaboration became the norm. This period referred to as the post-COVID and pre-GenAI era saw a substantial increase in the demand for more advanced digital skills. Employees were now expected to be proficient in a broader range of digital tools and platforms, including video conferencing software, collaborative online workspaces, and advanced data management systems. This era also introduced a greater emphasis on digital communication skills and the ability to navigate and leverage digital resources effectively to maintain productivity and connectivity in a remote working environment. As a result, we witnessed an upgrade in operational literacy and a new rise in the emphasis on information literacy and legal, ethical and social literacy.

> The biggest difference due to the COVID-19 pandemic was ... making the transition from your first move back into home because it's very much something where you have to re-jig your entire way of working. —Alum 17

Initially focused on basic ICT skills, the expectation on employees was upgraded to advanced ICT skills, especially adaptation to new software and tools suitable for remote working. This included mastering video conferencing platforms like Zoom, which became essential for maintaining team cohesion and conducting daily operations. Similarly, cloud-based solutions such as Google Drive were emphasised for their role in file sharing and real-time document collaboration, allowing teams to work together seamlessly despite physical distances. The rapid shift to remote work necessitated proficiency in digital communication

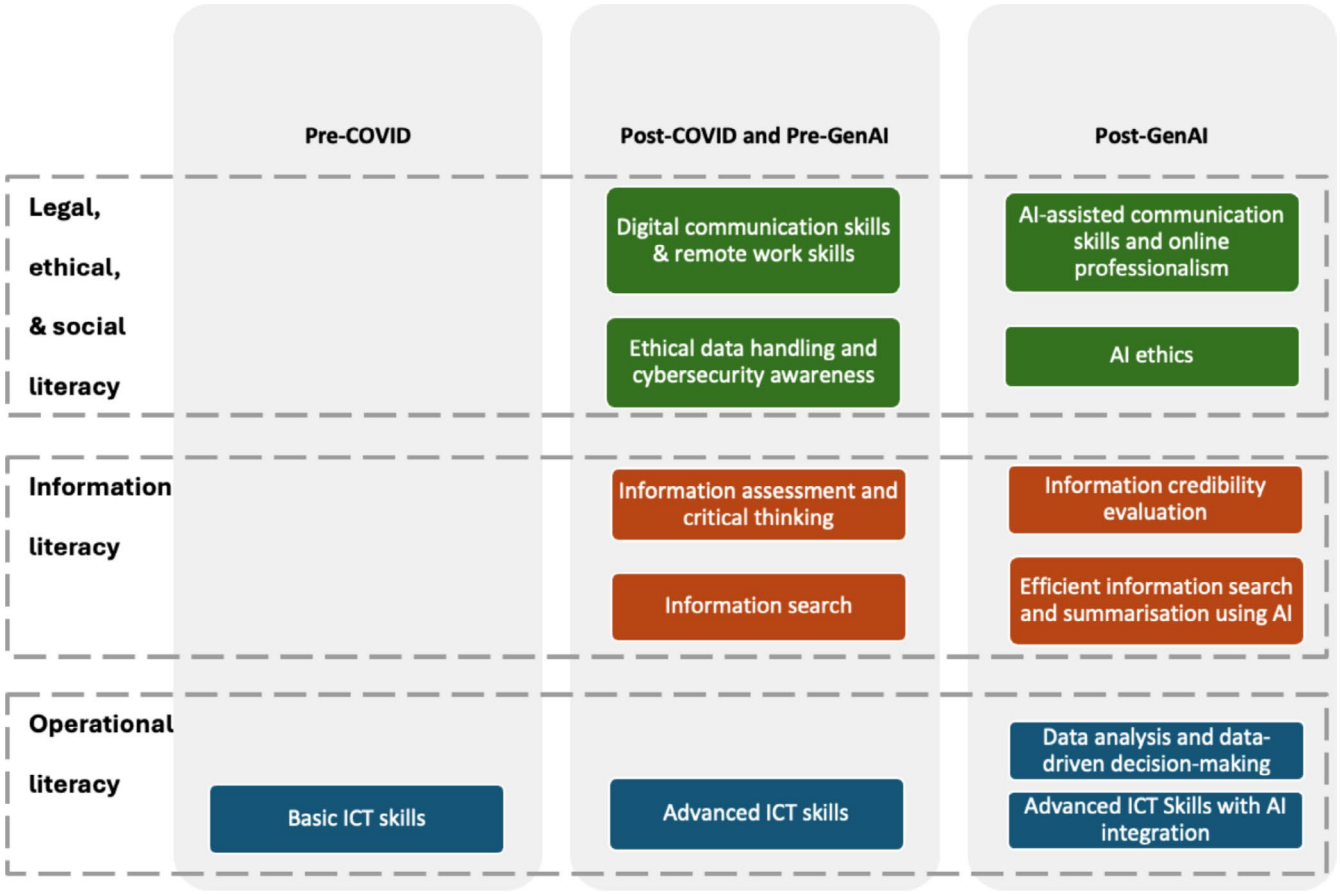

FIGURE 3 | Impact of COVID and AI on the evolution of expectations of employers' digital skills and literacy.

tools like Zoom and Microsoft Teams, highlighting the importance of effective remote work skills.

> Operational digital skills were always important, but not as critical as they became later. —Employer 2

> Organisations had to rapidly adapt to remote work, leading to an increased demand for employees who can efficiently manage remote work environments. —Employer 8

> I feel like because of COVID a lot of businesses did have to adapt and then as a result, we had to learn new skills. —Alum 14

The pandemic led to a greater emphasis on information literacy, previously not emphasised as much. Employers increasingly recognised the need for employees to possess not only basic information search skills but also the ability to assess and critically think about the information at hand.

> Information search and summarisation skills were necessary, but their importance has surged recently. —Employer 1

> The pandemic emphasised the importance of being able to find, evaluate, and use information effectively. Misinformation became a major issue. —Alum 2

4.1.3 | The Post-GenAI Era

Through the data, we can see the drive for integration of AI technologies into various business processes has prompted a growing demand for professionals who are skilled in AI and automation. Data analysis and data-driven decision-making have also taken centre stage in this new era. The ability to analyse and leverage data effectively has become a fundamental aspect of numerous job roles across different sectors, marking a shift towards more analytical and evidence-based approaches in decision-making processes.

> In the age of GenAI, data-driven decision-making has become critical, making data literacy a key skill for employees across industries. —Alum 17

Regarding legal, ethical and social literacy, AI ethics have gained prominence as AI becomes more integral to business practices. The ethical use of AI, encompassing issues such as data privacy and algorithmic bias, requires careful consideration and robust guidelines.

> The ethical implications of using AI, such as data privacy and algorithmic bias, are areas where we need to develop clear guidelines and understanding. —Employer 5

In addressing RQ1, our findings indicate that while certain technical skills, such as programming in IT-related fields or data analysis in finance, may be prioritised in specific roles, the emphasis on new digital literacy, for example, legal, ethical, social and information literacy, has been consistently highlighted across all sectors.

4.2 | RQ2: To What Extent Does the Knowledge and Skill Set Acquired by University Students Align or Diverge From the Practical Demands and Expectations of the Business Industry?

Our data show that while universities provide a solid foundation in many of the skills needed in the business industry, significant gaps remain in both the depth of technical skills and the practical application of soft skills. University curricula often include fundamental training in widely used software like the Microsoft Office Suite (Word, Excel, PowerPoint), aligning well with basic workplace expectations. Some specialised programmes also offer training in advanced software and tools relevant to specific industries, such as coding platforms, CRM systems like Salesforce, or data analysis tools like SPSS.

However, the proficiency level required in a professional setting is often much higher than what is typically taught in universities. Advanced software skills, including complex functions and data analysis capabilities, are often expected but not always thoroughly covered in academic programmes. Furthermore, these programmes frequently do not cover the full breadth or depth of digital skills needed in the business industry. As a result, graduates might be familiar with certain software but may lack the hands-on experience or in-depth knowledge required to use these tools effectively in a business context.

> When you compare yourself, as a fresh graduate, with experienced employees, you can definitely feel like you're at a disadvantage because some people really know how to use, for example, Excel very professionally and they know a lot of things which a fresh graduate might not know. —Employer 13

To detail the nuanced areas of digital literacy, we follow the JISC six elements of the individual capability framework (JISC 2024) and ask all interviewees to evaluate the digital literacy of university graduates across the six areas. These areas are assessed at four levels: foundation, intermediate, advanced and highly specialised. We then generate a radar chart (Figure 4) to illustrate the average proficiency in each area.

The radar chart provides a detailed comparison of digital literacy skills among university graduates, evaluated by alumni and employers across six key areas: ICT Proficiency, Information, Data and Media Literacy, Digital Creation, Problem Solving and Innovation, Digital Communication, Collaboration and Participation, Digital Learning and Development, and Digital Identity and Well-being. Across all six areas, the evaluations from both alumni and employers predominantly fall between the intermediate and advanced levels. This indicates that whilst graduates possess a moderate level of digital literacy, their skills are not at an advanced or highly specialised level, pointing to a digital gap that needs to be addressed.

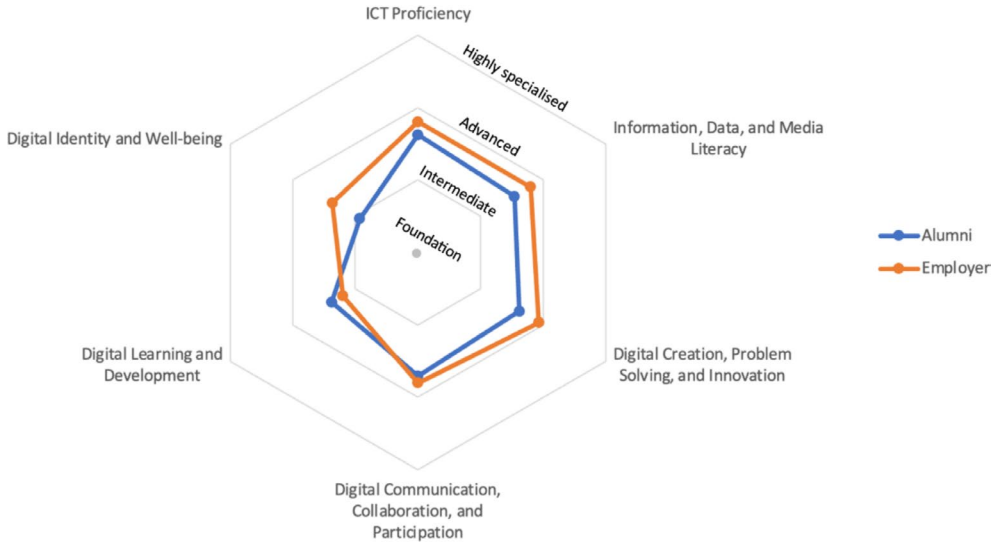

FIGURE 4 | Radar chart of graduates' digital literacy in six JISC framework areas.

ICT Proficiency scores are relatively high for both alumni and employers, suggesting that graduates generally possess a solid foundation in basic technical skills. In the area of information, data and media literacy, employers rate graduates higher than alumni do. This area spans intermediate to advanced skills, including the critical evaluation of information and effective data handling. Digital creation, problem solving and innovation are other domains in which employers have a slightly more favourable view compared to alumni. This area includes advanced and highly specialised skills, focusing on creativity and innovation in digital contexts. The slight discrepancy may indicate that graduates underestimate their capabilities or that universities need to enhance practical, hands-on experiences in these skills. For digital communication, collaboration and participation, both groups show close alignment, but employers give slightly higher ratings. This area encompasses foundation to advanced levels, focusing on the effective use of digital communication tools and collaboration platforms. In Digital learning and development, alumni rate their competencies lower than employers. This area involves intermediate to highly specialised skills, emphasising lifelong learning and adaptability. The lower self-assessment by alumni suggests that they may not feel adequately prepared for continuous professional development, highlighting a potential area for universities to enhance their curricula to better support ongoing learning.

Digital identity and well-being have the lowest scores from both groups, with alumni rating themselves particularly low. This area spans foundation to highly specialised levels and involves managing one's digital identity and maintaining digital well-being. Notably, alumni evaluations in this area are slightly below the foundation level, indicating a critical need for universities to provide more focused training and support in managing digital presence and well-being.

The radar chart reveals significant insights into the alignment and divergence between the digital literacy of university graduates and the expectations of employers. While there is a consensus between alumni and employers in several areas, notable gaps exist, particularly in Digital Identity and Well-being. This area, which encompasses soft skills, digital presence and online professionalism (O'Dea and Zhou 2023), appears to be critically underdeveloped in the eyes of both graduates and employers.

> Graduates are not but need to be educated on digital well-being to prevent the negative impacts of constant connectivity, such as stress and anxiety. —Employer 5

> It's a silly mistake but in my email, I added an emoji just to like and they highlighted not to add that because it made it become unprofessional. —Alum 10

> I once used slang in a work email and got feedback that it seemed unprofessional. —Alum 7

The quotes exemplify the challenges graduates face in navigating the subtleties of professional digital communication and managing a health relationship with technology. The radar chart shows that the lowest scoring area is digital identity and well-being, with alumni rating this competency slightly below the foundation level. Of the alumni and employers interviewed, 11 out of 25 alumni (44%) and 4 out of 15 employers (27%) were not familiar with the concept of digital well-being. This indicates a substantial digital gap in expectations of professional digital etiquette and the broader implications of their online presence. The significant digital gap highlights a critical area for curriculum development, which leads to our Research Question 3.

The gap between graduates' capabilities and industry expectations is generally evident across different industries. For instance, in consulting, where graduates tend to be more skilled and digitally literate, the industry's higher requirement for digital literacy means that a gap still persists.

> Graduates coming into consulting usually have a solid foundation in technical and theoretical knowledge. However, there's often a noticeable gap when it comes to applying these skills in practical, real-world scenarios. —Employer 4

4.3 | RQ3: What Can Universities Do to Bridge This Gap in the Future?

The analysis revealed several key themes that universities can focus on to enhance digital literacy and better align their graduates' skills with industry expectations. While specific technical skills may vary depending on the sector, our findings suggest that the strategies universities can implement to bridge the gap between graduates' skills and industry expectations are largely consistent across industries.

4.3.1 | Lifelong Continuous Learning and Adaptability

The most critical theme that emerged from the interviews is the necessity for fostering lifelong continuous learning and adaptability among university graduates. In an era where technological advancements occur at a fast pace, the ability to stay updated and adapt to new tools and processes is indispensable.

> In this digital age, the tools we use are constantly evolving. It's important to be a lifelong learner and stay updated with the latest technologies. —Alum 7

Employers increasingly prefer graduates who are already equipped with a robust foundation in advanced digital skills, as this reduces the need for extensive on-the-job training—a significant cost-saving measure, especially in challenging economic times.

> Given the bad economy, training budgets are tighter than ever. We need new hires who can hit the ground running with the latest skills and technologies. —Employer 3

4.3.2 | Digital Etiquette and Professionalism

Another significant theme is the gap between digital etiquette and professionalism. With the shift towards remote work and digital communication, maintaining professional conduct online has become more important than ever.

> Training on digital communication should be a core part of the curriculum. It prepares students for the realities of the modern workplace. —Employer 1

> With remote work becoming more common, it's vital to teach students how to communicate effectively in virtual settings. This includes video conferencing, collaborative tools, and maintaining professionalism online. —Alum 8

Our data show that alumni and employers favour incorporating training on digital communication best practices, such as workshops on email etiquette, and effective communication in remote environments into their curricula.

> It's important to teach students how to communicate effectively in a digital environment. This includes understanding the nuances of tone and formality in emails and other professional communications. —Alum 4

> Effective communication in remote environments is a skill that needs to be developed. Universities can play a big role in preparing students for this. —Employer 7

4.3.3 | Practical Training—Learning by Doing Through Experience and Reflection

The need for enhanced practical training is another key theme identified in the interviews. While universities provide theoretical knowledge and some hands-on experience, graduates often feel unprepared for the practical demands of the workplace. Alumni and employers alike highlighted the importance of real-world experience with industry-standard tools and software.

> Theoretical knowledge is important, but the practical application of this knowledge in a real-world setting is what truly matters. More internships and project-based learning could make a huge difference. —Alum 3

> We need employees who are not just familiar with basic software but are adept at using advanced analytics tools and can integrate AI solutions into our workflows. —Employer 5

Furthermore, participants mentioned that incorporating internships, co-op programs and project-based courses into the curriculum can provide direct exposure to the tools necessary to enhancing digital literacy.

> Internships have provided me with invaluable insights into the actual working environment and helped me understand the practical applications of my academic learnings. —Alum 12

> We look for candidates who have engaged in project-based learning because it shows they can apply theory to practice and learn from their experiences. —Employer 3

5 | Discussion

5.1 | Employees' Digital Skills and Literacy Readiness

Our findings reveal that the understanding of digital literacy has significantly evolved due to the impact of the COVID-19 pandemic and the emergence of AI technologies. Our findings align with Murray et al. (2022), who highlight the need to expand the constructs of digital literacy to address the ever-expanding range

of emerging technologies and their societal impact. From our data, pre-Covid-19, digital literacy expectations were relatively basic and centred around operational literacy. Employees were expected to have fundamental ICT skills, such as proficiency with word processors and spreadsheet software. The onset of the COVID-19 pandemic marked a major shift, increasing the demand for advanced digital skills as remote work and virtual collaboration became essential (De et al. 2020). The transition to remote work emphasised the importance of digital communication tools like Zoom and Microsoft Teams, which became crucial for maintaining productivity and engagement in a virtual environment.

The expectations have further evolved with the rise of generative AI technologies with a drive for integrating AI-driven solutions into work processes. Our findings show that employees' understanding of digital literacy extended to an understanding of incorporating AI technologies effectively into their work processes, to enhance productivity and efficiency. Additionally, there is a critical focus on the ethical use of AI, addressing issues like data privacy and algorithmic bias. The expectations were not only technical proficiency but also an enhanced focus on legal, ethical and social literacy (Buchholz et al. 2020).

5.2 | Digital Competency Proficiency Deficit

The presence of a digital deficit is evident, as our data shows. Across six key areas: ICT Proficiency, Information, Data, and Media Literacy, Digital Creation, Problem Solving, and Innovation, Digital Communication, Collaboration, and Participation, Digital Learning and Development, and Digital Identity and Well-being, the evaluations from both alumni and employers predominantly fall between the intermediate and advanced levels. Our findings show that some areas need more attention than others. For example, while ICT Proficiency is relatively high, indicating a solid foundation in basic technical skills, other areas such as digital identity and well-being need attention. This is consistent with studies by Lucas et al. (2022), Morgan et al. (2022) and Smith and Storrs (2023), who emphasise that foundational ICT skills are generally well-developed among graduates, but more advanced competencies, particularly in evaluating digital information and ethical digital behaviour, are deficit, for example, being proficient in some aspects of digital literacy, such as social networking but deficient in communication skills. Our data show low scores on digital identity and well-being, which received the lowest scores from both groups, with alumni rating themselves particularly low. This aligns with Morgan et al.'s (2022) findings that students report the lowest proficiency in using digital information, especially in evaluating and determining the bias and quality of information.

5.3 | Bridging the Digital Competency Gap

Our data reveals that despite a general proficiency in digital skills, significant gaps persist, especially in digital identity and well-being. Both alumni and employers rated this area the lowest, indicating a need for targeted educational interventions. To bridge this digital divide, universities must undertake comprehensive strategies that extend beyond traditional curricular approaches. Smith and Storrs (2023) emphasise the importance of lifelong learning. Educators cannot equip students with every skill they will need throughout their careers, but they can prepare them for self-directed learning and continuous skill development. The pace at which technology evolves can outstrip the ability of academic institutions to keep their curricula up to date if focused on tools rather than the critical application of the tools (Falloon 2020). Smith and Storrs (2023) argue that digital literacy initiatives should be part of a cyclical lifelong learning process that proactively meets the needs of students and educators in continually developing and applying digital literacies. By instilling the principles of lifelong learning, universities can ensure that graduates remain adaptable and capable of acquiring new skills as required. Encouraging self-directed learning habits, critical thinking and problem-solving skills empowers students to navigate the ever-changing digital landscape effectively.

Furthermore, universities must enhance their digital literacy initiatives by developing collaboration between educational institutions and industry. Morgan et al. (2022) highlight the critical role of work-integrated learning (WIL) in developing digital competencies. Embedding industry engagement into the curriculum through internships and practical projects helps students gain real-world experience and better understand the application of digital skills in professional settings. This collaboration ensures that the curriculum remains aligned with the evolving demands of the digital economy, preparing students for future technological challenges. Wolstencroft and Zhou (2020) advocate that courses should address any gaps that may exist in students' digital literacy knowledge and ensure that students are supported with the skills they need.

Addressing the digital literacy gap requires a multifaceted approach that includes building lifelong continuous learning and adaptability, improving digital etiquette and professionalism, and enhancing practical training. Universities can better prepare their students for the evolving demands of the business industry by offering ongoing education, providing targeted training on digital communication, and expanding hands-on learning opportunities.

6 | Limitations of the Study and Implications

The study primarily employs qualitative methods. While these methods provide deep insights into the perceptions of alumni and employers regarding digital literacy gaps, incorporating quantitative data would offer a more robust understanding of the issues. Future research should integrate quantitative approaches to complement the qualitative findings and provide a more comprehensive analysis. Our study focused on the perspectives of alumni and employers and did not include perspectives from academic staff. Academics play a crucial role in shaping the curriculum and training students, and their views on digital literacy gaps could provide important context and strategies for addressing these issues. Including interviews with academic staff in future research would help to create a more holistic understanding of the digital literacy landscape. Lastly, this study did not fully account for the diverse needs of different student groups. For example, students coming from widening participation backgrounds may face unique challenges and barriers

in developing digital literacy skills. Exploring the specific needs of various student demographics, as stated above, is essential to ensure inclusive and effective interventions. Future research should categorise students more precisely and investigate how digital literacy training can be tailored to meet the diverse needs of all students. For instance, consideration should be given to students who may possess limited digital skills. These students require training programs designed to build fundamental digital competencies from the ground up, ensuring they can effectively engage with digital tools and resources such as Microsoft Office 365, Zoom, MS Teams, Google Drive, DropBox and ChatGPT. Conversely, students who already possess some digital skills could benefit from more advanced training modules that enhance their existing skills and introduce them to more complex digital tools and concepts, such as industry-specific digital tools such as Python, PowerBI, AutoCAD, Bloomberg Terminal and Thomson Reuters Eikon.

Another limitation of our study is that we did not control for participants' backgrounds during the interviews. Future research could address this by selecting participants with particular backgrounds to enhance the relevance and specificity of the findings. Lastly, our study relies solely on qualitative methods, which might have restricted the depth of our analysis. Future studies could incorporate quantitative approaches to enrich the understanding of the data. For example, employing topic modelling techniques within natural language processing could provide a more detailed and systematic analysis of textual data.

Our study has practical and theoretical implications. It highlights digital gaps and skills, especially those needed post-COVID-19 and now with the emergence of AI from the perspectives of alumni and employers. The implications of our findings are significant for how higher education institutions can better prepare students for a rapidly changing digital environment. Embedding digital literacy into the curriculum is crucial, but it is equally important to focus on lifelong learning skills.

7 | Conclusion

The study reveals a complex landscape marked by different understandings of digital literacy, varying expectations between employers and students, and a focus on the in-depth practical development of digital skills for employability. Despite possessing moderate digital skills, students often lack the advanced competencies required in today's dynamic digital landscape. To bridge this gap, universities must prepare students for lifelong learning and expose them to opportunities to put into practice the theoretical learnings done in the classroom. Educators should align their curricula more closely with the evolving demands of the workforce, ensuring that students are equipped with not just a theoretical understanding of digital tools but also practical skills that are directly applicable to their future careers. As educators cannot equip students with every digital skill needed throughout their careers, preparing them for self-directed learning and continuous skill development is imperative. Incorporating digital literacy initiatives into a cyclical lifelong learning process, as advocated by Smith and Storrs (2023), will ensure that students and educators continuously develop and apply digital literacies.

Author Contributions

Xue Zhou: conceptualization, investigation, methodology, writing – original draft, writing – review and editing, supervision, data curation. **Peter Wolstencroft:** investigation, methodology, writing – original draft, conceptualization, writing – review and editing, data curation. **Lilian N. Schofield:** conceptualization, investigation, methodology, writing – original draft, writing – review and editing, data curation. **Lei Fang:** investigation, writing – original draft, methodology, conceptualization, writing – review and editing, project administration, data curation.

Disclosure

Our research team comprises researchers from diverse backgrounds and ethnic groups, genders and career stages. The team is dedicated to equity, diversity and inclusion.

Ethics Statement

Ethical guidelines for this research were followed throughout. It received approval from the university's ethics committee. Participants were fully informed of the research purposes, gave written informed consent and were made aware that they were free to withdraw anytime during data collection.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data are not publicly available due to privacy or ethical restrictions.

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