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ANALYSING UNIVERSITY STUDENTS' DIGITAL SKILLS GAP AND ITS IMPLICATIONS FOR SDGS: AN EMPIRICAL INVESTIGATION

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ABSTRACT

Objective: This paper aims to provide further insight into digital skills and analyse the digital skills gap among university students.

Theoretical Framework: The underpinning framework of this study is the digital skills measurement framework and tools that can be used to measure students' digital skills to find the digital skills gap.

Method: Data were collected from a sample of international university students using an online questionnaire designed specifically for this purpose. The collected data were analysed using the statistical package for the social sciences (SPSS).

Results and Discussion: The main findings show that the common digital skills gap falls between 10% to 48%, the work digital skills gap falls between 14% and 40%, and the advanced digital skills gap falls between 8% to 54%; where the majority of the related areas to advanced digital skills gap exceeds 30%. The results indicate that reducing the digital skills gap requires a combination of digital skills categories (common, work, and advanced digital skills) to be possessed by university students which are essential for everyday life and the workplace.

Research Implications: The practical and theoretical implications of this research are discussed, providing insights into how the results can be applied or influence practices in university education. These implications could encompass modifications in the university curriculums to be compatible with SDGs.

Originality/Value: This study contributes to the literature by providing further insight to the digital skills gap, and recommends incorporating knowledge and skills for the digital skills activities in universities' curriculums.

Keywords: sustainable development goals (SDGs), digital Skills, digital-skills gap, university curricula.

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1 INTRODUCTION

Digital technologies have deeply rooted in the everyday routines of individuals; from communicating and working, to shopping, learning, and entertaining. Therefore, having digital skills is crucial in today's interconnected

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world, as it enables individuals to access the digital landscape effectively, access information, and participate in the global economy (Eurostat, 2023). To keep pace with this technological digital transformation it is reported (Digital Adoption, 2024) that 91% of businesses are engaged in some form of digital initiative, 40% of organisations have brought digital initiatives to scale, and almost 90% of companies formerly embraced or are going to take a digital-first approach in their businesses. Moreover, the worldwide digital transformation market is anticipated to grow to $1,009.8 billion by 2025, in the meantime; the investment in global digital transformation is projected to hit 3.4 trillion U.S. dollars by 2026.

Feijao (2021) reported that the digital skills landscape is characterized by complex trends, presenting challenges and opportunities; where, in today's world, the nature of work has been transformed by rapid and extensive digitalization, making digital skills a crucial requirement for the contemporary workforce. Thus, employers are seeking employees with digital skills to adapt to an increasingly digitalized environment, besides soft skills; which are required to help workers adjust to evolving work conditions and are important to organisations.

The rapid advancements in digital technologies and digitalization are accompanied by a digital skills gap. Wiley (2021) reported that the digital skills gap index shows that most economies are failing to bridge the digital skills divide, the gap between the request for digital skills and the capacity of economies` policymakers to respond to the lack of digital skills, and education institutions and corporate trainers to deliver the required skills. Caveney (2024) reported that 46% of business leaders claim that the digital skills gap has been wider at their organisation since 2021. They add that for the growth of their companies they need to continually ensure that their employees are enabled to perform their job well. Meanwhile, the majority of executives either currently faced skill gaps in their workforce or anticipated encountering them in the near future.

Feijao *et al*. (2021) highlight the factors that cause the digital skills gap; the accelerated demand for digital skills, the digital and social inequalities that affect opportunities to develop digital skills, and the traditional educational

models. Furthermore, Elev8 Tek, (2023) reported from the Salesforce report that it is estimated that 14 countries could miss out on an $11.5 trillion cumulative GDP growth due to the digital skills gap. As a result, addressing the digital skills gap is important for the international economy and the future of the labour market through upskilling and encouraging innovative learning and collaboration. Thus, Elev8 Tek, (2023) suggests that the traditional educational system struggles to keep up with the digital skills gap; where the curricula need to equip students with the digital skills demanded in the labour market, in addition, the limited availability of digital learning tools hinders skill development in educational institutions.

The primary aim of this study is to present further insight into digital skills and analyse the digital skills gap among university students, to find the essential skills required for the day life and the workplace. To achieve this purpose; an investigation will be conducted on university students to find the actual digital skills possessed by them, analyse the digital skills gap, and suggest solutions that enable bridging this gap.

2 BACKGROUND AND LITERATURE REVIEW

2.1 DIGITAL SKILLS CONCEPT

Van Laar *et al*. (2019) show that; many concepts have been introduced to highlight the need to access technology such as digital skills, digital competence, e-skills, digital literacy, Internet skills, and media literacy. Digital skills are essential for today's worlds of employment and education, and individuals need them to function effectively as students, workers, and citizens. Hence, digital skills are crucial in determining employees' capabilities in using information and communication technology (ICT) to enhance a wide range of skills, enabling them to leverage ICTs.

Ozsoy *et al*. (2020) reported that digital skills refer to as technical and cognitive abilities that facilitate effective and efficient searching of needed information from web sources. Moreover, Alonso-García *et al*. (2023) show that digital skills are considered as the knowledge and skills possessed by individuals

about information and communication technology; including communication, informational, multimedia, and technological knowledge and skills.

Prior research (ITU, 2020; Mazurchenko *et al.*, 2022; AWS, 2022; Lang and Triantoro, 2022) highlights that digital skills are the necessary knowledge and skills for people to use ICTs for goals in their personal and professional lives; including problem-solving, digital information processing, communication, critical thinking, working on shared documents online, transferring knowledge to new working environments, and using software and digital devices Romi (2024).

2.2 DIGITAL SKILLS GAP

Taylor-Smith *et al.* (2019) reported from the literature that; digital skills are the required skills in employment; where, data and digital technologies become increasingly crucial such as programming, managing networks and databases, working with large datasets, communication, and project management. These skills are determined by employers as essential (which are sometimes lacking in graduates). Thus, the digital skills gap is described in terms of the shortage of digitally skilled workers and a lack of appropriate skills possessed by those currently employed. Barke (2021) adds that the digital skills gap refers to the limited supply of well-trained employees for ICT businesses; this gap occurs due to shortcomings in the education and training systems.

Feijao (2021) highlights that there are underlying drivers that continue to widen the digital skills gap. Long-term changes to the economy and industries through digitalization drive demand for digital skills; meanwhile the supply of 'tech talent' has not kept up with the pace of demand for new and specialized digital skills. Moreover, emerging technologies, digital and social inequalities, and traditional education models boost the digital skills gap.

Moreover, Stephany (2022) highlights that technological and social transformation changes the necessary skill composition of work, leading to the paradox of simultaneous unemployment and labour shortage. Meanwhile, the precise digital skills' requirement for mastering emerging technologies remains fuzzy; as international labour market competition grows and technological

change accelerates, the demand for skills will keep evolving, in addition, possessing the appropriate skills to meet the demands of new technology allows for the adjustment to evolving job criteria and brings extra benefits for workers.

Meanwhile, Reddy *et al*. (2023) reported from the literature (Roche, 2017; Reddy *et al*., 2020; Pinto, 2020) that the growing use of digital technologies, digital platforms, and technology-enabled services raises the need for people to possess the relevant digital skills to carry out their designated tasks effectively. Therefore, Individuals who do not have digital skills will not be able to handle the various domains of their lives.

Minor (2024) reported from the literature that; despite the growing reliance on technology for organisational development and collaboration, Microsoft (2021) highlights that the digital skills gap has been estimated at 69%. Moreover, Winterbotham *et al*. (2021) reported that thirty percent of job openings are deemed "hard to fill" since the candidates do not possess the required digital skills. Furthermore, by 2030, two-thirds of the workforce may suffer from some degree of digital underselling, with 5 million workers predicted to be "actually under-skilled" in fundamental digital skills (Industrial Strategy Council, 2019). Moreover, according to the World Economic Forum (2020), 90% of upcoming jobs will necessitate digital skills, and it is improbable that the skills present in the job market will be able to meet this demand. Consequently, there is cause for concern due to the accelerating rate of digitalization and the adoption of new technologies.

2.3 DIGITAL SKILLS MEASUREMENT

Digital skills (Isoda *et al*., 2021) should be universal as all citizens must have them to use ICT safely, critically, and creatively in the workplace, employment, leisure, or even social participation. Those skills are categorized into levels (Bank, 2021) foundation, life essential, and work essential digital skills. These categories (AWS, 2022; Lang and Triantoro, 2022) take the form of basic digital skills (such as word processing, email, and social media posting), intermediate digital skills (such as troubleshooting applications, data analysis,

drag-and-drop website design,), and advanced digital skills (such as software or application development, cloud architecture or maintenance, artificial intelligence, and machine learning). Furthermore, digital skills (Siddiq *et al.*, 2023) continue to evolve along with changes and societal needs, including new areas such as artificial intelligence and algorithmic skills.

Romi (2024) proposed a measurement tool for digital skills aggregated from prior research. This tool divides digital skills into three categories; first, common digital skills, second, work digital skills, and third, advanced/specialized digital skills. Common digital skills; refer to the digital skills everyone can possess regardless of specialization, which are required for handling day-to-day life tasks, this category can be measured using 30 items proposed for this purpose. Work digital skills; refer to handling work tasks and events, this category can be measured using 19 items besides the common digital skills. In addition, advanced/specialized digital skills; refer to skills processed by computing/ information specialists, this category can be measured using 17 items proposed for this purpose, besides the common digital skills and the educational digital skills.

3 RESEARCH METHODOLOGY AND METHODS

3.1 DATA COLLECTION

This research paper aims to investigate the digital skills gap among university students and provide further insights into digital skills. An online questionnaire designed specifically for this purpose is used to gather data from a sample of university students.

3.2 SAMPLING

The study population consists of international university students. Many online questionnaires have been distributed to international university students via emails, websites, messengers, etc. 192 questionnaires were returned, and 16 incomplete questionnaires were excluded. Thus, 176 usable questionnaires

were used for data analysis.

3.3 RESPONDENTS DEMOGRAPHICS

The respondents (Table 1) are distributed according to the gender, degree, and academic level of the students. The students' degrees are divided into PhD (9.6%), master's (10.8%), bachelor's (70.5%), and diploma degrees (9.1%); the respondents from all degree programs are logically distributed across academic levels. Furthermore, (34.1%) of the respondents are male, and (65.9%) are females.

Table1

Respondents' characteristics

Demographic variables	Values	Frequency	Percentage
Degree	PhD	17	9.6
	Master	19	10.8
	Bachelor	124	70.5
	Diploma	16	9.1
Students' Academic Level	1st Year	25	14.2
	2nd Year	49	27.8
	3rd Year	38	21.6
	4th Year	41	23.3
	5th Year	23	13.1
Gender	Male	60	34.1
	Female	116	65.9
Specialization	Information System-related majors	67	38.1
	Other majors	109	61.9

3.4 CONSTRUCTS MEASUREMENT

Digital skills were measured using an online questionnaire based on (Romi, 2024). The measurement tool divides digital skills into three categories; common digital skills, work digital skills, and advanced digital skills. Each of these categories is divided into many digital skills (Table 2). Responses for all questionnaire items were ranged using five-point Likert scale, using appropriate ranges for each category.

3.5 RELIABILITY AND VALIDITY OF CONSTRUCTS MEASUREMENT

To ensure the reliability of the measurement tool; a reliability analysis of the collected data was carried out for all categories of digital skills. The criteria used to determine each category's adequacy and reliability coefficient are those of Cristman and Van Aelst (2006). This criterion considers an alpha reliability of 0.6 or more as an adequate reliability coefficient. In addition, factor analysis of the collected data was conducted to ensure the validity of the category measurement instrument; with a loading factor of 0.5 or more considered very significant (Hair *et al.*, 1998).

The results (Table 2) of internal consistency reliability and the factor analysis for the categories' measurement tools show that each category's items are significantly correlated with the total items, and alpha reliability will not be enhanced if any of the constructs are deleted. Also, all categories' items fall under one dimension for each category with a loading exceeding 0.6. Therefore, the measurement tool was able to demonstrate the required validity.

Table 2

Experimental Scales for the Measurement Tool

Categories	# of Items	Alpha Reliability Estimate	Minimum Items Loading	Components Extracted
Common Digital Skills				
▪ Communicating	6	0.936	0.599	1
▪ Transacting	5	0.908	0.695	1
▪ Problem-Solving	3	0.927	0.837	1
▪ Information Processing	6	0.939	0.634	1
▪ Being safe & legal online	9	0.949	0.692	1
Work Digital Skills				
▪ Communicating	2	0.796	0.831	1
▪ Transacting	2	0.887	0.899	1
▪ Problem-Solving	3	0.891	0.787	1
▪ Information Processing	3	0.908	0.750	1
▪ Being safe & legal online	9	0.949	0.692	1
Advanced Digital Skill	17	0.953	0.674	1

4 ANALYSIS AND RESULTS

4.1 ANALYSING COMMON DIGITAL SKILLS GAP

The criteria that will be used for analysing the digital skills gap will be bases on the lack of appropriate skills current university students possess. This criterion will be adapted to students' responses; the digital skills gap will be applied to the responses for the actions "can't accomplish", and "accomplish with help".

Common Digital skills incorporate five categories; communicating, transacting, problem-solving, information processing, and being safe and legal online.

Table (3) represents communicating items and students' responses. Depending on the used criterion, the results show that 10.2% of students have a shortage in communicating with others using digital communicating tools and applications (e.g. WhatsApp or Messenger). 14.7 % have a shortage in sharing documents with others by attaching them to an email. 14.2% have a shortage in setting up an email account 14.7 have a shortage in communicating with others using video tools (e.g. Zoom. Meet, etc.). 26.1% have a shortage in using word processing applications to create documents (e.g. a CV or a letter). And 8.5% have a shortage in posting content on social media platforms (e.g. Facebook, Instagram, or Snapchat).

These results imply that 10% - 26% of university students are not prepared well for digital communication skills.

Table 3

Common Digital Skills/ Communicating

Category Items	Mean	Can't accomplish	Accomplish with help	Can accomplish	Confidently accomplish	Help others
		Frequency/ Percent	Frequency/ Percent	Frequency/ Percent	Frequency/ Percent	Frequency/ Percent
Communicating with others using digital communicating tools and applications.	3.88	12 6.8%	6 3.4%	48 27.3%	35 19.9%	75 42.6%
Sharing documents with others by attaching them to an email.	3.70	8 4.5%	18 10.2%	51 29.0%	40 22.7%	59 33.5%
Setting up an email account.	3.76	9 5.1%	16 9.1%	48 27.3%	38 21.6	65% 36.9%
Communicating with others using video tools (e.g. Zoom. Meet….).	3.66	8 4.5%	18 10.2%	56 31.8%	37 21.0%	57 32.4%
Using word processing applications to create documents (e.g. a CV or a letter).	3.26	15 8.5%	31 17.6%	56 31.8%	41 23.3%	33 18.8%
Posting content on social media platforms (e.g. Facebook, Instagram or Snapchat).	3.76	9 5.1%	6 3.4%	63 35.8%	38 21.6%	60 34.1%

Table (4) represents transacting items and students' responses. The results reveal that 18.7% of students have a shortage in setting up an account online that enables them to enrol in an online class (Google Classroom, Zoom …). 48.9% have a shortage in using credit/debit cards or other forms of online payment to buy services online. 22.2% have a shortage in accessing and using public services online, including filling in forms (e.g. booking appointments, reports, etc.). 15.9% have a shortage in uploading documents and photographs to fulfil an online transaction. 23.9% have a shortage in managing transactions online securely, via websites or Apps.

These results imply that 15% - 48% of university students are not prepared well for digital transacting skills.

Table 4

Common Digital Skills/ Transacting

Category Items	Mean	Can't accomplish Frequency/ Percent	Accomplish with help Frequency/ Percent	Can accomplish Frequency/ Percent	Confidently accomplish Frequency/ Percent	Help others Frequency/ Percent
Setting up an account online that enables buying goods or services.	3.53	12 6.8%	21 11.9%	54 30.7%	40 22.7%	49 27.8%
Using credit/debit cards or other forms of online payment to buy services online.	2.69	41 23.3%	45 25.6%	45 25.6%	17 9.7%	28 15.9%
Accessing and using public services online, including filling in forms	3.38	14 8.0%	25 14.2%	55 31.3%	44 25.0%	38 21.6%
Uploading documents and photographs to fulfil online transactions.	3.59	9 5.1%	19 10.8%	56 31.8%	44 25.0%	48 27.3%
Managing transactions online securely, via websites or Apps.	3.28	14 8.0%	28 15.9%	57 32.4%	49 27.8%	28 15.9%

Problem-solving skills analysis (Table 5) shows that the shortage in "utilizing the web to locate necessary information for problem-solving" skills are 10.2%. The shortage of skills in "using online tutorials, web chat, FAQs, and forums to solve problems and cases" is 15.9%. Meanwhile the shortage of skills in "using online tutorials, web chat, FAQs, and forums to improve skills in using the Internet and digital apps/products/services" is 17.1%.

These results reveal that the shortage in problem-solving skills is 10%-17%; this indicates that university students are not equipped with the required skills to help them in problem-solving.

Table 5

Common Digital Skills/ Problem-Solving

Category Items	Mean	Can't accomplish	Accomplish with help	Can accomplish	Confidently accomplish	Help others
		Frequency/ Percent	Frequency/ Percent	Frequency/ Percent	Frequency/ Percent	Frequency/ Percent
Utilizing the web to locate necessary information for problem-solving.	3.64	9 5.1%	9 5.1%	66 37.5%	44 25.0%	48 27.3%
Using online tutorials, web chat, FAQs and forums to solve problems and cases.	3.49	8 4.5%	20 11.4%	64 36.4%	45 25.6%	39 22.2%
Using online tutorials, web chat, FAQs and forums to improve skills in using the Internet and digital apps/products/services.	3.41	14 8.0%	16 9.1%	66 37.5%	44 25.0%	36 20.5%

Table (6) represents the information processing items and students' responses. The results show that 31.2% of students have a shortage in handling information and content (information and data processing). 13.6% have a shortage in using search engines to find the required information. 22.8% have a shortage in recognizing what information or content may, or may not, be trustworthy on websites/apps.

Moreover, 19.3% of students have a shortage in organizing information and content using files and folders (either on specific devices, across multiple devices, or on the Cloud). 16.4% have a shortage in using the Internet to stream or download content (e.g. videos, books, lectures...). 20.5% have a shortage in using bookmarks to save and retrieve websites and information. 27.3% have a shortage in storing information online and accessing content from a different device (e.g. using the Cloud).

These results imply that 13% - 27% of university students are not prepared well for information processing skills.

Table 6

Common Digital Skills/ Information Processing

Category Items	Mean	Can't accomplish	Accomplish with help	Can accomplish	Confidently accomplish	Help others
		Frequency/ Percent	Frequency/ Percent	Frequency/ Percent	Frequency/ Percent	Frequency/ Percent
Handling information and content / Information and data processing.	3.14	18 10.2%	37 21.0%	51 29.0%	42 23.9%	28 15.9%
Using search engines to find the required information.	3.64	9 5.1%	15 8.5%	59 33.5%	40 22.7%	53 30.1%
Recognizing what information or content may, or may not, be trustworthy on websites/apps.	3.32	11 6.3%	29 16.5%	65 36.9%	35 19.9%	36 20.5%
Organizing information and content using files and folders (specific device, across multiple devices, or on the Cloud).	3.42	10 5.7%	24 13.6%	61 34.7%	44 25.0%	37 21.0%
Using the Internet to stream or download course-related content (e.g. videos, books, lectures...).	3.45	8 4.5%	21 11.9%	63 35.8%	51 29.0%	33 18.8%
Using bookmarks to save and retrieve websites and information.	3.31	16 9.1%	20 11.4%	63 35.8%	48 27.3%	29 16.5%
Storing information online and access content from a different device (e.g. using the Cloud).	3.18	19 10.8%	29 16.5%	57 32.4%	43 24.4%	28 15.9%

Analysing the digital skills related to being safe and legal online (Table 7) reveal that 19.9 % of university students have a shortage in responding to requests for authentication. 27.9% have a shortage in recognizing and avoiding suspicious links

In addition, 18.2% of university students don't know the consequences od sharing online activities. 16.5% have a shortage in keeping the information which is used to access online accounts secure by using different and secure passwords for websites and accounts. 14.2% of the respondents don't obtain consent before sharing or using someone else's data or intellectual property. 27.3% can't assess the potential vulnerabilities associated with interacting in online activities.

Furthermore, 31.8% of students don't possess the required skills to identify secure websites. 21% don't have the ability for privacy settings on social media and other accounts. 40.4% have a shortage in updating computer security systems.

Therefore, students' safety and legislation skills remains incomplete; where, the shortage in these skills is between 14% to 40%.

Table 7

Common Digital Skills/ Being Safe and Legal Online

Category Items	Mean	Can't accomplish	Accomplish with help	Can accomplish	Confidently accomplish	Help others
		Frequency/ Percent	Frequency/ Percent	Frequency/ Percent	Frequency/ Percent	Frequency/ Percent
Responding to requests for authentication.	3.40	13 7.4%	22 12.5%	61 34.7%	42 23.9%	38 21.6%
Recognizing and avoiding suspicious links.	3.11	23 13.1%	26 14.8%	62 35.2%	38 21.6%	27 15.3%
Carefully sharing online activities.	3.40	12 6.8%	20 11.4%	67 38.1%	40 22.7%	37 21.0%
Keeping the information used for online accounts secure by using secure passwords for websites and accounts.	3.43	7 4.0%	22 12.5%	65 36.9%	52 29.5%	30 17.0%
Be sure to obtain consent before sharing or using someone else's data or intellectual property.	3.46	8 4.5%	17 9.7%	66 37.5%	56 31.8%	29 16.5%
Assessing the potential vulnerabilities associated with interacting in online activities.	3.15	17 9.7%	31 17.6%	60 34.1%	45 25.6%	23 13.1%
Identifying secure websites.	3.04	24 13.6%	32 18.2%	59 33.5%	35 19.9%	26 14.8%
Setting the privacy preferences for social media and any other account.	3.40	10 5.7%	27 15.3%	58 33.0%	44 25.0%	37 21.0%
Updating computer security systems.	2.93	23 13.1%	48 27.3%	49 27.8%	31 17.6%	25 14.2%

4.2 ANALYSING WORK DIGITAL SKILLS GAP

The criteria that will be used for analysing the digital skills gap will be the lack of appropriate skills current university students possess. This criterion will be adapted to students' responses; the digital skills gap will be applied to the responses for the actions "can't accomplish", and "accomplish with help".

Table (8) represents the students' responses to work digital skills activities. These skills incorporate five categories; communicating, transacting, problem-solving, information processing, and being safe and legal online.

The results show that there is a shortage of 18.2% in students' skills that enable them to use digital collaboration tools to meet with, share and

collaborate with people (e.g. Google Meet/Zoom... etc.). in addition to 34.7% of students have a shortage in setting up and manage an account on a professional online network/community, (e.g. LinkedIn, Research Gate, Indeed).

Table 8

Work Digital Skills

Category Items	Mean	Can't accomplish	Accomplish with help	Can accomplish	Confidently accomplish	Help others
		Frequency/ Percent	Frequency/ Percent	Frequency / Percent	Frequency/ Percent	Frequency/ Percent
Communicating						
Using digital collaboration tools to meet with people, share and collaborate with them (e.g. Google meet/Zoom... etc.).	3.42	10 5.7%	22 12.5%	63 35.8%	46 26.1%	35 19.9%
Setting up and manage an account on a professional online network/community, (e.g. LinkedIn, Research Gate, Indeed).	3.04	13 7.4%	48 27.3%	59 33.5%	31 17.6%	25 14.2%
Transacting						
Accessing information digitally, including password protected it.	3.08	20 11.4%	37 21.0%	54 30.7%	39 22.2%	26 14.8%
Managing digital records and account through digital systems.	3.15	20 11.4%	40 22.7%	44 25.0%	38 21.6%	34 19.3%
Problem Solving						
Using the Internet to find information that helps in solving problems.	3.41	10 5.7%	22 12.5%	63 35.8%	47 26.7%	34 19.3%
Using different digital tools to improve performance i.e. saving time or more efficient performance.	3.28	22 12.5%	17 9.7%	58 33.0%	48 27.3%	31 17.6%
Using appropriate software to manipulate different tasks (e.g. Spreadsheets, MS Project, special online software…)	3.00	28 15.9%	33 18.8%	52 29.5%	37 21.0%	26 14.8%
Information Processing						
Developing digital content.	2.62	36 20.5%	56 31.8%	40 22.7%	27 15.3%	17 9.7%
Integrating and re-elaborating digital content.	2.59	42 23.9%	52 29.5%	38 21.6%	24 13.6%	20 11.4%

Concerning transacting skills, the results show that 14.48% of students have a shortage in accessing information digitally, including password protection. 34% of students have a shortage in managing digital records and their accounts through digital systems.

The students' responses (Table 7) to the problem-solving skills show that 18.2% of them have a shortage in using the Internet to find information that

helps them in solving problems.

22.2% have a shortage in using different digital tools to improve their performance (i.e. saving time or more efficient performance). 34.7 % have a shortage in using appropriate software to manipulate different tasks (e.g. Spreadsheets, MS Project, special online software…).

Moreover, the students' responses on information processing activities show that they have a shortage of 52.3% in developing digital content, and 53.4% shortage in integrating and re-elaborating digital content. Meanwhile, the results of being safe and legal online come to be the same as in common digital skills.

These results imply that the shortage in the work digital skills is greater than that of the common digital skills.

4.3 ANALYSING ADVANCED DIGITAL SKILLS GAP

The analysis of advanced digital skills was conducted on students with computer-related majors who are 3rd, 4th, and 5th year academic level. The "unskilled" response will be used as the criterion to identify the gap in students' advanced digital skills.

The results (Table 9) show that the advanced digital skills gap is rated from 8% to 54%. This gap becomes obvious in graphic and visual design, enterprise resource planning (ERP), cybersecurity, software quality assurance, augmented reality/virtual reality, machine learning (ML), blockchain, and big data; where the advanced digital skills gap exceeds 30%.

Table 9

Advanced Digital Skills

Category Items	Mean	Unskilled	Novice	Satisfying	Proficient	Expert
Application Development	2.38	24.3%	24.3%	43.2%	5.4%	2.7%
Web Development	2.70	16.2%	18.9%	48.6%	10.8%	5.4%
Graphic and Visual Design	2.08	35.1%	24.3%	37.8%	2.7%	0.0%
Database management and Programming	2.81	8.1%	29.7%	37.8%	21.6%	2.7%
Data Analytics	2.62	16.2%	29.7%	32.4%	18.9%	2.7%
Enterprise Resource Planning (ERP)	2.16	32.4%	35.1%	21.6%	5.4%	5.4%
Network Configuration, General Networking	2.16	29.7%	29.7%	35.1%	5.4%	0.0%
Cybersecurity	1.97	40.5%	29.7%	24.3%	2.7%	2.7%
Operating Systems	2.68	16.2%	32.4%	27.0%	16.2%	8.1%
Software Quality Assurance	1.89	45.9%	27.0%	18.9%	8.1%	0.0%
Artificial intelligence	2.57	16.2%	35.1%	29.7%	13.5%	5.4%
Augmented Reality/Virtual Reality	2.16	37.8%	24.3%	27.0%	5.4%	5.4%
Cloud-based tools (e.g., file-sharing services, messaging applications like Slack, cloud-based CRM tools)	2.43	16.2%	40.5%	32.4%	5.4%	5.4%
Internet of Things (IoT)	2.59	16.2%	32.4%	32.4%	13.5%	5.4%
Machine Learning (ML)	2.11	32.4%	37.8%	18.9%	8.1%	2.7%
Blockchain	1.84	54.1%	21.6%	13.5%	8.1%	2.7%
Big Data	1.97	29.7%	48.6%	18.9%	2.7%	0.0%

5 DISCUSSION

This study aims to provide further insight into digital skills and analyse the digital skills gap among university students to find the essential digital skills required for everyday life and the workplace. To pursue this purpose; the required data were collected from a sample of international university students. In addition, an analysis was conducted to find the digital skills gap and university students' readiness for work. Where, the respondents from the university students incorporate respondents from computer-related and other majors, and are distributed among university degrees (PhD, Master, Bachelor, Diploma), and all academic levels (1st, 2nd, 3rd, 4th, 5th year level).

The results (Table 9) of analysing the common digital skills gap of the respondents show that 10% to 26% of university students are not prepared well for digital communication skills. 15% to 48% of university students are not prepared well for digital transacting skills. Meanwhile, the shortage in problem-solving skills is 10%-17%, and the shortage in information processing skills gap ranges from 13% to 27%. In addition, the respondents' safety and legislation skills remain incomplete; where the shortage in these skills ranges from 14% to

40%.

These results are consistent with Stephany (2022) and Reddy *et al*. (2023); where, the growing use of digital technologies, digital platforms, technology-enabled services, and social transformation changes the necessary skill composition, and raises the need for people to possess the relevant digital skills to carry out their designated tasks.

The analysis of the work digital skills (Table 10) gap of the respondents reveals that; the work digital communication skills gap falls between 18% to 34%. Furthermore, the work digital transacting skills gap falls between 14.48% to 34%. Meanwhile, the work digital problem-solving skills gap falls between 18.2% to 34.7 %. In addition, the work digital information processing skills exceed 50%, and the work online safety and legislation skills gap falls between 14% to 40%.

Table 10

Summary of Digital Skills Gap

Categories	Mean	Gap	
		Min.	Max.
Common Digital Skills			
▪ Communicating	3.67	10%	26%
▪ Transacting	3.29	15%	48%
▪ Problem Solving	3.51	10%	17%
▪ Information Processing	3.35	13%	27%
▪ Being Safe and Legal Online	3.25	14%	40%
Work Digital Skills			
▪ Communicating	3.23	18%	34%
▪ Transacting	3.11	14%	34%
▪ Problem Solving	3.23	18%	34%
▪ Information Processing	2.73	52%	53%
▪ Being Safe and Legal Online	3.25	14%	40%
Advanced Digital Skills	2.05	8%	54%

These results are consistent with Taylor-Smith *et al*. (2019) where skills are determined by employers as essential which are sometimes lacking in graduates. Moreover, the consistency of the results with Barke (2021) and Feijao (2021) where the digital skills gap refers to the limited supply of well-trained employees for ICT businesses and occurs due to shortcomings in the education and training systems.

The analysis of the advanced digital skills gap (Table 9) is conducted to

students with computer-related majors who are 3rd, 4th, and 5th year academic level. The results show that the advanced digital skills gap falls between 8% to 54%. Where the majority of the related areas to advanced digital skills gap exceeds 30%.

These results are consistent with Microsoft (2021) and Winterbotham *et al*. (2021) where the digital skills gap is estimated to exceed 60%.

6 CONCLUSION AND RECOMMENDATIONS

This research paper aims to determine the digital skills gap among university students. Data were collected from university students and analysed depending on specific criteria. The respondents from the university students incorporate respondents from computer-related and other majors and are distributed among university degrees (PhD, Master, Bachelor, Diploma), and all academic levels (1st, 2nd, 3rd, 4th, 5th year level).

The results show that the common digital skills gap falls between 10% to 48%. Where the communication skills gap falls between 10% to 26%, the digital transacting skills gap falls between 15% to 48%. In addition, the information processing skills gap ranges from 13% to 27%, safety and legislation skills gap range from 14% to 40%.

Furthermore, the gap in work digital skills falls between 14% and 40%. This gap becomes clear in the work digital skills categories; where the communication skills gap falls between 18% to 34%, the work digital transacting skills gap falls between 14.48% to 34%, the work digital problem-solving skills gap falls between 18.2% to 34.7, the work digital information processing skills exceed 50%, and the work online safety and legislation skills gap falls between 14% to 40%.

Moreover, the advanced digital skills gap falls between 8% to 54%. Where the majority of the related areas to advanced digital skills gap exceeds 30%. This gap can be reduced when grouping the advanced digital skills gap into major areas.

The results indicate that reducing the digital skills gap requires a combination of digital skills categories to be possessed by university students

which are required for everyday life and the workplace. Therefore, this study recommends incorporating knowledge and skills for digital skills activities in universities' curricula; these skills are categorized into common, work, and advanced digital skills.

6.1 COMMON DIGITAL SKILLS

6.1.1 Communicating

- Communicating with others using digital communicating tools and applications;
- Sharing documents with others by attaching them to an email.
- Setting up an email account;
- Communicating with others using video tools (e.g. Zoom. Meet, etc.).
- Using word processing applications to create documents (e.g. a CV or a letter);
- Posting content on social media platforms (e.g. Facebook, Instagram or Snapchat).

6.1.2 Transacting

- Setting up an account online that enables buying goods or services;
- Using credit/debit cards or other forms of online payment to buy services online;
- Accessing and using public services online, including filling in forms;
- Uploading documents and photographs to fulfil online transactions;
- Managing transactions online securely, via websites or Apps.

6.1.3 Problem-Solving

- Using the Internet to find information that helps in solving problems;
- Using online tutorials, web chat, FAQs and forums to solve problems and cases;

- Using online tutorials, web chat, FAQs and forums to improve skills in using the Internet and digital apps/products/services.

6.1.4 Information Processing

- Handling information and content / Information and data processing.
- Using search engines to find the required information;
- Recognizing what information or content may, or may not, be trustworthy on websites/apps;
- Organizing information and content using files and folders (either on specific device, across multiple devices, or on the Cloud);
- Using the Internet to stream or download course-related content (e.g. videos, books, lectures...);
- Using bookmarks to save and retrieve websites and information;
- Storing information online and access content from a different device (e.g. using the Cloud).

6.1.5 Being Safe and Legal Online

- Responding to requests for authentication;
- Recognizing and avoiding suspicious links;
- Carefully sharing online activities;
- Keeping the information used to access online accounts secure by using different and secure passwords for websites and accounts;
- Be sure to obtain consent before sharing or using someone else's data or intellectual property;
- Assessing the potential vulnerabilities associated with interacting in online activities;
- Identifying secure websites;
- Setting the privacy preferences for social media and any other account;
- Updating computer security systems.

6.2 WORK DIGITAL SKILLS

6.2.1 Communicating

- Using digital collaboration tools to meet with people, share and collaborate with them (e.g. Google meet/Zoom... etc.);
- Setting up and manage an account on a professional online network/community, (e.g. LinkedIn, Research Gate, Indeed).

6.2.2 Transacting

- Accessing information digitally, including password protected it;
- Managing digital records and account through digital systems.

6.2.3 Problem Solving

- Using the Internet to find information that helps in solving problems;
- Using different digital tools to improve performance i.e. saving time or more efficient performance;
- Using appropriate software to manipulate different tasks (e.g. Spreadsheets, MS Project, special online software, etc.)

6.3 INFORMATION PROCESSING

- Developing digital contente;
- Integrating and re-elaborating digital content.

6.4 ADVANCED DIGITAL SKILLS

Grouping and aligning the knowledge and skills for specialised students in computer-related majors to the work requirements. grouping can be started from areas such as application development, web development, graphic and visual design, database management and programming, data analytics,

enterprise, resource planning (ERP), network configuration, general networking, cybersecurity, operating systems, software quality assurance, artificial intelligence, augmented reality/virtual reality, cloud-based tools (e.g., file, sharing services, messaging applications like Slack, cloud-based CRM tools), internet of things (IoT), machine learning (ML), blockchain, and big data.

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