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Exploring the digital divide among students of diverse demographic backgrounds: A survey of UK undergraduates

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Abstract

This research investigates the digital divide among undergraduate students across various demographic backgrounds at UK universities, focusing on the progression of this gap over three academic years. Through the theoretical lens of connectivism and analyzing data from 595 students in two business schools via a survey, this study explores the disparity in digital literacy between widening and non-widening participants between domestic and international students. Our findings indicate that Year 2 students display peak confidence in their digital abilities, which notably declines by Year 3. The digital divide between widening participants and their counterparts progressively exacerbates throughout the undergraduate journey. Distinctly, the division between home and international students is highlighted by their proficiency in particular digital skills, where each group excels in specific areas. Furthermore, we observe that formal educational resources do not meet the diverse needs of all student groups, thus potentially broadening the digital divide. In contrast, widening participants and international students often resort to online resources over traditional educational support. Drawing on these insights, we advocate for strategies that include continuous self-assessment, tailored support, and adaptability enhancement to bridge this digital divide and advance inclusive education.

Introduction

The digital divide — the gap between those who have ready access to digital technologies and those who do not — has been a focal point of scholarly inquiry for decades (e.g., Afzal et al., 2023; Clarke, 2012; Cruz-Jesus et al., 2016; Gorski, 2005; Hartnett, 2017; Teo & Divakar, 2021; Youssef et al., 2022). With the rapid evolution of technology and digital learning being part of the ecosystem of modern higher education (Alenezi, 2023; Rajaram, 2023), understanding this divide has become crucial, especially within the context of higher education (Van de Werfhorst et al., 2022; Yelland & Neal, 2013). This divide not only encompasses access to digital devices and the internet (Clarke, 2012; Hartnett, 2017) but also includes disparities in digital literacy and the effective use of technology for learning and professional development (Jaggars et al., 2021; Morgan et al., 2022).

Recent global events, particularly the COVID-19 pandemic and digital transformation in higher education driven by technological advancement, have intensified the reliance on digital technologies for educational purposes (De Nito et al., 2023; Peres et al., 2023; Sanni et al., 2022; Sato et al., 2023; Rajaram, 2021; Zhou et al., 2023; Zhou & Wolstencroft, 2020). This shift has spotlighted and potentially widened disparities among students from various demographic backgrounds (Jamil & Muschert, 2024; Karakose, 2021), as the digital divide is closely linked to broader societal inequalities (Tewathia et al., 2020). Lack of access to digital technologies and skills exacerbates disadvantages in both education and future employment (Vasilescu et al., 2020), which would have severe ramifications in the larger context of society and its growth, potentially widening social and economic inequalities, and hindering the development of a digitally skilled workforce . Therefore, bridging this gap is crucial for promoting educational equity and socio-economic mobility (Cheshmehzangi et al., 2023; Ucar et al., 2021). In the UK, concerns about equitable access to digital education are particularly pronounced among diverse undergraduate students, raising questions about inclusivity and fairness in educational outcomes (QAA, 2023; Rudolph, 2023, p. 242).

Despite the breadth of studies on the digital divide, there is a notable scarcity of focused research investigating these disparities among UK university students across different years of study and demographic features, particularly concerning widening and non-widening participants and between home and international students. In the context of Connectivism, learning is not only about acquiring information, but about navigating and forming connections within a network of digital resources, tools, and communities (Siemens, 2005). This theory emphasizes that disparities in access to digital tools and skills can limit students' capacity to build and leverage these networks effectively, thereby impacting their learning outcomes. Hence, it is essential to ensure that primary learning resources are readily accessible and that students have ease of mobility within digital networks to facilitate their academic and personal growth. This access supports their engagement and integration into the learning environment, ultimately contributing to optimal student development (Rajaram, 2023). The distinct impact of formal educational resources, like institutional support versus self-learning and online resources, on digital disparities has not been thoroughly examined. To address this gap, we address the following research questions:

(1) Is there a digital divide among undergraduate students across different academic years, between widening and non-widening participants, and between home and international students?

According to Connectivism, a student's ability to access and interact with digital learning communities directly influences their learning potential (Siemens et al., 2020), because the connection empowers students to actively engage in collaborative learning, develop essential digital competencies, and apply knowledge in practical contexts.
(2) What are the support systems available to enhance digital skills? Specifically, how do formal educational resources, like institutional support, compare to self-learning and online resources in mitigating or exacerbating this digital divide? Investigating these support systems aligns with the principles of Connectivism by promoting equitable access to knowledge networks.

In pursuit of answers, we conducted a survey assessing digital literacy, information and communication technologies (ICT) attitudes, and access to digital resources among 595 undergraduate students from various UK business schools. Drawing on Connectivism theory, we conceptualize the digital divide as a multidimensional gap encompassing three dimensions. The first dimension, digital literacy, is essential for students to effectively engage with networked educational environments, serving as the basis for their interaction within digital learning communities (Siemens et al., 2020). The second dimension, students' ICT attitudes, impact their willingness and motivation to form and sustain connections within these communities (Chatterjee & Correia, 2020). The third dimension, access to digital resources, such as institutional support and self-directed online learning tools, supports the students' participation and successful connection to the learning networks (Alam, 2023).

The organization of this paper is as follows: Section Two reviews the existing literature pertinent to the topic. Section Three outlines the research methodology employed in this study. Section Four details the results and subsequent analysis. Section Five discusses the findings, and Section Six concludes the paper by summarizing key insights and suggesting directions for future research.

Literature review

Digital divide among different demographic groups of students

The concept of the digital divide has evolved in recent years, expanding beyond the basic question of access to digital tools (Clarke, 2012; Hartnett, 2017; Yelland & Neal, 2013) and incorporating more nuanced dimensions such as digital skills, proficiency, and effective utilization across various demographic groups (e.g., Afzal et al., 2023; Youssef et al., 2022; Lee, 2024). Inequalities in the usage of digital equipment continue to persist globally (Jamil &

Muschert, 2024; Van de Werfhorst et al., 2022), leading to differentiated educational outcomes (Jaggars et al., 2021; Morgan et al., 2022). The inequalities extend beyond access and competence. According to Ervianti et al. (2023), Morgan (2022), and Pala and Başıbüyük (2023), digital literacy plays a crucial role in determining academic performance. Students with lower digital proficiency face significant hurdles in their educational journey, further compounding pre-existing disadvantages (Karakose, 2021).

These disparities are often tied to socio-economic and educational backgrounds. For example, students from lower-income families often lack adequate access to digital devices, which limits their opportunities to practice and develop digital skills compared to their more privileged peers (Reddick et al., 2020). Additionally, students from educationally underprivileged backgrounds—such as those who attended schools in rural areas with limited technological resources—may not receive sufficient digital training during their early education, resulting in lower proficiency and confidence in using technology for academic purposes (Di Pietro, 2021). These disparities collectively widen the digital divide, limiting students' opportunities for academic achievement and reducing their ability to engage in digital learning environments effectively (Chinta et al., 2024).

Debate on the impact of digital transformation on educational equity

There is an ongoing debate on whether digital transformation in higher education serves to bridge or widen the gap between disadvantaged students and their more privileged peers. On one hand, proponents argue that digital transformation represents a significant opportunity to democratize education, making it more accessible and equitable. Researchers like Clarke (2012), Habashi et al. (2023), Tartaglia (2020), and Yelland and Neal (2013) emphasize that the integration of digital tools in education can offer broader access to learning resources, flexible learning environments, and personalized learning experiences that can benefit all students, especially those who have historically been marginalized. These scholars highlight the potential for digital education to level the playing field by removing traditional barriers to learning, such as geographical limitations, financial constraints, and rigid scheduling.

On the other hand, critics argue that digital transformation may inadvertently perpetuate or even exacerbate the existing digital divide (Chinta et al., 2024; Scatiggio, 2020; Van de Werfhorst et al., 2022). For example, Chinta et al. (2024) caution that AI-driven educational systems and digital platforms may reinforce inequities, leading to discriminatory outcomes against marginalized groups. James et al. (2023) warn that algorithmic decision-making in digital education environments risks reinforcing inequities if not carefully monitored. This debate has gained more attention following the COVID-19 pandemic, which accelerated the transition to online learning and highlighted the existing digital divide, with some researchers warning that these disparities may have been intensified (Karakose, 2021; Jamil & Muschert, 2024).

Connectivism and the digital divide

Connectivism provides a valuable lens for understanding the influence of digital access and networked knowledge on educational outcomes. As proposed by Siemens (2005), Connectivism suggests that knowledge is distributed across a web of connections, and that learning occurs as individuals interact, grow, and adapt within this network. According to Connectivism, knowledge resides in diverse opinions and that learning often happens outside the individual—within digital tools, networks, and other non-human appliances (Goldie, 2016; Siemens, 2004). The ability to form and maintain connections with specialized nodes or information sources is crucial, as is the capacity to locate knowledge ("know-where") rather than merely acquiring information ("know-what" and "know-how") (Siemens, 2004, 2005). In an education setting, a digital divide can emerge when some students lack the access or skills necessary to participate fully in these digital networks, thereby limiting their learning opportunities (Downes, 2022; Siemens et al., 2020).

Existing research underscores how the digital divide affects widening participation students—those from disadvantaged socio-economic backgrounds—often face barriers to accessing digital resources, which restricts their ability to engage with collaborative and networked learning environments (Clarke, 2012; Chinta et al., 2024). These barriers prevent them from effectively connecting with essential knowledge nodes, undermining their educational experience and potential outcomes. Similarly, international students frequently encounter challenges due to unfamiliarity with local digital tools and platforms, compounded by potential gaps in digital literacy shaped by their previous educational systems (Chang et al., 2014; Van De Werfhorst, 2022). From a Connectivism standpoint, the digital divide thus limits these students' ability to connect within the learning network, further widening the gap.

Resources and support to narrow the digital divide

Connectivism advocates for equitable access to digital resources and networked learning opportunities, emphasizing the need for targeted interventions that address the distinct needs of these groups (Downes, 2022). While digital transformation has the potential to either bridge or widen educational gaps, the effectiveness of this process largely depends on the availability and quality of support and resources tailored to the needs of disadvantaged students. The importance of tailored support and resources in addressing the digital divide is underscored by various studies that examine the role of digital tools and strategies in mitigating educational disparities. Clarke (2012) and Tartaglia (2020) highlight that disadvantaged students often turn to online resources as a critical compensatory mechanism to overcome the barriers they face in digital literacy, effectively using digital resources themselves to narrow the existing digital divide.

Moreover, Yelland and Neal (2013) discuss the alignment of digital and social inclusion, emphasizing the need for equitable access to digital tools and resources. Their research demonstrates that providing access to technology is not

enough; there must be a concerted effort to integrate these tools into the broader educational context to ensure that disadvantaged students can fully benefit. This perspective is supported by McAleavy et al. (2020), who argue that in times of crisis, such as during the COVID-19 pandemic, it is crucial for governments and educational institutions to systematically audit the digital divide and implement distance learning regimes that are contextually appropriate. This approach ensures that all students, regardless of background, have access to quality education, even in challenging circumstances. A specific example of digital learning resources is the educational integration on mobile devices. Albert Gómez et al. (2018) illustrate how mobile digital resources (MDR) can enhance the motivation and engagement of students from disadvantaged backgrounds. By leveraging the ubiquity and accessibility of mobile technology, these resources provide a flexible and inclusive learning environment that caters to the needs of students who might otherwise be excluded from digital learning communities.

Gaps in the current literature

While the digital divide between various student groups has been widely studied (e.g., Yelland & Neal, 2013; Afzal et al., 2023, Jamil & Muschert, 2024; Van de Werfhorst et al., 2022), there is still a shortage of empirical research, especially through the Connectivism lens, to explore the current state of digital divide in higher education, with an emphasis on inclusive education (Boyraz & Ocak, 2021; Goldie, 2016; QAA, 2023). Additionally, the evolution of this digital divide over the three academic years has been largely overlooked. Moreover, there is a notable shortage of studies on the effectiveness of resources designed to support various demographic groups, especially disadvantaged students, in navigating and benefiting from digital resources (Selwyn, 2024). Existing literature on the digital divide often assumes a straightforward correlation between access to digital resources and improved educational outcomes, implying that simply providing technology can bridge educational gaps. Through the lens of Connectivism, we illustrate that true digital competency involves not only access but also the ability to effectively engage with and navigate digital networks (Siemens, 2005; Downes, 2022). Widening participation and international students, despite having access to digital tools, often lack the confidence and competencies to integrate fully into these learning networks.

Methodology

Research design and respondents

Our study employed a survey-based design to investigate the impact of digital literacy and ICT attitudes among undergraduate business students in the UK. A total of 595 students from Years 1 to 3 across two UK business schools participated in the survey, with data collected over the period from 2021 to 2023. A random sampling method was used to select participants, ensuring diverse representation across demographic backgrounds.

Demographic information was first collected to capture a comprehensive profile of the participants, including gender, age, English fluency, home student status, and ethnicity, as shown in Figure 1. This chart reveals a nearly equal gender split among participants, with 53.0% male and 46.6% female. Most respondents are aged 19-24 years (91.4%). A significant proportion of the participants are international students (60.3%) and fluent in English (69.8%). Ethnicity data shows a diverse cohort, predominantly Chinese (39.0%), Asian / Asian British (31.6%), and White (13.4%), with other ethnic groups making up a smaller percentage. The survey also investigated whether participants met any widening participation criteria, such as being the first in their family to attend higher education, receiving free school meals, or living in social housing. Figure 2 summarizes these metrics. Notably, 35.8% speak English as a second language, and 15.1% are the first in their family to attend higher education. Other categories, such as those living in social housing (3.4%) and those with a learning difficulty or disability (2.2%), are also represented.

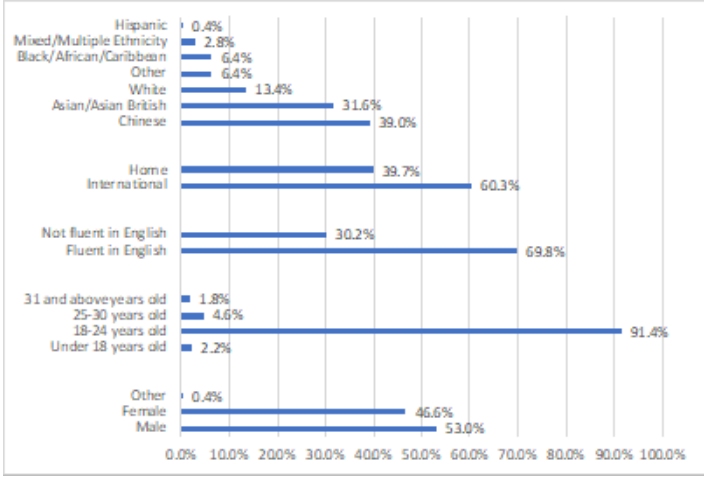


Figure 1. Distribution of participants by gender, age, course, English fluency, home student status, and ethnicity.

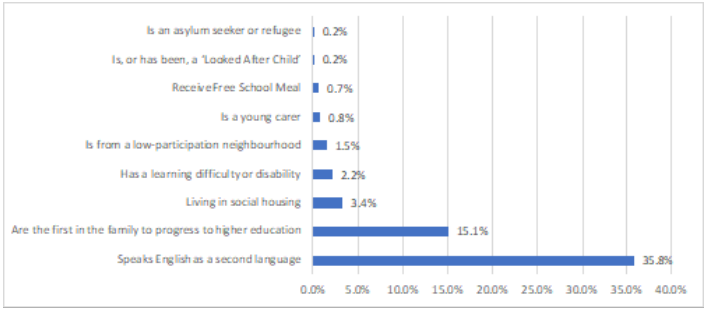


Figure 2. Distribution of participants meeting widening participation criteria.

Measures and instrumentation

Data collection was conducted online to enhance accessibility and encourage participation. We used Qualtrics, an online survey platform, to collect and host the survey data.

Questions regarding digital literacy are detailed in Appendix (Table A1), scaled to a range of 0 to 5 for comparison. We designed our survey questions using a methodological framework informed by the JISC 2019 report (JISC, 2019).

Firstly, students self-assessed their overall digital literacy (Q1) to provide a baseline of their perceived capabilities. Secondly, attitudes towards digital learning were explored through questions (Q2_1 to Q2_7) gauging agreement with statements about ICT in learning, covering aspects like enjoyment, interest, motivation, self-directed learning, and the need for more ICT use by teachers. Thirdly, learning dimensions of digital literacy were examined through questions assessing confidence in technical skills, ability to learn new technologies, familiarity with various ICT tools, and collaboration skills using ICT (Q3_1 to Q3_5 and Q4_1 to Q4_5). The survey also evaluated proficiencies in ICT-based technologies across three categories: productivity tools (Q5_1 to Q5_8), creative tools (Q6_1 to Q6_4), and communication and collaboration tools (Q7_1 to Q7_4).

Finally, two open-ended questions provided deeper insights into the participants' challenges and the resources they use related to digital literacy and technology. The first question, "Have you encountered technical problems using the technologies? If yes, how did you resolve the problem?" (Q8_1) aimed to understand the challenges faced by students and the strategies they employed to overcome these issues. The second question, "How do you gain your digital skills?" (Q8_2) explored their learning processes and resources. A thematic analysis of these responses identified recurring themes, uncovering patterns and insights.

Procedures and ethical considerations

Prior to the large-scale data collection, a pilot test was conducted to refine the survey and ensure the clarity of the questions. Ethical approval was obtained from the two participating institutions. Measures were in place to protect the anonymity and confidentiality of respondents, fostering an environment conducive to honest responses. Informed consent was obtained from all participants before the survey.

Data analysis strategy

The quantitative data was processed to draw insights into digital literacy levels across demographic groups, focusing on widening participants vs. non-widening participants and home vs. international students. ANOVA and t-tests were utilized to compare digital literacy across students from various academic years and among distinct demographic groups. Thematic analysis was applied to open-ended responses, which helped in identifying patterns in students' digital skill acquisition and problem-solving strategies.

Findings

Existence of the digital divide

We find there is an existence of a digital divide across different demographic groups, particularly across different academic years, between widening and non-widening participants, and between international and home students.

Digital divide across years

We find a significant gap across students of different years. The detailed results are presented in Table 1, where we used ANOVA to compare the three groups. The significant colour coding in Table 1 indicates significance levels, with lighter colours representing higher significance: dark grey for non-significance, light grey for significance at 5%, and white for significance at 1%. Figure 3 displays the mean values for all questions across the three academic years.

Table 1. ANOVA results comparing digital literacy across students from different academic years.

	Variable	Year 1 Mean	Year 2 Mean	Year 3 Mean	F-statistic	p-value	Multiple Comparisons
Overall digital literacy	Q1	3.1524	3.3620	3.1076	3.4469	0.0325	Year 2>Year 1>Year 3
Students' attitudes to digital learning	Q2_1	3.5064	3.4041	3.3247	1.7859	0.1686	Year 1=Year 2=Year 3
	Q2_2	3.3142	3.2363	3.1477	1.8050	0.1654	Year 1=Year 2=Year 3
	Q2_3	3.5344	3.4000	3.3867	1.6697	0.1893	Year 1=Year 2=Year 3
	Q2_4	3.2956	3.2086	3.1881	0.7957	0.4518	Year 1=Year 2=Year 3
	Q2_5	3.4610	3.5613	3.3757	1.4772	0.2292	Year 2=Year 1=Year 3
	Q2_6	3.8349	3.9502	3.9196	0.7767	0.4604	Year 2=Year 3=Year 1
	Q2_7	3.5026	3.5438	3.3927	1.0587	0.3476	Year 2=Year 1=Year 3
Learning dimensions of digital literacy	Q3_1	2.9153	3.2354	2.8137	6.8824	0.0011	Year 2>Year 1>Year 3
	Q3_2	3.3504	3.5356	3.2583	3.2996	0.0376	Year 2>Year 1>Year 3
	Q3_3	3.3060	3.4724	3.1906	3.3718	0.0350	Year 2>Year 1>Year 3
	Q3_4	2.9157	3.2618	2.7717	9.3168	0.0001	Year 2>Year 1>Year 3
	Q3_5	3.1527	3.4456	3.2722	3.3929	0.0343	Year 2>Year 3>Year 1
	Q4_1	3.0233	3.5621	3.1430	16.7813	0.0000	Year 2>Year 3>Year 1
	Q4_2	3.4267	3.8512	3.3848	16.4801	0.0000	Year 2>Year 1>Year 3
	Q4_3	3.3583	3.8009	3.2194	18.2353	0.0000	Year 2>Year 1>Year 3
	Q4_4	3.5323	3.8744	3.4893	9.0534	0.0001	Year 2>Year 1>Year 3
	Q4_5	3.2851	3.4003	3.2201	1.2088	0.2993	Year 2=Year 1=Year 3
Productivity tools	Q5_1	2.9573	3.5322	3.2139	13.9462	0.0000	Year 2>Year 3>Year 1
	Q5_2	2.6122	3.0146	2.9067	8.6517	0.0002	Year 2>Year 3>Year 1
	Q5_3	3.1214	3.5829	3.3553	12.0525	0.0000	Year 2>Year 3>Year 1
	Q5_4	3.2878	3.6579	3.2286	9.5293	0.0001	Year 2>Year 1>Year 3
	Q5_5	3.4960	3.8533	3.4226	10.7020	0.0000	Year 2>Year 1>Year 3
	Q5_6	3.3216	3.6233	3.4293	5.6264	0.0038	Year 2>Year 3>Year 1
	Q5_7	3.4229	3.7849	3.4083	9.1011	0.0001	Year 2>Year 1>Year 3
	Q5_8	3.2612	3.4958	3.4471	3.5213	0.0302	Year 2>Year 3>Year 1
Creative tools	Q6_1	2.0349	2.1294	2.1505	0.6999	0.4971	Year 3=Year 2=Year 1
	Q6_2	2.1114	2.2349	2.2492	0.9467	0.3886	Year 3=Year 2=Year 1
	Q6_3	1.4971	1.6350	1.6921	1.7636	0.1724	Year 3=Year 2=Year 1
	Q6_4	3.0571	3.4929	3.2574	7.6445	0.0005	Year 2>Year 3>Year 1
Communication and collaboration tools	Q7_1	3.5569	4.0362	3.4486	17.6294	0.0000	Year 2>Year 1>Year 3
	Q7_2	3.7743	4.1424	3.7818	8.0106	0.0004	Year 2>Year 3>Year 1
	Q7_3	3.7932	4.1385	3.7458	8.8358	0.0002	Year 2>Year 1>Year 3
	Q7_4	3.2142	3.5319	3.3615	5.2903	0.0053	Year 2>Year 3>Year 1

Note: A lighter colour implies higher significance. Dark grey cells imply non-significance, light grey cells imply significance at 5%, and white cells imply significance at 1%.

Year 2 students exhibited the highest digital literacy (Q1) with an average score of 3.3620, exceeding Year 1's 3.1524 and Year 3's 3.1076, a statistically significant outcome (p=0.0325). This unexpected result suggests that Year 2 students, having adjusted to the university's digital resources, are not yet challenged by the complexities of Year 3, where students nearing the workforce perceive a skills gap.

Students' attitudes towards digital learning (questions Q2_1 through Q2_7) showed no notable yearly changes, suggesting consistent ICT exposure across academic years.

In digital learning dimensions (Q3_1 to Q4_5), Year 2 students again scored highest. Notably, in ICT problem-solving (Q3_1) and creating digital artifacts (Q3_5), they scored 3.2354 and 3.4456 respectively, outperforming other years. This high performance did not carry into Year 3, potentially due to an increased focus on imminent job market challenges and perceived gaps in practical applications of their skills.

Productivity tools usage was highest in Year 2 across all tasks, with word processing (Q5_1) scoring 3.5322. This peak performance extends to their use of spreadsheets and presentations. Year 3's lower scores reflect a focus shift toward final projects and job preparations.

Creative tools such as video and photo editing showed no significant yearly differences, maintaining consistently low confidence levels across all academic years. The lack of

improvement in creative skills, notably in video and photo editing, suggests inadequate integration of creative ICT tools in the curriculum.

For communication and collaboration tools, Year 2 scored highest at 4.0362 in using social media for education, emphasizing effective engagement and collaboration. Year 3's lower scores may indicate prioritization of individual job readiness over collaborative skills, indicating a need for enhancing participation in digital learning communities in the final year.

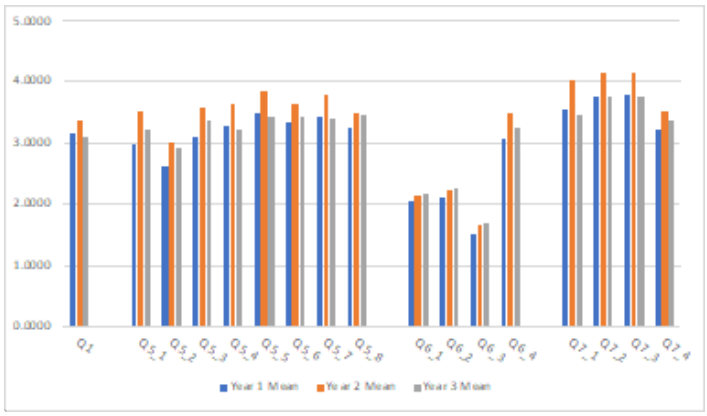
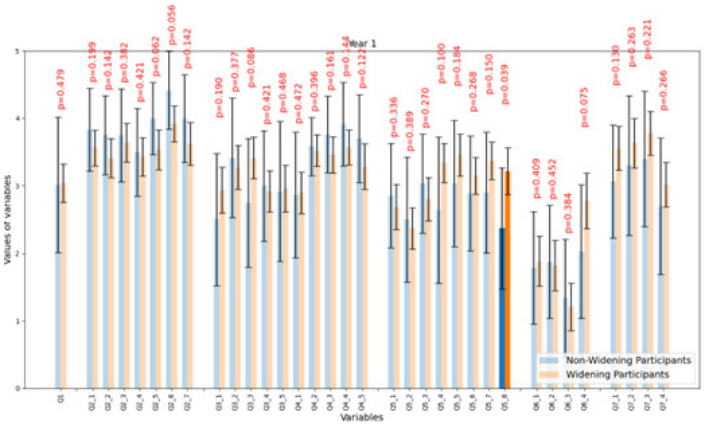


Figure 3. Comparison of the scores in proficiency of ICT-based technologies and digital literacy.

These results highlight the digital proficiency gap between different years, with Year 2 students generally exhibiting higher confidence and skills in digital literacy.

Enlarging digital divide between widening and non-widening participants

T-tests were conducted for each question to assess disparities in digital literacy between widening and non-widening participants. The results, shown in Figure 4, use bar colour intensity to signify statistical significance: darker bars indicate significant differences at the 5% level, and lighter bars denote non-significance. Organized by academic year, the top, middle, and bottom plots of Figure 4 represent Year 1, Year 2, and Year 3 students, respectively. Each pair of bars has a 95% confidence interval, emphasizing the variability around the mean differences, with corresponding p-values displayed above. Standardizing all values to a 0-5 scale facilitates direct comparison across questions.



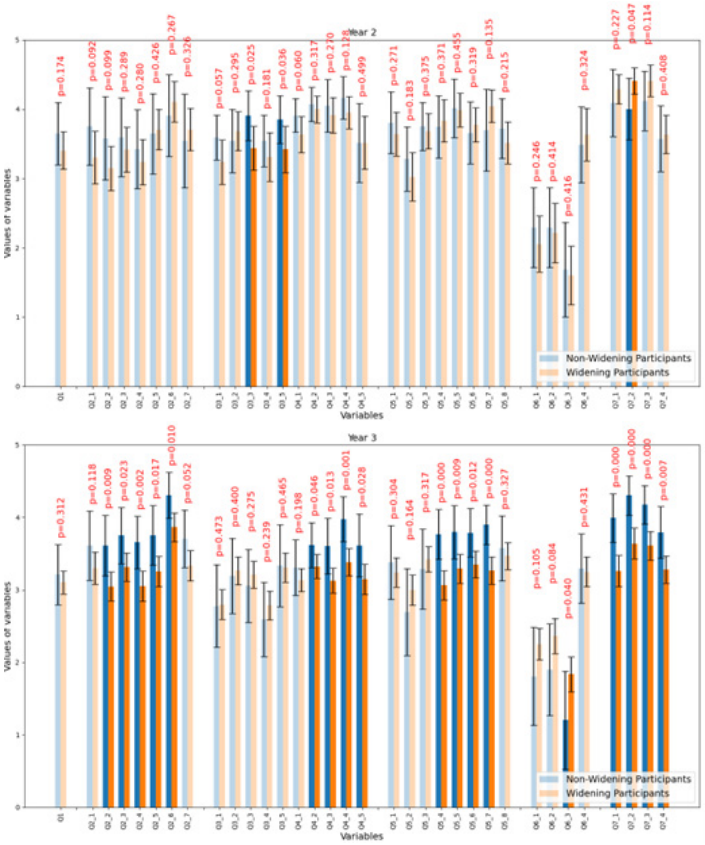


Figure 4. Temporal analysis of the enlarging digital divide between widening and non-widening participants across three academic years.

Note: Darker-coloured bars denote significant differences at the 5% level, while lighter-coloured bars represent non-significant outcomes. The top plot depicts Year 1 students, the middle plot for Year 2, and the bottom for Year 3. The height of the bars shows the mean value. A 95% confidence interval accompanies each pair of bars for the questions, and the p-values from the t-tests are prominently displayed above these bars. All values have been rescaled to a 0-5 range.

Year 1 students displayed minimal differences in digital literacy between widening and non-widening groups, with a notable exception in Q5_8, where widening participants excelled in using learning management systems, such as Moodle, Locate, or the University student portal.

For Year 2 students, significant differences shifted towards learning dimensions of digital literacy and communication tools. Non-widening participants performed enhanced abilities in adapting to new technologies (Q3_3) and using ICT for learning and creating digital artifacts (Q3_5). Conversely, widening participants exhibited superior skills in instant messaging technologies (Q7_2), reflecting a stronger inclination towards maintaining social connections digitally, which is less academically focused.

In Year 3, the disparity widened significantly, with non-widening participants excelling in 17 out of 34 metrics. This suggests that educational support systems are benefiting non-widening participants more, allowing them to advance more rapidly in areas ranging from basic digital literacy (Q1) to

ICT competencies across multiple domains such as attitudes to digital learning (Q2_1 to Q2_7), learning dimensions of digital literacy (Q3_1 to Q3_5, Q4_1 to Q4_5), and proficiency in productivity and creative tools (Q5_1 to Q5_8, Q6_1, Q6_2, Q6_4). The exception was Q6_3, concerning web design software, where widening participants scored higher.

The initial uniformity in digital skills suggests an equitable beginning; however, the trajectory favouring non-widening participants raises questions about the inclusivity and effectiveness of current educational strategies aimed at widening participants.

Digital divide between international and home students

We conducted a similar analysis comparing the digital literacy and proficiency of home versus international students (see Figure 5) but did not examine trends across the three academic years due to the absence of a clear temporal pattern.

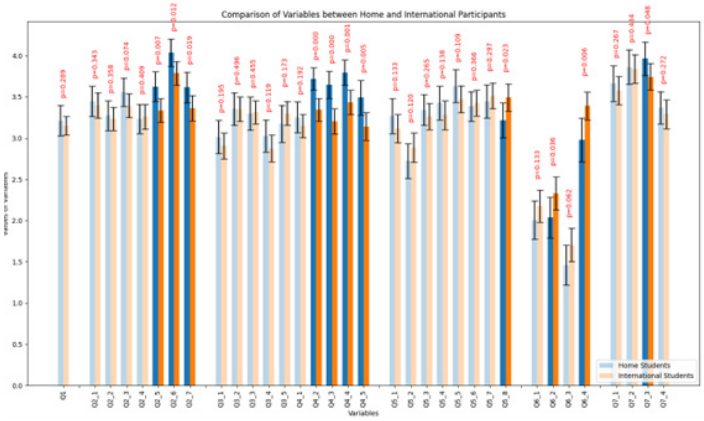


Figure 5. The digital divide between home and international students.

Note: Darker-coloured bars denote significant differences at the 5% level, while lighter-coloured bars represent non-significant outcomes. The height of the bars shows the mean value. A 95% confidence interval accompanies each pair of bars for the questions, and the p-values from the t-tests are prominently displayed above these bars. All values have been rescaled to a 0-5 range.

Home students demonstrated a robust foundation in digital literacy, excelling in areas such as self-directed learning through ICT, leveraging mobile technologies for learning, and advocating for more ICT integration by teachers, as evidenced by their higher scores in Q2_5, Q2_6, and Q2_7. Furthermore, their proficiency in navigating web-based resources, evidenced by higher scores in Q4_2, Q4_3, and Q4_4, and their adeptness at collaborating online, as seen in Q4_5 and Q7_3, underscore their stronger foundation in digital literacy. This advantage is likely due to consistent exposure to the national education system aligned with their university's digital tools.

International students outperformed in productivity and creative tools such as using learning management systems (Q5_8), photo and image editing software like Photoshop (Q6_2), and content marketing skills involving blog posts and YouTube (Q6_4), reflecting their diverse educational backgrounds might emphasize practical digital tool usage. However, they faced challenges in self-directed learning and ICT integration.

Digital literacy-related support and resources

The former findings highlighted a significant digital divide between widening and non-widening participants, as well as between home and international students. These gaps underscore the need for tailored support mechanisms that can bridge these divides and ensure equitable access to digital competencies. This section delves into the types of support and resources that are currently in place and evaluates their effectiveness.

Encountering and resolving technical problems using technologies

The survey responses to Q8_1, "Have you encountered technical problems using the technologies? If yes, how did you resolve the problem?", reveal significant insights into the experiences of widening and non-widening participants across different academic years. The themes derived from thematic analysis and the comparison of technical problem resolution between widening and non-widening participants for Year 1 and Year 3 are reported in Figure 6.

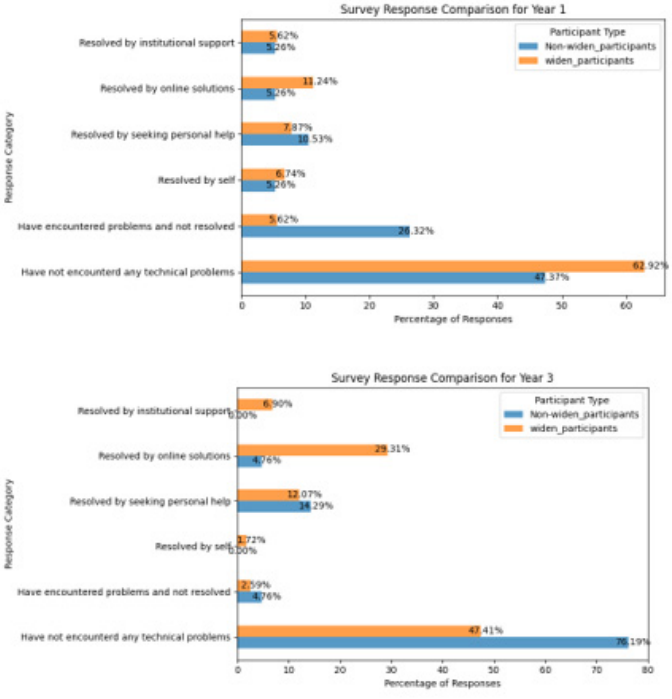


Figure 6. Comparison of technical problem resolution between widening and non-widening participants for Year 1 and Year 3.

In Year 1, widening and non-widening participants had similar rates of resolving technical issues through institutional support and personal help. However, a notable difference was observed in the "have not encountered any technical

problems" category, with 62.92% of widening participants reporting no issues compared to only 47.37% of non-widening participants. Additionally, a significant disparity was seen in unresolved problems—26.32% of non-widening participants did not resolve their issues, compared to only 5.62% of widening participants. Widening participants also utilized online solutions for problem resolution (11.24%) more frequently compared to non-widening participants (5.26%).

By Year 3, the disparity widened: 76.19% of widening participants reported no technical problems, significantly higher than 47.41% of non-widening participants. The use of online solutions increased markedly for widening participants to 29.31%, compared to just 4.76% for non-widening participants. The findings suggest a growing proficiency and proactive approach among widening participants in using online resources to resolve issues, contrasting with higher unresolved problems among non-widening participants.

Both groups similarly addressed technical issues, though widening participants showed a more proactive approach in Year 1. By Year 3, a notable shift occurred: a greater share of widening participants reported no technical issues and made more use of online solutions. This increase might seem to *contradict* the observed broadening digital divide from earlier sections, where widening participants appeared disadvantaged. However, these earlier assessments involved comprehensive digital literacy aspects such as overall proficiency and specific skill sets, while Q8_1 focused solely on technical problem-solving. Widening participants have developed effective strategies for dealing with technical issues via online solutions, even if their general digital proficiency remained lower. Further discussion on the apparent contradiction will be discussed in Section 4.2.2.

Figure 7 reports on how international and home students tackled technical issues during their studies. For Year 1 students, more international students (63.33%) did not have technical problems than home students (55.32%). Both groups were similarly inclined to seek personal help, around 8.3% each, but international students more frequently resolved issues online (12.77% vs. 8.33%). They also outpaced home students in self-resolving issues (10.64% vs. 3.33%).

For Year 3 students, the usage of online solutions rose for international students (28.87%) compared to home students (17.50%), and the gap in encountering no technical problems closed between the groups. Consistently, around 12.4% of each group sought personal help. Minor differences in institutional support usage persisted, and fewer students from both groups resolved issues independently, with international students at 1.72% and home students at none. The percentage of students not encountering any technical problems nearly equalized, with 51.55% of home and 52.50% of international students reporting no issues.

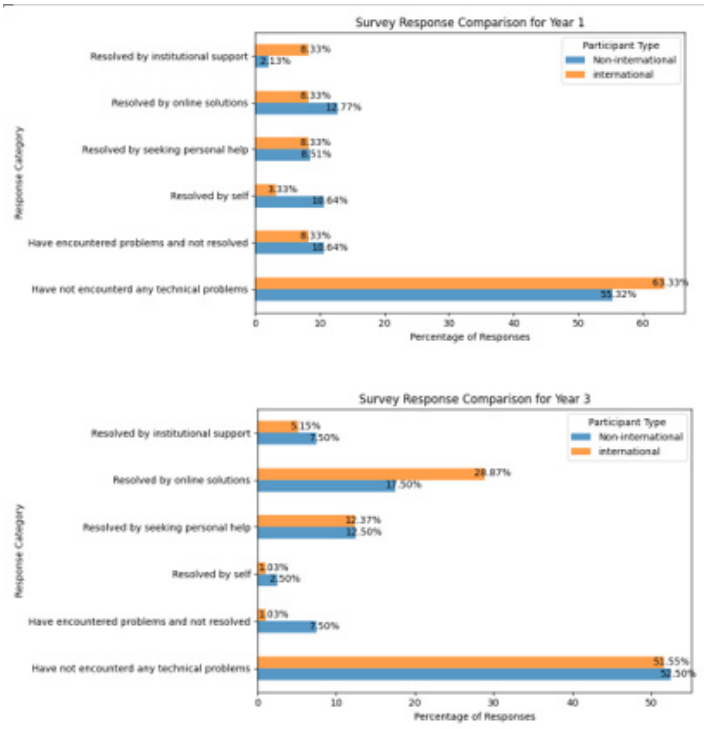


Figure 7. Comparison of technical problem resolution between home and international students for Year 1 and Year 3.

Acquiring digital skills

The survey responses to Q8_2 "How do you gain your digital skills?" reveal notable differences in the methods used by widening and non-widening participants across different academic years. The seven themes identified from the thematic analysis and the comparison between the two groups are reported in Figure 8. The Year 1 data show non-widening participants more frequently embracing self-learning (52.38%) compared to widening participants (38.46%). Online resources are also widely utilized by both groups, though slightly more by widening participants (26.92% vs. 23.81%). There is a stark contrast in reliance on formal education, with 19.23% of widening participants using it, far more than non-widening participants at 4.76%. Notably, a higher proportion of widening participants (9.52%) adopt mixed learning methods than non-widening participants (1.28%), with some reporting no access to digital learning opportunities (7.69% widening vs. 9.52% non-widening).

For Year 3 students, preferences shift notably; 50% of non-widening participants depend heavily on formal education, a significant rise from Year 1. Conversely, widening participants' use of online resources increases to 34.75%. In contrast, only 4.17% of non-widening participants engage with online resources, indicating a decline. Self-learning rates decrease among non-widening participants to 25%, while 23.73% of widening participants persist with this method. Moreover, non-widening participants more commonly use mixed methods (16.67%) compared to widening participants (8.47%). Interestingly, by the third year, all non-widening participants report some access to digital skills development, unlike a small percentage of widening participants (3.39%) who still find themselves

without opportunities. This evolution underscores a growing divergence in learning strategies between the two groups over their academic journey.

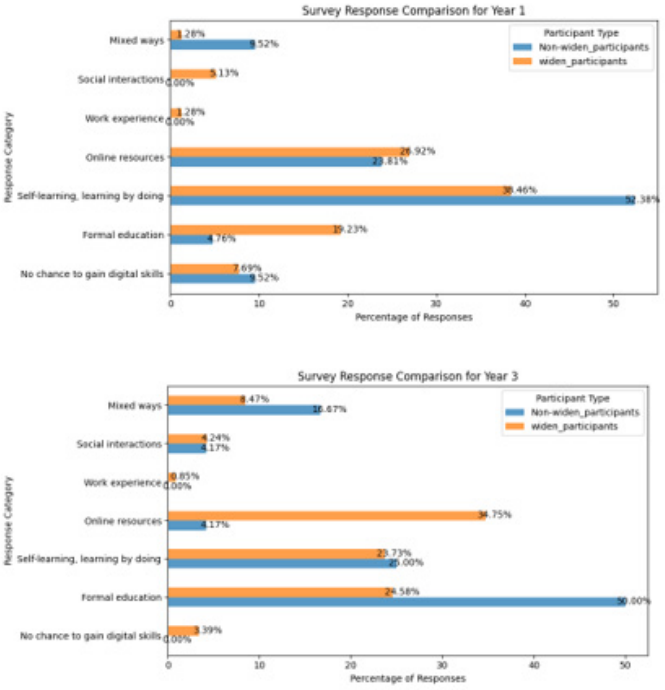


Figure 8. Comparison of resources on gaining digital skills between widening and non-widening participants for Year 1 and Year 3.

After three years of undergraduate education, non-widening participants heavily relied on formal education to develop their digital skills, while widening participants depended more on online resources. This observation is consistent with the results of Q8_1, where non-widening participants showed a higher percentage of encountering and resolving technical problems using institutional support. The contradiction noted earlier, where non-widening participants were found to be in a better situation regarding overall digital literacy, can be explained by this reliance on formal education. While formal higher education appears to favour non-widening participants, thereby enlarging the digital divide, widening participants have been compensating by turning to online resources to bridge this gap. This will be discussed further in Section 5.2.

Figure 9 illustrates these differences between home and international students over the years. For Year 1 students, a significant percentage of international students (29.82%) reported using online resources to gain digital skills, compared to 19.51% of home students. International students also showed a higher reliance on formal education (21.05%) compared to home students (9.76%) in Year 1. Conversely, a higher percentage of home students (51.22%) engaged in self-learning and learning by doing compared to home students (35.09%).

In Year 3, the patterns evolved. The reliance on online resources remained high for international students (36.27%) and decreased for home students (12.50%). Meanwhile, the percentage of students relying on formal education grew

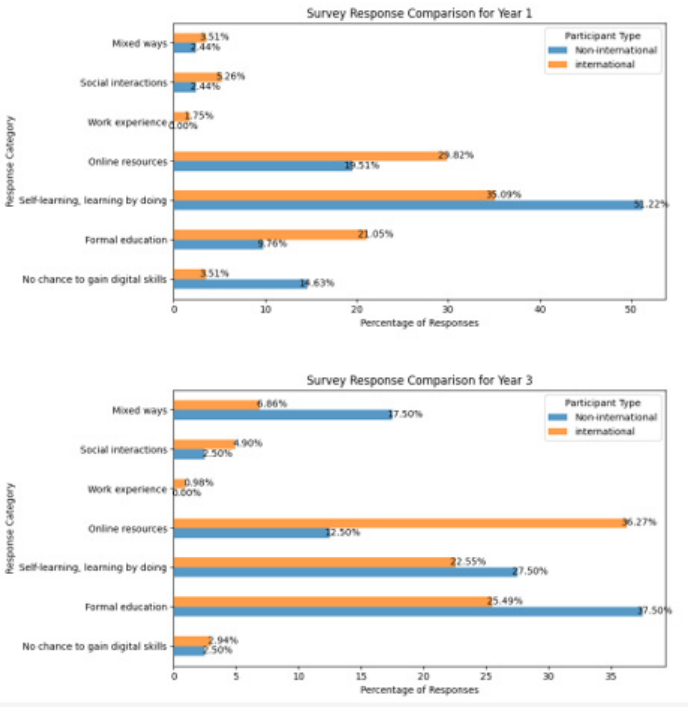


Figure 9. Comparison of resources on gaining digital skills between home and international students for Year 1 and Year 3.

for both groups but remained higher for home students (37.50%) compared to international students (25.49%). The engagement in self-learning and learning by doing showed a notable decrease, with 27.50% of home students and 22.55% of international students adopting this method.

International students consistently relied more on online resources throughout their academic journey, likely due to their need for flexible and accessible learning options. Home students, on the other hand, increasingly benefited from formal education, reflecting possibly better integration into structured educational support systems. These findings highlight the need for tailored support strategies that address the distinct preferences and needs of international and home students in acquiring digital literacy.

Discussion

Our study aims to examine the digital divide across various demographic backgrounds and evaluate the effectiveness of the existing digital support and resources available to students. The findings reveal an expanding digital divide, aligning well with the existing research on the prevalence of digital inequalities (e.g., Jamil & Muschert, 2024; Van de Werfhorst et al., 2022). These disparities often result in discriminatory outcomes, as the digital divide may inadvertently perpetuate existing biases (Chinta et al., 2024; Scatiggio, 2020; Van de Werfhorst et al., 2022) and can significantly affect educational outcomes (Jaggars et al., 2021; Morgan et al., 2022; Youssef et al., 2022). Our study specifically focuses on the progression of this gap over a three-year academic journey, which has rarely been explored in previous research. Additionally, extending existing studies on strategies to narrow the Digital divide

(e.g., Afzal et al., 2023; Khan et al., 2023), we assess existing support mechanisms and their efficacy in addressing these disparities and propose strategic measures to mitigate them effectively.

The Digital divide through the theoretical lens of Connectivism

Through the lens of Connectivism, our research contributes to the ongoing debate regarding the impact of digital transformation on educational disparities (Clarke, 2012; Habashi et al., 2023; Karakose, 2021; Tartaglia, 2020; Yelland & Neal, 2013). In the context of undergraduate students in the UK, we show that digital transformation exacerbates the digital divide over three academic years and between widening and non-widening students. Additionally, our findings provide a granular perspective, revealing distinct areas of strength between home and international students. Echoing studies on Connectivism (e.g., Downes, 2022; Siemens et al., 2020), this widening divide reflects unequal access to the digital networks and resources essential for knowledge acquisition and skill development. Widening participation students, often from disadvantaged backgrounds, and international students face specific barriers in effectively integrating into the digital learning environment due to limited familiarity with or access to institutional digital support (Chinta et al., 2024). This hinders their capacity to form and sustain the connections needed for continual learning, as Connectivism emphasizes (Siemens, 2004, 2005; Goldie, 2016). The distinct digital skills gap, where home students excel in areas such as collaborative digital tools while international students perform better in creative digital skills, suggests that students' digital literacy development is unevenly supported by the current educational infrastructure.

The following discussion will offer targeted solutions and recommendations based on our empirical findings, aimed at enhancing students' capacity to establish and sustain connections within digital knowledge networks, as highlighted by Connectivism principles.

The enlarging digital divide over the three years — continuous self-assessment

Our findings reveal that Year 2 students exhibited the highest confidence in their digital skills, a proficiency that unexpectedly declined by Year 3. This decline could be attributed to a range of factors, including the increased academic and practical demands encountered in the final year, which may challenge students' existing competencies. One possible explanation is that while Year 2 students may feel confident with their foundational digital skills, they may experience a sudden realization of unmet advanced skill requirements as they approach real-world applications and career-related tasks. This pattern suggests a potential gap in ongoing digital skill development and support tailored to evolving academic and professional expectations. An alternative explanation might be the pressure of increased academic workload and preparation for post-graduate opportunities, which could shift focus away from digital skill development. Potential confounding factors may include variations in support provided across academic years, differences in exposure to internships or practical work experiences, or individual differences in adaptability to digital demands.

Inspired by the research of self-assessments and tracking students' learning analytics (Ifenthaler et al., 2023), this observation underscores the urgent need for continuous self-assessment to prevent last-minute surprises in the final year, which often proves too late for effective intervention. Implementing regular feedback mechanisms and adaptive learning modules could help students identify and address their skill gaps in real time, ensuring they are better equipped for both academic and professional challenges. Such strategies would also contribute to a more resilient and capable graduate cohort.

The enlarging digital divide between widening and non-widening participants — effective support mechanisms for evolving needs

Our study illuminates a concerning trend where the digital divide between widening and non-widening participants expands throughout undergraduate education, aligning well with existing research (e.g., Judijanto et al., 2022; Lee, 2024; Salas-Pilco et al., 2022). Initially, students enter their academic journey on generally equal footing regarding digital literacy. However, a significant divergence emerges as they progress, heavily favouring non-widening participants. This growing disparity points to potential flaws within the educational system, particularly in how it supports students who meet widening participation criteria. Such students often come from backgrounds that might already pose barriers to academic and technological access, and the failure to address these barriers adequately throughout their university tenure contributes to their lagging behind their peers.

The increasing gap underscores the necessity for educational strategies that align and adapt to meet their evolving needs through targeted interventions. Schools may implement more effective support mechanisms, such as personalized learning plans (Shemshack et al., 2020; Pratama et al., 2023) and enhanced access to digital resources, which cater specifically to the needs of widening participants. Additionally, continuous monitoring and adjustment of educational strategies will be crucial to ensure that all students can thrive in an increasingly digital learning environment as suggested by Connectivism, fostering a more inclusive digital learning community.

The digital divide between home and international students across different types of digital skills — tailored support

We find that home students excel in utilizing ICT for cooperation and advocating for increased ICT integration in education, benefiting from the alignment between their national education systems and university resources. In contrast, international students demonstrate superior skills in creative tools, reflecting their diverse educational backgrounds, but they face challenges in self-directed

learning and ICT integration. Our findings complement research on the challenges faced by international students in the post-pandemic era (Steyn & Gunter, 2023; Zhao & Xue, 2023), highlighting the distinct strengths and challenges encountered by home and international students in digital literacy.

The finding underscores the necessity for tailored support strategies to ensure all students can fully benefit from digital resources, e.g., enhancing support for home students in creative digital skills such as photo editing and content marketing. For international students, greater access to and integration with the institution's broader ICT resources would help improve their digital competencies. This approach resonates with the findings of Rodríguez-Abitia et al. (2020), who highlight that contextual factors are crucial in determining how effectively an institution can leverage technology to enhance its education quality.

Digital support and resources — developing adaptive skills, integrating online resources into curriculum, and preventing technological stagnation

The previous discussions underscored the significant digital divide among different student demographics. This emphasizes the necessity for customized support and resources to bridge these divides.

For widening participants and international students, there is a clear benefit in enhancing access to robust online learning platforms and resources, coupled with support systems that encourage self-directed learning and problem-solving. This finding aligns with Tartaglia (2020) and Clarke (2012), who observed that disadvantaged students increasingly turn to online and digital resources as a means to bridge the digital divide.

This apparent contradiction to the broader digital divide observed in earlier sections, where widening participants were generally at a disadvantage, highlights a critical aspect of digital literacy: the capacity to adapt and utilize available resources to solve problems (Green et al., 2020; Sato et al., 2023). It indicates that widening participants and international students, perhaps out of necessity or facilitated by targeted interventions, become adept at navigating online platforms and tools, which may not be captured fully by traditional measures of digital literacy. This adaptation may serve as a compensatory mechanism, allowing these students to bridge gaps in their digital skills independently. Given these observations, educational strategies should focus on the development of such adaptive skills early in the educational journey. Providing robust online resources, coupled with training on how to effectively use these tools, could significantly benefit widening participants. For international students, the sustained use of online resources suggests that institutions integrate these online resources more deeply into the curriculum to support them better. This strategy echoes existing literature recommending the integration of technology into teaching (Ashour, 2020; Rajaram, 2021, Rajaram, 2023). Furthermore, fostering an educational environment that encourages experimentation and self-directed learning with digital tools might help reduce the initial disparities observed and prepare all students more equally for the technological demands of the modern workplace.

It is notable that formal educational resources, such as institutional support and formal education, tend to favour non-widening and home students, possibly due to these groups having better access to or familiarity with the educational system's infrastructure. The finding extends Hoare and Johnston (2011) and O'Toole et al. (2024) on how students get formal education resources and gain a sense of fit with institutional systems. This discrepancy further calls for a reassessment of how support services are distributed and tailored, ensuring that interventions effectively address students' unique needs to bridge the digital divide truly.

For home and non-widening students, efforts might focus more on challenging the existing competencies and pushing the envelope on incorporating advanced digital tools and collaborative platforms into the learning experience to prevent technological stagnation (Zhao, 2009; Cucinelli & Farhan, 2024).

Conclusion

Our study offers insights into the digital divide among undergraduate students from various demographic backgrounds across UK universities, particularly within business schools. The analysis illuminates that the digital divide evolves throughout students' academic journeys, with students facing a stark realization of their insufficient digital competencies when transitioning into job markets. This realization underscores a critical need for enhanced practical digital skills to meet real-world demands and continuous self-assessment. Furthermore, the disparities between the widening participants and their peers not only endure but broaden. The distinction between home and international students is particularly nuanced, with each cohort excelling in specific digital competencies, which suggests differentiated educational needs and supports. Overall, our study findings suggest that addressing the digital divide requires proactive, tailored interventions that evolve with students' academic progress, particularly for widening participants, while also recognizing and leveraging the distinct digital strengths of home and international students to foster a more inclusive educational environment.

Theoretical implications

Through the theoretical lens of connectivism, our findings enrich the ongoing discussion on the role of digital educational resources in either mitigating or exacerbating the digital divide (Clarke, 2012; Habashi et al., 2023; Karakose, 2021; Tartaglia, 2020; Yelland & Neal, 2013). By conceptualizing digital competency as more than mere access to technology—encompassing the skills required to engage and navigate digital networks effectively—our findings challenge the common assumption in the existing literature that access to digital resources alone can bridge educational gaps. This perspective underscores the importance of providing resources and cultivating the skills

necessary for students to fully integrate into digital learning environments. We found that formal educational resources often do not equally meet the needs of all student groups, with widening participation and international students tending to rely more on online resources than on institutional support. This insight underscores the need for educational institutions to reassess their support structures to ensure they are inclusive and accessible to all students (QAA, 2023), so as to enhance students' capacity to establish and sustain connections within the digital learning communities (Siemens, 2005; Siemens et al., 2020).

Broader practical implications beyond UK universities

Our research contributes to the existing body of literature by investigating how the digital divide evolves across different academic years. While prior studies have predominantly addressed global disparities in digital access and equipment usage (Hartnett, 2017; Jamil & Muschert, 2024; Van de Werfhorst et al., 2022), our study offers a more nuanced exploration of the evolution of digital skills across the three academic years, within the context of UK higher education.

The digital divide faced by widening participation and international students is not unique to the UK; similar challenges have been documented in other countries experiencing rapid digital transformations in their education systems (e.g., Jamil & Muschert, 2024), especially when students have diverse learning requirements (Tomlinson, 2014). For instance, students in countries with less developed digital infrastructure often struggle with equitable access to learning technologies, which reinforces socio-economic inequalities (Akinlar et al., 2023; AlSadrani et al., 2020; Cheshmehzangi et al., 2023; Tewathia et al., 2020; Ucar et al., 2021).

Our findings and proposed solutions can be applied internationally, considering contextual differences across regions. First, continuous self-assessment is crucial globally for identifying and addressing issues early, allowing institutions to implement targeted interventions that more effectively bridge the digital divide (Chang et al., 2004). Providing tailored support for different demographic groups is another key area for global application. Additionally, fostering adaptability in students serves as a vital compensatory mechanism for those who are disadvantaged in their digital skills (Kholiavko et al., 2021). Integrating adaptive digital skills and online resources into curricula is vital to prevent technological stagnation, particularly in developed countries, where ensuring that educational practices keep pace with technological advancement is crucial for inclusive educational progress.

Limitations and future research

While our study offers valuable insights, it is not without limitations. The scope of our research was confined to a specific group of students within UK business schools. The study primarily reflects the experiences of students in specific institutional settings, which may not fully represent the diverse experiences of students across different regions and academic areas. Additionally, the use of self-reported data introduces potential bias, as participants' responses may be influenced by personal perceptions, which could impact the objectivity of the results. Future research could expand on this by including a broader range of students from different disciplines and conducting longitudinal studies to assess the long-term impact of digital literacy on academic performance.

Moreover, our study primarily focused on the quantitative analysis of digital literacy. Future studies could benefit from incorporating qualitative methods to gain a deeper understanding of students' personal experiences and challenges in developing digital skills.

Furthermore, this study did not incorporate questions or discussions on Generative AI (GenAI) since the survey questionnaire was designed before its widespread use. As AI technologies—particularly GenAI—are becoming more prevalent, it would be beneficial to explore their impact on higher education (e.g., Chaka, 2024; Mills et al., 2023; Rudolph et al., 2023; Sevnarayan & Potter, 2024). Future studies should investigate how GenAI tools like ChatGPT influence students' learning processes, potentially reshaping fair and inclusive education (Rudolph, 2023, p. 424).

Finally, the exploration of the ethical and social dimensions of digital literacy, specifically in the digital divide and "digital poverty" aspects (Manduna, 2016; Setthasuravich & Kato, 2020), could add value as an essential layer to this important ongoing conversation. Addressing these issues from a more inclusive and accessible standpoint would provide a more comprehensive view of the digital landscape in higher education. Overall, these areas represent promising avenues for further exploration to build on our findings.

Appendix

Table A1. Questions from the survey on students' digital literacy, ICT attitudes towards digital learning experiences, and digital resources and support.

Overall digital literacy	
Q1	How would you rate your digital literacy on a scale of 0-5? 0 is very poor and 5 is that you are an expert
Students' attitudes to digital learning	
Q2_1	Please indicate how agreeable you are with the following by circling the appropriate number at right. 0 is strongly disagree and 5 is strongly agree. - I like using ICT for learning
Q2_2	Please indicate how agreeable you are with the following by circling the appropriate number at right. 0 is strongly disagree and 5 is strongly agree. - I learn better with ICT
Q2_3	Please indicate how agreeable you are with the following by circling the appropriate number at right. 0 is strongly disagree and 5 is strongly agree. - ICT makes learning more interesting
Q2_4	Please indicate how agreeable you are with the following by circling the appropriate number at right. 0 is strongly disagree and 5 is strongly agree. - I am more motivated to learn with ICT
Q2_5	Please indicate how agreeable you are with the following by circling the appropriate number at right. 0 is strongly disagree and 5 is strongly agree. - ICT enables me to be a self-directed and independent learner
Q2_6	Please indicate how agreeable you are with the following by circling the appropriate number at right. 0 is strongly disagree and 5 is strongly agree. - There is a lot of potential in the use of mobile technologies (e.g. mobile phones, PDAs, iPods, tablets etc.) for learning
Q2_7	Please indicate how agreeable you are with the following by circling the appropriate number at right. 0 is strongly disagree and 5 is strongly agree. - Teachers/lecturers should use more ICT in their teaching of my classes
Learning dimensions of digital literacy	
Q3_1	Please indicate how agreeable you are with the following by circling the appropriate number at right. 0 is strongly disagree and 5 is strongly agree. - I know how to solve my own technical ICT problems.
Q3_2	Please indicate how agreeable you are with the following by circling the appropriate number at right. 0 is strongly disagree and 5 is strongly agree. - I can learn new technologies easily.
Q3_3	Please indicate how agreeable you are with the following by circling the appropriate number at right. 0 is strongly disagree and 5 is strongly agree. - I keep up with important new technologies.
Q3_4	Please indicate how agreeable you are with the following by circling the appropriate number at right. 0 is strongly disagree and 5 is strongly agree. - I know about a lot of different technologies.
Q3_5	Please indicate how agreeable you are with the following by circling the appropriate number at right. 0 is strongly disagree and 5 is strongly agree. - I have the technical skills I need to use ICT for learning and to create artefacts (e.g. presentations, digital stories, wikis, blogs) that demonstrate my understanding of what I have learnt
Q4_1	Please indicate how agreeable you are with the following by dragging the appropriate number at right. 0 is strongly disagree and 5 is strongly agree. - I have good ICT skills

Q4_2	Please indicate how agreeable you are with the following by dragging the appropriate number at right. 0 is strongly disagree and 5 is strongly agree. - I am confident with my search and evaluate skills in regards to obtaining information from the Web
Q4_3	Please indicate how agreeable you are with the following by dragging the appropriate number at right. 0 is strongly disagree and 5 is strongly agree. - I am familiar with issues related to web-based activities e.g. cyber safety, search issues, plagiarism
Q4_4	Please indicate how agreeable you are with the following by dragging the appropriate number at right. 0 is strongly disagree and 5 is strongly agree. - ICT enables me to collaborate better with my peers on project work and other learning activities
Q4_5	Please indicate how agreeable you are with the following by dragging the appropriate number at right. 0 is strongly disagree and 5 is strongly agree. - I frequently obtain help with my university work from my friends over the Internet e.g. through Skype, Facebook, Blogs
Proficiencies of ICT-based technologies	
Productivity tools	
Q5_1	Please indicate your proficiency of using different ICT-based technologies. 0 is very poor and 5 is that you are an expert. - Word processor: Word or Pages
Q5_2	Please indicate your proficiency of using different ICT-based technologies. 0 is very poor and 5 is that you are an expert. - Spreadsheet: Excel, Numbers
Q5_3	Please indicate your proficiency of using different ICT-based technologies. 0 is very poor and 5 is that you are an expert. - Presentation: PowerPoint, Keynote, Prezi
Q5_4	Please indicate your proficiency of using different ICT-based technologies. 0 is very poor and 5 is that you are an expert. - Mobile devices organiser: address book, appointments
Q5_5	Please indicate your proficiency of using different ICT-based technologies. 0 is very poor and 5 is that you are an expert. - Online documents organiser: Google Docs, Onedrive, Dropbox
Q5_6	Please indicate your proficiency of using different ICT-based technologies. 0 is very poor and 5 is that you are an expert. - Reference information for study purpose: Online Dictionaries, Content specific websites
Q5_7	Please indicate your proficiency of using different ICT-based technologies. 0 is very poor and 5 is that you are an expert. - Information Search: news, holidaying, even timetables
Q5_8	Please indicate your proficiency of using different ICT-based technologies. 0 is very poor and 5 is that you are an expert. - Learning management system in the university: Moodle, Locate, University student Portal
Creative tools	
Q6_1	Please indicate your proficiency of using different ICT-based technologies. 0 is very poor and 5 is that you are an expert. - Video editing: iMovie, MovieMaker, Screencast-O-Matic
Q6_2	Please indicate your proficiency of using different ICT-based technologies. 0 is very poor and 5 is that you are an expert. - Photo/image editing: Photoshop, Photoscape
Q6_3	Please indicate your proficiency of using different ICT-based technologies. 0 is very poor and 5 is that you are an expert. - Web design software: Dreamweaver, Frontpage, Wikispace
Q6_4	Please indicate your proficiency of using different ICT-based technologies. 0 is very poor and 5 is that you are an expert. - Content Marketing: Blog posts, Youtube, Podcasts, Infographics
Communication and collaboration tools	
Q7_1	Please indicate your proficiency of using different ICT-based technologies. 0 is very poor and 5 is that you are an expert. - Social Media: Facebook, Twitter, Linkedin, Myspace
Q7_2	Please indicate your proficiency of using different ICT-based technologies. 0 is very poor and 5 is that you are an expert. - Instant Message: What's up, Skype, Wechat, MSN, ICQ
Q7_3	Please indicate your proficiency of using different ICT-based technologies. 0 is very poor and 5 is that you are an expert. - Email: Yahoo, Gmail, Outlook, Hotmail
Q7_4	Please indicate your proficiency of using different ICT-based technologies. 0 is very poor and 5 is that you are an expert. - In-class discussion apps: Padlet, Kahoot, Socrative
Problems, support, and resources	
Q8_1	Have you encountered technical problems using the technologies? If yes, how did you resolve the problem?
Q8_2	How do you gain your digital skills?

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