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FROM CLASSROOM TO WORKPLACE: ASSESSING EMPLOYMENT OUTCOMES FOR GRADUATES WITH ICT AND DIGITAL SKILLS FROM EUROPEAN UNIVERSITIES

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ABSTRACT

Purpose- This study aims to examine how individuals' ICT and digital skills, along with the demand for ICT-knowledgeable candidates in the labour market, predict employment in positions requiring ICT skills.

Methodology- The study uses a multiple linear stepwise regression. The data is collected from publicly available sources, such as Eurostat (2024), the official online statistical platform of the European Union (EU).

Findings - The findings suggest that digital skills and the demand for ICT-skilled graduates in the labour market positively influence employment rates in positions requiring ICT skills. Conversely, graduates' possession of ICT skills has a negative impact on employment.

Implications - This study underscores the importance of collaboration among policymakers, higher education institutions, and industry partners to ensure alignment between the demand and supply of digital skills among tertiary education graduates. By addressing this alignment, stakeholders can enhance graduates' employability and better meet industry needs. These findings contribute significantly to the ongoing dialogue surrounding improving higher education to foster graduates' readiness for the workforce.

Keywords: Please provide up to Keywords: Digital skills, Tertiary education graduates, Employability, stepwise regression, EU27

INTRODUCTION

Technological advancements have rapidly transformed industries in the past 2 decades (Alenezi et al., 2023; Ikhtiyorovna, 2023). The advent of technologies such as artificial intelligence (AI), the Internet of Things (IoT), augmented reality (AR), and virtual reality (VR) has led to a significant shift in industries and thus impacting Higher education. This transformation has created the urgency to equip

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graduates with digital skills to fill the needs of the labour market. Aligning with the current need, higher education institutions are crucial in preparing graduates with the digital competencies required by today's competitive job market (Chemli et al., 2023; Jiang et al., 2023; Zhang et al., 2023). Digital skills encompass various abilities, including information literacy, digital communication, and proficient use of various technologies. As technology permeates every aspect of industries, graduates must possess the requisite digital acumen to remain adaptable and competitive. Extensive research consistently demonstrates a positive correlation between digital competencies and employability across various sectors (Aljohani et al., 2022; Avram et al., 2019). Individuals with advanced digital skills not only enjoy better job prospects but also demonstrate greater adaptability to technological shifts. Specific skills such as programming and data analysis are particularly required, reflecting the evolving nature of job roles in the digital era.

Despite the growing demand for digital skills, a gap persists between graduates' skill sets and employers' requirements ((Alhloul & Kiss, 2022; Galve-Górriz & Gargallo Castel, 2010). This gap underlines the importance of targeted reviews by HEIs to bridge the digital skills divide and ensure graduates are well-prepared for employment.

Moreover, policymakers are crucial in shaping educational policies prioritising digital literacy and skills development. By investing in digital education initiatives and fostering collaboration between Higher Education Institutions (HEI) and industries, policymakers can empower graduates with the relevant digital skills needed to succeed in today's job market (Camilleri, 2020; Chemli et al., 2023; OECD 2017).

In light of these considerations, this study investigates the impact of individual ICT and digital skills and labour market demand for digital talent on the employment outcomes of graduates from European higher education institutions. By examining the intersection of technology, education, and employability, this research seeks to provide valuable insights into the factors influencing employment outcomes in the digital age.

LITERATURE REVIEW

Tertiary Education and Digital Skills

Several studies have demonstrated the gap between the current skills of employees and the future skills required by the labour market and destination management organisations (Baum, 2018; Carlisle et al., 2023), some of which focused specifically on digital skill mismatch (Chemli et al., 2023). Digital skills encompass a broad range of competencies, including information literacy, digital communication, and proficiency in utilising various technologies.

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As artificial intelligence (AI), internet of things (IoT), augmented reality (AR), and virtual reality (VR) increasingly permeate various industries, including tourism and hospitality, the demand for tertiary graduates equipped with relevant digital skills has surged. This shift underscores the importance of preparedness among graduates to secure fitting roles in the evolving job market. The literature highlights the dynamic nature of digital skills, with constant evolution necessitating a continuous commitment to reskilling (Chaudhuri et al., 2023) and upskilling to improve their technical skills to adapt to digital innovations in the future (Huang et al., 2021). In the contemporary workforce, individuals possessing advanced digital skills are not only better positioned to secure employment but also demonstrate increased adaptability in the face of technological advancements.

As the primary source of digital competencies, tertiary education institutions play a pivotal role in shaping individuals' digital competencies (Haleem et al., 2022). Integrating digital skills into higher education curricula has gained prominence, reflecting a recognition of the evolving demands of the job market. Studies highlight diverse models and strategies universities employ to impart digital skills, from dedicated courses to infusing technology across disciplines ((Pažur et al., 2023).

A pertinent curriculum should cater to the rising need for digital skills by empowering students to proficiently navigate networked information sharing, devise potential solutions, and effectively implement them (Yu & Duchin, 2024).

Employability and Digital Competencies

Consistent research findings underscore a positive link between digital competencies and employability. Individuals with advanced digital skills not only have better job prospects but also demonstrate increased adaptability to technological changes. Specific skills like programming and data analysis are particularly sought in various industries, as evidenced by case studies and empirical data.

Given the diverse demands across economic sectors, targeted studies involving various employers are necessary. Such research can shed light on the specific digital competencies valued by different sectors (Baah-Acheamfuor et al., 2023). Policymakers responsible for education should prioritise equipping youth with digital skills to enhance their success in today's job market (Kee et al., 2023).

In line with this, De Villiers Scheepers et al. (2024) analyse digital career competencies (DCC) metrics, offering insights into how these metrics can aid universities, students, and stakeholders in understanding competency development. These metrics serve as a concise framework for evaluating and fostering DCC growth in higher education. Additionally, studies emphasise the importance of boosting students' confidence in their skills and career paths for success in the digital workplace.

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Confidence is linked to essential competencies like business acumen and social and digital adaptability, which are crucial for navigating the evolving work landscape (Potgieter et al., 2023).

Moreover, Berniak-Woźny et al. (2023) identify a gap between students' perceived and actual competencies and propose recommendations for enhancing competency development among university students. This ensures their readiness for the changing workplace environment (Chemli et al., 2024; Suarta et al., 2023). Through these integrated efforts, from targeted research to policy emphasis and practical application, stakeholders can better prepare students for success in the dynamic digital workplace.

Therefore, the interconnectedness between digital competencies, employability, and higher educational policies emphasises the importance of a multifaceted approach to preparing students for the modern workforce. Targeted studies illuminating sector-specific digital skill demands, coupled with policy initiatives aimed at fostering digital literacy among youth, can significantly enhance their employability prospects. Additionally, frameworks such as those proposed by De Villiers Scheepers et al. (2024) provide valuable tools for understanding and cultivating digital career competencies within higher education. Addressing the gap highlighted by Berniak-Woźny et al. (2023) is essential for empowering students to overcome the complexities of digital advancements and usage at the workplace with proficiency and resilience. By integrating these insights and initiatives, higher education institutions and other stakeholders can better equip students to thrive in the ever-evolving digital economy.

While existing studies have investigated the relationship between digital skills and tertiary education, as well as tertiary education and employability, a notable gap still needs to be in the literature regarding cross-country comparative analyses within the EU27 concerning the intersection of technology, education, and employability. Our research endeavours to address this gap by examining potential disparities across EU27 countries in this context.

Moreover, the literature review identifies a considerable gap regarding the insufficient emphasis on individual ICT and digital skills and their correlation with integration into the labour market. Therefore, this study primarily investigates whether individuals proficient in advanced computer skills, such as creating integrated files, utilising advanced spreadsheet features, and editing multimedia files, demonstrate higher probabilities of securing employment in roles requiring ICT skills acquired through education. Consequently, the research proposes two main hypotheses:

H1: There is a direct correlation between individuals' proficiency in ICT and Digital skills and their ability to secure employment in positions requiring ICT-related skills.

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H2: The demand for candidates possessing expertise in ICT within the labour market positively influences the employment of individuals equipped with ICT skills acquired through education.

METHODOLOGY

This study aims to investigate the correlation between labour market demand for ICT skilled graduates, employment rates for recent graduates, individual levels of digital skills for tertiary education graduates and Tertiary educational attainment as time-varying predictors on the employment rates with ICT skills over time, of young graduates of tertiary education across 28 countries in Europe and EU 27.

Thus, the research question is as follows: What is the intricate relationship between labour market demand for ICT specialists, employment rates of recent graduates, tertiary educational attainment, and individual level of digital skills, and their combined impact on the employment status of individuals with ICT education for a diverse set of 27 countries?

A quantitative research methodology was adopted to address this research's primary objective. Data was gathered from publicly available source Eurostat (2024), the European Union (EU) official statistical online platform. The use of multiple linear regression was appropriate in this study to assess the collective impact of multiple independent variables (refer to Table 1). A primary test was conducted using a multilevel regression to assess the impact of the independent variables (IVs) on the dependent variable (DV) across different countries. This regression included two blocks for the independent variables: Block 1 represented the countries, and Block 2 comprised the actual independent variables. The change in R-squared value was utilised to measure the impact of adding the IVs block.

However, the primary analysis results indicated a very low R-squared change of 0.04 between the two models. This suggests minimal variation across countries when considering the selected variables. Consequently, it was decided to perform a multiple regression analysis to further investigate the relationships between the independent and dependent variables without considering the country as a separate block. This decision was made based on the evidence suggesting insufficient across-country variation in our variables to permit separate consideration within the analysis.

Data collection and cleaning

The study uses secondary data from the primary source Eurostat (2024) (European Commission, 2024). The variables collected are (1) Individuals' level of ICT skills, (2) Individuals' level of digital skills, (3) Labour market demand for ICT specialists, (4) Employment rates of recent graduates and (5) tertiary educational attainment, (6) enterprises using software solutions such as CRM. The authors

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used filters aligned with the study scope, mainly to keep data related to tertiary education and the service industry. In addition, data marked as unreliable or incomplete has been excluded, resulting in removing certain countries from the dataset.

Data analysis

This study uses a multiple linear regression analysis to test the two previously mentioned hypotheses. The dependent variable is the employed persons with ITC education (DV). Our research involved studying various independent variables, all of which are continuous, as detailed in Table .

Table 1. *Model description*

Variables			
Dependent variable - DV			
DV		Employed persons with ICT education (2022)	Continuous
Predictors			
IV1	IV1L1	Individuals' level of computer skills - Individuals who have created files integrating elements such as text, pictures, tables, charts, animations or sound (3 months)	Continuous
	IV1L2	Individuals' level of computer skills - Individuals who used advanced features of spreadsheet software to organise, analyse, structure or modify data (3 months)	
	IV1L3	Individuals' level of computer skills - Individuals who edited photos, video or audio files (3 months)	
IV2	IV2L1	Individuals' level of digital skills - Individuals with basic or above basic information and data literacy skills	Continuous
	IV2L2	Individuals' level of digital skills - Individuals with basic or above basic information and data literacy skills	Continuous
IV3		Labour market demand for ICT specialists	Continuous
IV4		Employment rates of recent graduates	Continuous
IV5		Tertiary educational attainment	Continuous
IV6		Enterprises using software solutions	Continuous

The authors employed a stepwise multiple linear regression approach to systematically select the most influential independent variables for predicting the number of employed individuals with ICT education. Stepwise regression offers a structured method to sift through a large pool of potential predictors and identify those with the strongest associations with the dependent variable. By

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iteratively adding and removing variables based on statistical criteria, such as significance levels, we aimed to construct a parsimonious model that captures the essential factors driving employment outcomes for graduates with ICT skills from higher education. This approach helps streamline the analysis process, focusing our attention on the most relevant variables while minimising the risk of overfitting the model to the data. Ultimately, the use of stepwise regression enhances the interpretability and robustness of our findings, providing valuable insights into the factors influencing employment for graduates with ICT and digital skills.

To ensure the validity of the multiple linear regression results, several assumptions were tested using SPSS, including the absence of multicollinearity, homoscedasticity, normal distribution, and non-significance.

RESULTS AND DISCUSSION

This study examined the multicollinearity assumption through the correlation table, using the tolerance and variance inflation factors (VIF) (Aguinis et al., 2013; Mansfield & Helms, 1982; Thayer, 2002). The results revealed three main predictor variables for DV.

It was noted that 100% of the variance of the independent variable in Model 1 IV2L2 was not accounted for by other independent variables. In Model 2, the tolerance values (Table 3) were found to be greater than 0.1 accounting for 0.603, and the VIF values less than 10, both equal to 1.658. In Model 3, the tolerance values are 3 of them greater than 0.1, successively 0.591 for IV2L2 and IV3, and 0.976 for IV1L2, and VIF less than 10 (ranging from 1.025 to 1.692), indicating that there were no multicollinearity concerns in the 3 models (Mansfield & Helms, 1982). Furthermore, the cook's distance (the measure of the residual statistics) was found to be less than 1 for the 3 models, with a maximum value of 0.18, indicating that no outliers were disrupting the models (Aguinis et al., 2013). The main predictors for the DV are IV2L2, IV3, and IV1L2. Thus, the individual's level of digital skills, the labour market demand for ICT specialists, and the individual's level of computer skills using advanced features. However, the use of software solutions in enterprises, tertiary education attainment and employment rates of recent graduates were excluded from the model due to non-statistical significance.

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Table 2. *Multiple Linear Regressions - Variables in the Equations*

Models		Unstandardised Coefficients		t	Sig.	Correlations	Collinearity Statistics	
		B	Std. Error			Part	Tolerance	VIF
1	(Constant)	61,550	3,396	18,122	<,001			
	IV2L2	0,502	0,103	4,859	<,001	0,	1,000	1,000
2	(Constant)	31,747	10,365	3,063	0,005			
	IV2L2	0,721	0,116	6,226	<,001	0,777	0,603	1,658
	IV3	0,532	0,177	3,000	0,006	0,374	0,603	1,658
3	(Constant)	35,020	9,656	3,627	0,001			
	IV2L2	0,686	0,108	6,361	<,001	0,732	0,591	1,692
	IV3	0,479	0,165	2,905	0,008	0,334	0,591	1,691
	IV1L2	-0,916	0,399	-2,296	0,031	-0,264	0,976	1,025
Ajusted R Square F N P<0.05		0,465 (b); 0,595 (c) and 0,656 (d) 23,613 (b); 20,084 (c) and 17,529 (d) 27						
a Dependent Variable: DV								

In the ANOVA analysis (Table 3), the null hypotheses were tested and found to be statistically significant (P<0.05). The F value was determined to be 23.613 with degrees of freedom of 1 and 25 for Model 1, F_c=20.084 with degrees of freedom of 2 and 24 for Model 2, and finally, F_d=17.529 with degrees of freedom of 3 and 23 for Model 3. These results led to rejecting the null hypotheses and the slope, implying that the models are statistically significant.

The unstandardised coefficients outlined in Table 2 signify the predicted change in the dependent variable (DV). For example, based on Model 3, a one-point increase in IV2L2, IV3, and IV1L2 corresponds to an expected change in the DV by 0.686, 0.479, and -0.916, respectively. Beta values, however, reflect the relative impact of independent variables (IVs) while considering the influence of other predictor variables. Notably, IV2L2 and IV1L2 demonstrate more substantial effects and stronger associations with the changes observed in the DV. The unstandardised coefficient, when squared, represents the variance explained on the dependent variable (DV) by the respective predictor. Therefore, eliminating the predictor IV2L2 would result in a reduction of 73.2% in the variance of the DV. This reduction would be more substantial than removing any other predictors in Model 3, a conclusion consistent with the analysis of beta values. Likewise, removing IV3 would lead to a decrease in the variance of the dependent variable (DV) by 51.8%, while eliminating IV1L2 would result in a reduction of 26.4% in the DV's variance. This hypothesis suggests that a rising demand for ICT specialists in the labour market, combined with individuals acquiring digital skills, is associated with increased employment rates among graduates proficient in ICT skills. However, proficiency in

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computer skills seems to affect the employment prospects of these graduates adversely. Recent research suggests a changing landscape regarding the importance of ICT skills in determining graduate employability.

Contrary to previous studies such as Koppi et al. (2009) suggesting that enhanced ICT skills improve graduates' access to the labour market, recent technological advancements have altered this landscape. While past studies underscored the importance of ICT skills, the evolving nature of technology has transformed these skills from being advantageous to becoming essential prerequisites for employment. As a result, digital competencies have eclipsed traditional ICT skills as a fundamental requirement in today's job market.

Table 3. *ANOVA*

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3,635,948	1	3,635,948	23,613	<,001b
	Residual	3,849,506	25	153,980		
	Total	7,485,454	26			
2	Regression	4,685,755	2	2,342,877	20,084	<,001c
	Residual	2,799,699	24	116,654		
	Total	7,485,454	26			
3	Regression	5,207,715	3	1,735,905	17,529	<,001d
	Residual	2,277,740	23	99,032		
	Total	7,485,454	26			
a Dependent Variable: DV						
b Predictors: (Constant), IV2L2						
c Predictors: (Constant), IV2L2, IV3						
d Predictors: (Constant), IV2L2, IV3, IV1L2						

Analysis of the probability plots (P-P plots) reveals a strong alignment between the distribution of data points and the reference line for both dependent variables. Additionally, the residuals demonstrate a normal distribution pattern, as shown in Figure 1. Moreover, the scatterplot presented in Figure 2 confirms the absence of outliers near either axis, contributing to a desirable distribution shape. Notably, points are evenly dispersed, both above and below zero, on the X-axis and to the left and right on the Y-axis. These observations collectively suggest homoscedasticity in the dataset, as depicted in Figure 2.

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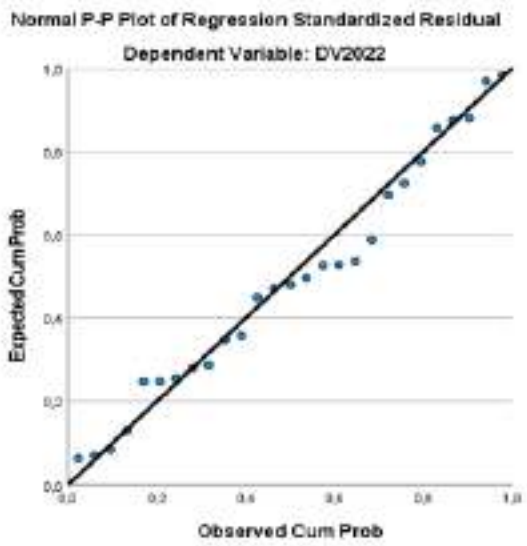
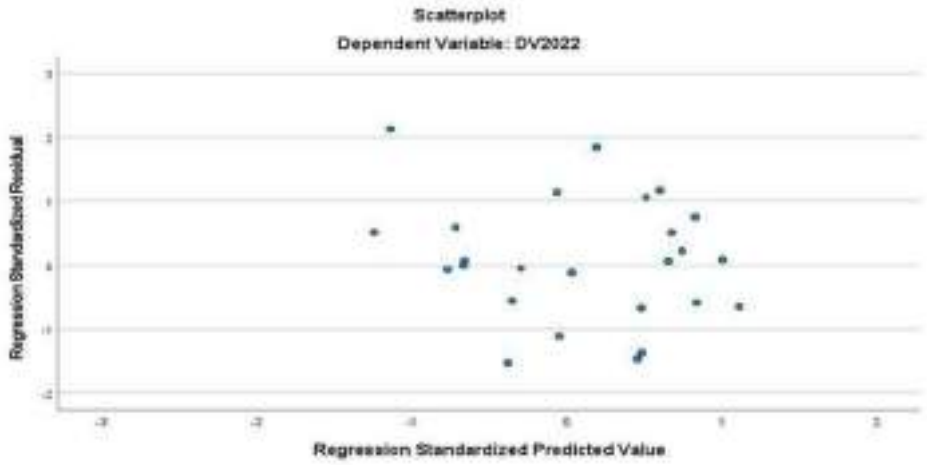
Figure 1. *Normal P-P Plot of Regression Standardised Residual*



The results suggest that individuals with ICT skills tend to access the labour market more easily; however, holding ICT skills negatively impacts the job market, supporting H1. Additionally, it is found that firms requiring ICT skills for graduates looking for jobs, enhance the employment of individuals equipped with ICT skills acquired through education, supporting H2.

Figure 2. *Figure 2. Scatterplot Z-Residual/ Z-Predicted*



CONCLUSIONS AND IMPLICATIONS

The study concludes that digital skills represent one of the most important competencies allowing graduates to access employment. With the changing needs and requirements for new entrants, companies, whether using or not software and technologies, require certain skills, including digital ones.

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The academic debate about the skills necessary for employment opportunities is constantly evolving. While previous studies have yielded valuable insights, it is imperative to acknowledge the changing landscape driven by technological advancements and ongoing societal shifts. Consequently, while acknowledging the contributions of past research, notably by Hecker & Loprest (2019) and Pirzada & Khan (2013), it's essential to interpret their findings within the contemporary context shaped by rapid technological progress.

This study aligns with recent scholarship, exemplified by the work of Zhang et al. (2023), which emphasises the importance of digital skills in facilitating access to employment. Building upon the groundwork laid by these prior studies, our research further underscores the critical role of digital competencies in navigating today's dynamic job market. By exploring the intricate relationship between digital skills and employability, our study enriches the ongoing discourse on workforce preparedness in an era characterised by digital transformation and innovation.

In today's professional arena, attaining digital skills has evolved beyond merely offering an edge for graduates; it has become an indispensable requirement. Higher education institutions must embed digital literacy within their academic programs and customise these proficiencies to address the unique needs of diverse industries.

Our study challenges the traditional notion that individual-level ICT skills provide a competitive edge, as Koppi et al. (2009) posited previously. Instead, we assert that in today's post-COVID era, characterised by remote work and the proliferation of online employment opportunities, proficiency in ICT is no longer a distinguishing feature but a fundamental requirement for all individuals. This shift in perspective underscores the urgency for graduates to possess a baseline level of digital competency rather than viewing it as a unique selling point.

Highlighting ICT skills as a competitive advantage may unintentionally give employers a false impression, considering their widespread prevalence rather than unique value. Hence, educational institutions and policymakers must acknowledge and respond to this paradigm shift. By emphasising fostering digital skills within the educational framework, graduates can effectively address the evolving requirements of the modern job market, bolstering their competitiveness in an increasingly digitalised environment.

Furthermore, the study's findings indicate a lack of significant variation in the employment of graduates with ICT skills across the 28 countries examined. This observation underscores the effectiveness of collective efforts at the European level to address employment challenges and promote the integration of ICT skills into tertiary education. Another significant conclusion drawn from the study pertains to the increasing demand for ICT skills in job offerings, which has contributed

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to the heightened employment prospects for graduates possessing such skills. Consequently, while mentioning basic computer skills may not sway companies seeking candidates with ICT proficiency, they are likely to show greater interest in candidates with advanced knowledge or familiarity with software applications. These findings are consistent with the findings of Chemli et al. (2024).

Managerial implications

The research findings reveal a fundamental shift in employment dynamics: digital skills have become indispensable across sectors. Recognising technology's transformative impact, employers prioritise candidates with solid digital competencies. This paradigm shift stresses the urgent need for Higher Educational Institutions to adapt curricula to the current needs. Students must be equipped with the relevant digital skills that align with the industry's evolving demands. This adaptation includes fostering information literacy and software applications and improving data analysis capabilities.

Given these insights, policymakers are called to take proactive steps in leading initiatives to upskill the workforce and facilitate continuous and lifelong learning opportunities. Policymakers should prioritise integrating digital literacy programs into higher education institution (HEI) curricula and incentivise businesses to offer ongoing training to enhance digital skills among their employees. Additionally, HEIs should foster collaboration with industry partners to tailor curricula to meet both current and anticipated future demands of the labour market, thereby ensuring that graduates are adequately prepared to thrive in an ever-evolving digital landscape. By bridging the digital gap, policymakers can easily enhance employment prospects for recent graduates from tertiary education. The research findings clearly indicate the necessity of embracing digital competencies to navigate the ever-changing landscape of today's job market.

Furthermore, the study clarifies the dynamic nature of ICT skills and their pivotal role in shaping graduate employability. While traditional ICT skills retain relevance, digital competencies have emerged as decisive factors for success. With the rapid evolution of technology reshaping various industries, individuals must actively engage in continuous learning and adaptability to stay competitive. Lifelong learning and professional development initiatives are not merely advantageous but essential for navigating the shifting landscape of job requirements and career opportunities.

This research goes beyond offering insights; it provides practical recommendations for stakeholders. Policymakers and educators can make informed decisions by grasping the interaction between ICT skills, labour market dynamics, and graduate employability. This comprehensive approach, which empowers individuals with the necessary skills for the digital economy, is crucial for promoting sustainable economic growth and individual success in our constantly evolving society.

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