Digital literacy of Vietnamese human resources

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Abstract:

The comprehensive digital transformation taking place across all aspects of global and Vietnamese societal life is both objective and inevitable. The successful execution of this transformation necessitates the development of appropriate digital human resources. Digital literacy has emerged as a paramount competence of the 21st century. Despite the qualifications and skills of Vietnam's human resources, digital literacy remains limited. The demand for digital literacy is substantial and represents an urgent requirement for Vietnam in its pursuit of establishing a digital government, society, and economy. This paper explores facets of digital literacy, analyses the current state of digital literacy amongst Vietnamese human resources, and, based on this analysis, proposes recommendations and solutions to advance the digital literacy of Vietnamese workers.

Keywords: **digital literacy, digital transformation, human resources.**

Classification numbers: **3.2, 7**

1. Introduction

The world is experiencing dramatic changes, signifying the advent of a new era strongly influenced by digital transformation. Digital transformation is the driving force of the fourth industrial revolution, wherein digital technology moulds global society and future economic activity. At its core, digital transformation is a process that induces significant changes in an object's properties by integrating information, electronic equipment, and communication technology, and enabling online connections [1]. This process demands an organised approach, a clear plan, and the involvement of all stakeholders, both internal and external to the organisation. This is often termed a digital transformation strategy, designed to swiftly and creatively harness the potential and impacts of emerging technologies [2].

Digital transformation is the process of change associated with the application of digital technology across all facets of human social life [3]. Physical assets are progressively transitioning into digital assets. Human resources within organisations and businesses are significantly affected as job roles continuously evolve and decision-making becomes increasingly reliant on the management of knowledge and skills. The operation of organisations and businesses is heavily influenced by social networks and mobile technology. Digital literacy opens opportunities for the expansion and redefinition of business markets. Digital transformation fundamentally changes entities by creatively applying digital technologies along with key resources and capabilities, thereby completely improving an entity and redefining its value to stakeholders [4]. Human resources play a pivotal role in this process. Consequently, to successfully implement digital transformation, it is essential to develop human resources possessing digital literacy.

In the digital era, evolution of production technology leads to daily shifts in jobs, with the disappearance and emergence of roles demanding new expertise and skills. A report from the International Labour Organization (ILO) indicates that Vietnam is the most affected country within ASEAN in terms of labour and employment due to digital transformation, with 70% of workers in basic occupations being impacted [5]. Thus, digital literacy is a crucial factor for achieving future success in study, research, and career development [6]. The need to develop human resources with digital literacy is an urgent requirement for Vietnam to effectively execute the national digital transformation.

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2. Digital literacy and the importance of digital literacy in the new era

2.1. Digital literacy

The term 'literacy', as per the Cambridge English Dictionary, refers to the ability to read and write. The range of concepts it describes have evolved and diversified over time, particularly in recent decades, as 'skill-based literacies' have developed in response to increasing information complexity and emerging technologies. These concepts imply critical thinking in evaluating information sourced from mass media, such as television, radio, newspapers, magazines, and the internet [7].

To navigate the complexities of the current information environment, a comprehensive and sophisticated form of literacy is required. It should encompass all skill-based literacies but should not be confined to them or any particular technology or set of technologies [7].

The term "digital literacy" was initiated in the 1990s by several authors to denote the ability to read and comprehend hypertextual and multimedia texts. R. Lanham (1995) [8] proposed one of the earliest conceptual definitions, arguing that the term "literacy" had expanded its semantic reach from "the ability to read and write" to "the ability to understand information"; however, it is presented. He emphasised the multimediated nature of digital information, asserting that digital literacy involves being skilled at deciphering complex images and sounds, as well as the syntactical subtleties of words [8].

Digital literacy incorporates Information & Communication Technologies (ICT)/computer literacy, information literacy, technological literacy, media literacy, communication literacy, visual literacy, network literacy, e-literacy, digital competence, among others [9].

In the context of the fourth industrial revolution, with the robust development of science and technology, digital transformation is increasingly becoming an inevitable trend worldwide, including Vietnam. For the successful implementation of digital transformation across all sectors-digital government, digital society, and digital economy-corresponding human resources equipped with digital literacy are required.

UNESCO defines digital literacy as the ability to use digital devices, communication applications, and the internet to access and manage information. It enables individuals to create and share digital content, communicate, and collaborate, and effectively and creatively solve problems in life, study, work, and general social activities. At a basic level, digital literacy is demonstrated through the ability to use digital devices and online applications. At an advanced level, it involves utilising digital technologies to enhance competence and adaptability in career fields, such as those in the information and communication technology sectors. Technologies such as artificial intelligence (AI), machine learning, big data analytics, blockchain..., change skill requirements, thereby influencing capacity building and skill development within the workforce in the digital economy. Digital literacy is a blend of computer capacity, information technology (IT) capacity, information capacity, and communication capacity [10].

The World Bank (2020) [11] report stipulates that digital literacy is the ability to access, manage, understand, integrate, communicate, evaluate, and create secure and relevant information. According to this report, the digital skills framework for the workforce generally comprises seven competencies-operating software and equipment; knowledge of data and information; communication and collaboration; digital content creation; safety; problem-solving; career-related competencies-each at four proficiency levels (basic, intermediate, advanced, and highly specialised).

Digital literacy represents a fundamental ability to use computers confidently, securely, and effectively, inclusive of software proficiency [12]. It is also interpreted as the capacity to utilise digital technology and communication tools to access, manage, analyse, and evaluate information; to construct new knowledge; and to communicate with others, thereby effectively participating in society [13]. Furthermore, digital literacy incorporates life skills, which extend beyond the ability to use technology, information, and communication devices, and incorporate the capacity to socialise, learn, and develop attitudes and critical, creative, and inspiring thinking as digital competencies [14].

Building upon the comparison of international competency frameworks, and referencing Facebook's

We Think Digital courses and the content of the Introduction to Information Competence module, the VNU University of Social Sciences and Humanities (under Vietnam National University, Hanoi) has proposed a digital literacy framework model comprising seven competency groups with 26 standards. These include: (1) Operating equipment and software; (2) Information and data mining; (3) Communication and cooperation in the digital environment; (4) Digital safety and security; (5) Digital content creation; (6) Learning and developing digital skills; and (7) Utilising digital competence for the profession.

Table 1 shows that, corresponding to each capacity is a description of the capabilities to be achieved. The specific competencies described in each group mainly focus on applying technology into practice through attitude, empathy, critical thinking, problem-solving, and innovation. This competency framework has been widely consulted by training institutions in Vietnam to build digital literacy development programs, with the goal of helping learners acquire the necessary skills and knowledge to study, work and communicate positively and securely in the digital environment.

Digital literacy encompasses a combination of behaviours, expertise, know-how, work habits, personality traits, and key insights, incorporating not only technical skills but cognitive skills and soft skills as well.

2.2. The importance of digital literacy in the new era

Technological advancements such as cloud computing, AI, big data, internet of things (IoT), along with the catalytic impact of the COVID-19 pandemic, have introduced new work trends like telecommuting and virtual work. According to McKinsey and Company (2021) [16], the post-COVID-19 trend suggests that approximately 20%-25% of workers in developed economies could work remotely for three or more days a week. As per Sabina Weston (2021) [17], by 2030 up to 75% of jobs will necessitate advanced digital skills, which greatly influences the workforce.

To meet the demands of work in the digital era, equipping new capacities, especially digital literacy, is considered a vital issue for the workforce. As most jobs will be digitised, the ability to use digital technology will be a requirement of almost every profession, with the digital industry becoming a key player in the economy.

According to Microsoft's report (2020) [18], between 2020 and 2025, there will be approximately 149 million jobs related to new technologies created, with 98 million jobs associated with software development, 23 million linked to data and cloud computing roles, and about 20 million jobs connected to AI, machine learning, data analysis. This suggests a transformation in the global workforce, and workers must equip themselves with new skills, particularly digital skills, to meet the new demands of the labour market if they wish to avoid unemployment.

Table 1. Digital literacy framework of human resources.

No	Capability group	Ability description
1	Operating equipment and software	Identify, select, and use hardware devices and software applications to identify and process data and digital information in problem-solving.
2	Information and data mining	Identify individual information needs; implement strategies to find, locate, and access information; evaluate news sources and their content; store, manage, and organise information; and use information ethically and legally.
3	Communicating and collaborating in a digital environment	Interact and communicate through digital technology and practise digital citizenship. Manage your digital identity and reputation in the digital environment. Use digital tools and technologies to collaborate, design, and create resources and knowledge.
4	Digital safety and security	Protect devices, content, personal data, and privacy in the digital environment. Safeguard your health and spirit. Recognise the impact of digital technology on social well-being and social inclusion, and the impact of digital technologies and their use on the environment.
5	Digital content creation	Create and edit digital content. Transform and combine information and digital content into existing knowledge. Understand the licensing and copyright systems involved in the digital content creation process.
6	Learning and developing digital skills	Identify opportunities and challenges in the online learning environment. Understand personal needs and preferences as a digital learner. Promote open access and information sharing. Recognise the importance of lifelong learning for personal growth.
7	Utilising digital capabilities for your career	Operate digital technologies in specific career contexts. Understand, analyse, and evaluate data, information, and digital content specific to professional practice. Practise innovation and entrepreneurship in a digital environment.

Source: VNU University of Social Sciences and Humanities (2021) [15].

Table 2. Survey on the role of digital competence.

Year	Author	Name survey	Object survey	Main conclusion
2019	J. Abel-Koch, et al. [19]	European Small and Medium Business Survey: Going Digital	2586 businesses with 20249 employees in Poland, France, UK, Spain, Germany	The lack of digital literacy amongst employees in the enterprise and external labour market is a significant obstacle for businesses in all five countries
2019	M. O'Loughlin, et al. [20]	Global Digital Skills Survey	Information technology experts of organizations around the world	19% of businesses have applied digital technology and changed business processes, yet employees and business processes have not adapted in time
2020	BrainStation [21]	Survey on Digital Literacy	Unknown	83% of those surveyed believe their level of understanding of data in the organisation is medium and low, and that this deficiency has adversely affected the success of the organisation

Source: [19-21].

In Table 2, the survey results show the lack of understanding about the digital literacy of employees is one of the major obstacles for businesses, especially in the context that businesses are in the process of applying digital technology and changing business processes [19-21].

According to estimates by A. Cameron, et al. (2019) [22], by 2035, about 15% of all jobs in Vietnam will be automated and up to 38.1% of current jobs in Vietnam could be transformed or relocated due to the impact of automation by 2045. This implies that a significant proportion of Vietnamese workers will risk unemployment if they are not upgraded or equipped with new skills, especially digital capabilities. The World Bank report (2021) [23] suggests that the Vietnamese economy will lose about 2 million jobs by 2045 if no solution is found to bridge the gap between supply and demand in terms of human resources for digital transformation.

It can be concluded that digital literacy is one of the important competencies of the 21st century and an essential capacity in the context of digital transformation, encompassing not only the ability to use IT but also the soft skills needed for adapting to the changing labour market

3. Guidelines and policies of the Communist Party of Vietnam and the Government on improving digital literacy of human resources

Digital transformation is a vital requirement for development; thus, Vietnam cannot afford to remain detached. Over the recent years, Vietnam has been amongst the pioneering countries advocating for a national digital transformation programme to meet the nation's developmental requirements in the new era. In this context, the digital literacy of human resources has been identified as a pivotal factor for successful digital transformation. The Communist Party of Vietnam and the Government have hence developed and issued a series of strategic documents to enhance the workforce skills in adapting to the Fourth Industrial Revolution's trends of digitisation and automation. The policy emphases include:

Prime Minister's Decision No. 681/QD-TTg (June 4, 2019), "On promulgating a roadmap for the implementation of sustainable development goals until 2030". The objective is to notably augment the number of workers with skills aligned with labour market demand. By 2025 and 2030, the proportion of trained workers will be 70 and 75% respectively; the percentage of workers with IT skills will be 80 and 90% respectively [24].

The 12th Politburo's Resolution No. 52-NQ/TW (September 27, 2019), "On a number of guidelines and policies to actively participate in the fourth industrial revolution". Clause 5, Section III addresses human resource development policy: "Overall review and reform of educational and training contents and programmes towards developing accessibility, creative thinking and adaptability within a continually changing and evolving technological environment" and "Innovation in teaching and learning methods based on digital technology application; assessment of enterprises for the quality of IT university training" [25].

Prime Minister's Directive No. 24/CT-TTg (May 28, 2020) "On promoting and developing skilled human resources, contributing to improving labour productivity and increasing national competitiveness in the new situation". This directive "encourages enterprises to recognise, recruit, employ, and pay wages and salaries to employees based on skills and practical capacity; prioritise workers who have been trained or have national vocational skills certificates as prescribed by law" [26].

Prime Minister's Decision No. 749/QD-TTg (June 3, 2020), approving the "National Digital Transformation

Programme to 2025, with orientation to 2030". The goal is to reach the dual objective of developing a digital government, digital economy, digital society, and forming Vietnamese digital technology enterprises with global reach by 2030 [27].

Prime Minister's Decision No. 1486/QD-TTg (October 1, 2020), on "Vietnam Labour Skills Day" is aimed at inspiring the domestic community to support labour skill development, thus contributing to enhancing productivity, labour efficiency, and national competitiveness [28].

Prime Minister's Decision No. 2289/QD-TTg (December 31, 2020), promulgating the "National Strategy on the 4th Industrial Revolution to 2030". It proposes regulations to "evaluate workers' skills in relation to the requirements of the fourth industrial revolution and suggest solutions and policies to enhance the skills of the workforce"; "Building retraining programmes for workers to transition into jobs requiring new skills of the fourth industrial revolution" [29].

The 10-year socio-economic development strategy for the period 2021-2030 emphasises four central needs for Vietnamese human resources: (i) Technical human resources, (ii) Digital human resources management, (iii) Management level human resources: technical management, business management, public/social management, and (iv) Human resources for social care. Based on these, the Government issued Decision 176/QD-TTg promulgating the Programme to support the development of the labour market until 2030. This Programme aims to lay a solid foundation for the synchronous development of labour market factors, contributing to the effective mobilisation, allocation and usage of resources for socio-economic development; transforming the labour structure towards modern development and ensuring the connection between the domestic labour market and the regional and global labour market.

Prime Minister's Decision 146/QD-TTg (2022) [30] approves the Project "Raising Awareness, Popularizing Skills and Developing Human Resources for National Digital Transformation to 2025, Orientation Towards 2030". The project recognises: "Digital skills universalisation is the key for people to access digital knowledge and skills to participate in the digital transformation process, opening up opportunities to access digital services on an equal basis, contributing to an inclusive digital society. Human resource development is key to effective and sustainable digital transformation, helping to successfully realise the goals of the National Digital Transformation Programme to 2025, with a vision to 2030" [30]. Thus, it is critical to enhance the quality and efficiency of training and development of human resources for digital transformation across each industry, each field, and each locality.

4. Assessment of digital literacy of Vietnamese human resources

4.1. Availability of digital information

Vietnam possesses a robust infrastructure essential for the development of digital human resources.

The Vietnamese Government advocated for nationwide internet connectivity in 1997. Although Vietnam was slower to adopt the internet compared to other nations, since 1997, it has become one of the world's fastest-developing countries in terms of internet connectivity. Thanks to the comprehensive broadband infrastructure across the country, internet connectivity is ubiquitous, ranging from urban areas to rural communities, from plains to mountains, borders and islands. Consequently, the IT competency of the majority of Vietnamese citizens has significantly improved.

The advent of the internet prompted societal transformations. Technological penetration began shaping an application-based economic system, altering societal structure. The escalating internet usage also bridged merchants, consumers, and families. The emergence of smart cities, particularly those adopting IT; the advent of the 4th industrial revolution characterised by comprehensive digitisation, including product and service digitisation, customer engagement digitisation, and productivity enhancement through digitisation; public services becoming faster and more efficient; all these factors contributed to the rise of the digital generation (the generation with technological capabilities).

According to the Digital Economy Index report surveyed by the Financial Times and Omdia, published at the end of November 2022, Vietnam ranked second for the world's fastest digital economic growth rate (12.3%) in 2022 (just behind India), third fastest in the world (10.3%) in 2023 (after Mexico and India), and is predicted to top the global growth rate of the digital economy from 2022 to 2026 [31]. Furthermore, in the 7th Southeast Asian e-Conomy SEA digital economy report,

announced by Google, Temasek, and Bain & Company on October 27, 2022, Vietnam's internet economy reached USD 23 billion in 2022 and is projected to reach USD 49 billion in 2025. This is the fastest growth rate in the region, and Vietnam's internet economy is anticipated to expand rapidly, potentially reaching a record level of USD 120-200 billion by 2030 [31].

By January 2023, Vietnam had 77.93 million internet users, constituting an internet usage rate of 79.1% of the total population, the 12th highest in the world and the 6th in Asia. Over 70 million people used social networks, predominantly YouTube and Facebook (ranked 7th out of 10 countries using Facebook and one of the 10 countries with the highest number of YouTube users worldwide). The prevalence of social networks in Vietnam continues to grow, showing no signs of slowing down [32]. This robust infrastructure provides Vietnam with the opportunity for swift digital economic transformation and stimulates the demand for digital human resources.

Another influential factor impacting the digital literacy of human resources is a country's economic, social, and educational status. In Vietnam, rapid economic growth has transformed it from one of the world's poorest countries into a lower-middle-income country. Consequently, the general education level in Vietnam has improved. This is evidenced by Vietnam's high scores in the Program for International Student Assessment (PISA) in 2012, 2015, 2018, and 2022, where Vietnamese students' learning outcomes far exceeded many countries in the Organisation for Economic Cooperation and Development [33].

Since 2006, the Vietnamese Government has advocated for the socialisation of IT dissemination across society, encouraging domestic and foreign organisations and individuals to participate in many forms of IT training. Policies have been enacted to enhance computer literacy and the application of IT in all fields of study, promote online distance learning for all types of training, and recognise the legal value of diplomas and certificates in an online learning environment. Most educational institutions have started using open-source software in their training activities.

Informatics is taught effectively and efficiently at all educational levels. In general education, it is an elective subject at the primary and lower secondary levels, and compulsory at the high school level. The development of applied informatics learning programmes according to knowledge modules allows for flexible and practical application to many levels, incorporating new technology content, and actively using open-source software in IT curricula at all levels. Throughout the implementation process since 2006, the education sector and society as a whole have recognised the importance of Informatics, and the percentage of Informatics training in primary and lower secondary schools has been rapidly increasing.

Figure 1 provides data on elementary, middle, and high schools that teach Informatics. In 2006, the percentage of primary schools and junior high schools that taught informatics was very low (7.1% in primary schools and 30.5%) in junior high schools. However, with a high growth rate for many years, by 2020, the percentage of schools that teach informatics will be quite high: 72.4% for primary school and 89.3% for lower secondary school level. For the upper secondary level, the rate is relatively stable, close to 100%.

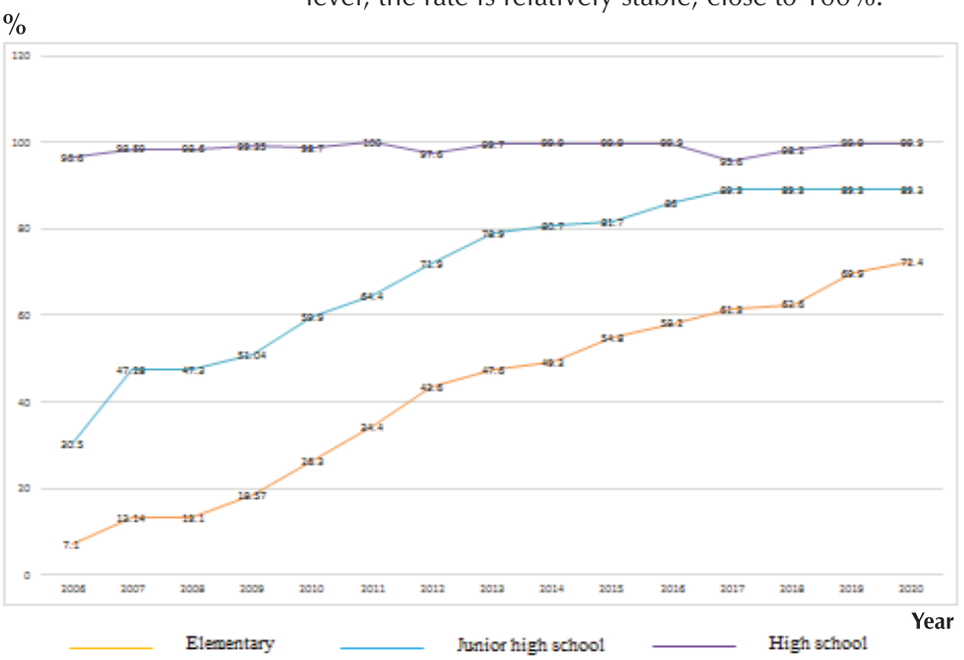

Fig. 1. Percentage of high schools that teach informatics. Source: Author compiled from Vietnam ICT Index (year 2006 to 2020) of Office of National Steering Committee for Information Technology and Ministry of Information and Communications.

One significant factor influencing the digital proficiency of human resources is the extent of IT training. In Vietnam, as of 2020, 158 universities and 442 colleges and vocational schools offer IT courses. For the academic year 2020-2021, the combined enrolment target for university courses in IT, electronics, telecommunications, and information security is 82,085 students. The annual number of university and college students specialising in IT and communications is estimated to be over 50,000. Vocational schools in IT are projected to produce around 12,000 graduates annually [34].

Table 3 provides the number of universities, colleges, vocational schools, and enrolment targets for IT majors from 2010 to 2020 and demonstrates the reality of IT enrolment is quite high.

Table 3. Number of universities, colleges, vocational schools, and enrolment targets for IT majors (2010-2020).

Year	College and University block		College, vocational secondary school	
	College and University number	*Enrolment targets (students)*	*College, Vocational secondary school number*	*Enrolment targets (students)*
2010	277	60,332	186	66,631
2011	290	64,796	113	32,632
2012	290	65,501	143	25,527
2013	290	67,518	228	24,569
2016	250	68,883	204	18,311
2017	131	48,631	412	67,673
2018	149	51,114	412	67,662
2019	158	68,435	442	52,424
2020	158	82,085	442	56,838

Source: Ministry of Information and Communications (2014-2021) [35-40].

In 2020, actual enrolment rates in universities and colleges were high, reaching 84%, and 68.27% for colleges and vocational schools [40]. The number of IT graduates has been steadily increasing each year, with the graduation rate reaching 93.88% (around 64,000 individuals) in 2016. For vocational schools, the graduation rate stands at 52.4%, equating to approximately 9,600 people [36].

To enhance the quality of education, universities and colleges focus not only on investing in material and technical facilities and educational reform, but also on enhancing the professional qualifications and English proficiency of the IT teaching staff. Numerous universities have policies to attract overseas Vietnamese scientists and international IT experts for participation in training and scientific research. This involves promoting high-quality training associations, exchanging lecturers and experts with foreign countries, and encouraging experts and technicians with professional experience in enterprises to participate in training IT human resources.

Since 2017, the Ministry of Education and Training has endorsed a strategy that permits universities and colleges to provide IT training according to specific mechanisms. This entails dedicating 30-50% of the course time to practical study and work experience, directly under the tutelage of enterprise experts. The educational institutions work closely with IT enterprises during the training process to improve students' practical skills and their applicability in real-world settings. Universities are required to publicise the employment rate of their graduates (12 months post-graduation) on their websites and report these figures to the Ministry of Education and Training. Training institutions are encouraged to offer training according to the orders of businesses and societal needs, and to foster links between user facilities and IT human resource training institutions. As a result, there has been a substantial number of students and graduates in IT, a portion of whom have met the high requirements for working and conducting research within the IT industry.

Despite the high number of IT training institutions, the quality of training is inconsistent. A handful of institutions have the necessary capacity, equipment, and training methods to meet international standards, while the majority do not meet societal requirements. Students aspiring to secure employment in large companies or specialise in IT often need to attain additional international certifications in programming and network administration, improve their foreign language skills, and enhance their soft skills.

The link between enterprises and training institutions remains weak, and Vietnamese IT enterprises have not actively collaborated with universities and colleges in IT training and career

orientation. Although the Government has encouraged partnerships between enterprises, universities, and research institutes to develop IT human resources, the reality falls short of expectations. The collaboration between training institutions and enterprises is still nascent. The current cooperation is largely one-sided, with schools needing enterprises to increase practical training, while the latter does not yet fully recognise the schools as a stable source of quality labour.

4.2. Digital processing capacity

The quality of human resources in Vietnam has shown significant improvement. Despite lower levels of public spending on health, education, and social protection, Vietnam's human capital index continues to surpass the average of countries with comparable income levels. Among the countries in the East Asia - Pacific region, Vietnam is one of the top performers on the human capital index. According to the United Nations Development Programme's Global Human Development Report 2020, Vietnam's Human Development Index (HDI) for 2019 was 0.704, ranking 117th out of 189 countries and territories [41]. From 1990 to 2019, Vietnam's HDI increased by more than 48%, moving from 0.475 to 0.704. Vietnam's 2019 HDI score of 0.704 exceeded the 0.689 average for developing countries but fell short of the High Human Development average of 0.753 and the 0.747 average for countries in East Asia and Africa Pacific. As per the General Statistics Office, the proportion of trained workers in Vietnam increased from 40% in 2010 to 65% in 2020. The percentage of workers aged 15 years and older in employment with training has progressively increased from 15.4% in 2011 to 24.1% in 2020 [41]. Therefore, the prevalence of high-quality human resources in Vietnam has been steadily increasing, with some industries, such as medical, mechanical, technology, and construction, reaching regional standards.

Vietnam's human resources have significant advantages, primarily comprising young, hard-working, progressive workers. The population is large and has a relatively solid background in mathematics and IT. The quality of labour has been gradually improving over the years. Trained labour has, to an extent, met the requirements of enterprises and the labour market. The technical workforce has steadily mastered science and technology, undertaking most complex work positions in production and business. Therefore, these factors provide favourable conditions for meeting the technical, technological, and operational requirements of the labour market when transitioning to the digital economy [42].

However, the quality of Vietnam's human resources remains somewhat constrained: The country lacks a significant number of methodically trained, high-quality workers to meet the requirements of true experts in vital economic sectors such as finance, banking, insurance, energy, mechanical engineering, information and telecommunications, environment, and international law [43]. As per the World Bank's assessment, the quality of human resources in Vietnam only scored 3.79 out of 10 points, ranking 11th out of 12 surveyed Asian countries. South Korea reached 6.91 points, India 5.76 points, and Malaysia 5.59 points. Many indicators of Vietnam's human resource quality remain subpar compared to developed countries in the region [43]. Workers without professional and technical qualifications also constitute a significant proportion of the labour force.

Workers lacking professional and technical qualifications make up a substantial proportion of the labour force.

Table 4 shows that the labour force without technical qualifications accounts for a high proportion with 79.7% in 2015, by 2021, although the rate has decreased, it still accounts for 73.9%. The trained labour force comprises roughly one-quarter of the country's total labour rate. As of the first quarter of 2023, the nation had approximately 38.1 million untrained workers [44]. This poses a considerable challenge for employees as production activities are becoming increasingly automated, necessitating workers to adapt to technological advancements, particularly in the context of an evolving business environment.

Vietnam's labour productivity remains somewhat limited: Over the years, Vietnam's labour productivity has seen notable improvement in both value and speed. Nevertheless, it still lags behind that of other Southeast Asian countries.

Table 4. Professional and technical qualifications of employees, 2015-2021 (unit: %).

Targets	2015	2016	2017	2018	2019	2020	2021
No technical qualifications	79,7	79,1	78,3	78,0	77,2	76,0	73,9
Primary	5,0	5,0	5,4	5,5	3,7	4,7	6,8
Professional range	4,0	3,9	3,8	3,8	4,7	4,4	4,1
College	2,7	2,8	2,9	3,2	3,8	3,8	3,6
University and above	8,6	9,2	9,6	9,7	10,6	11,1	11,7

Source: Synthesised data from the "Vietnam Labor and Employment Survey" of the General Statistics Office.

Table 5 shows the labour productivity of Vietnam compared to Southeast Asian countries. Although there has been an improvement in recent years, Vietnam still holds the 8th position in the region, behind Singapore, Brunei, Malaysia, Thailand, Indonesia, Philippines, and Laos. In 2019, Singapore's labour productivity was 11.5 times higher than that of Vietnam.

The lower education levels of the workforce can be considered a contributing factor to Vietnam's relatively low labour productivity within the region. In 2020, the workforce with a secondary school diploma or higher made up 61.2% of the total number of employees. Conversely, the number of workers who have graduated from high school or higher, or possess professional and technical qualifications, accounted for only 38.8% [41] (Fig. 2).

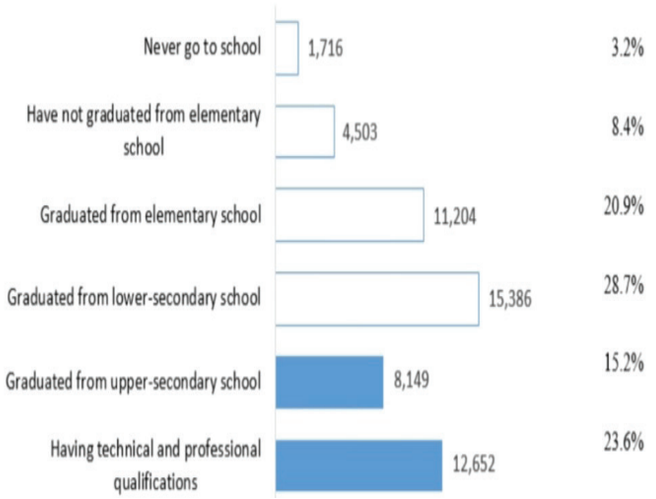

Fig. 2. Vietnam's labour force by education level (unit: thousand persons). Source: General Statistics Office (2020) [41].

Moreover, the digital literacy of Vietnamese human resources remains underdeveloped: According to the Global Competitiveness Index 4.0 (GCI 4.0) 2019, Vietnam currently ranks 67th out of 141 countries on the GCI 4.0 index, yet only 93rd in terms of skills, representing the lowest ranking among the thirteen indicators [45]. Consequently, inadequate skill levels can be seen as a hurdle for Vietnamese workers in the 4.0 job market and an impediment to Vietnam's journey towards global integration in the future.

Table 5. Labour productivity of Vietnam compared to other Southeast Asian countries (unit: USD in GDP PPP).

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Singapore	136.243	139.918	141.219	145.405	146.818	147.417	151.030	156.376	160.348	159.680
Brunei	147.354	150.119	149.045	143.778	138.331	136.813	133.030	134.309	129.057	133.209
Malaysia	48.813	49.061	49.750	49.865	51.467	52.986	54.641	56.625	57.841	59.364
Thailand	25.028	24.542	26.268	27.448	28.014	28.956	30.174	31.586	32.523	33.502
Indonesia	18.360	19.033	19.033	20.488	21.166	22.034	22.851	23.303	24.013	24.425
Philippines	14.955	15.016	15.805	16.582	17.102	17.877	18.690	20.379	21.202	21.832
Lao PDR	9.843	10.362	10.911	11.498	12.083	12.677	13.285	13.920	14.507	14.887
Viet Nam	8.833	9.214	9.547	9.851	10.299	10.933	11.559	12.216	12.859	13.817
Myanmar	6.689	6.999	7.446	8.007	8.572	9.091	9.774	10.584	11.036	11.548
Cambodia	4.818	4.999	5.393	5.847	6.160	6.475	6.656	6.959	7.368	7.774
Timor-Leste	7.831	8.094	8.393	8.361	8.524	8.560	8.632	8.018	7.704	7.741

Source: ILO (2019).

In terms of the digital skills scores for the Asia-Pacific workforce, Singapore and Malaysia are the two frontrunners, while Vietnam's standing is relatively low in comparison to other regional countries [45].

Figure 3 shows the digital skills scores of the workforce in some Asia-Pacific countries, with Vietnam scoring quite low compared to other countries, reaching 46.1 points in 2019, behind many countries in the region.

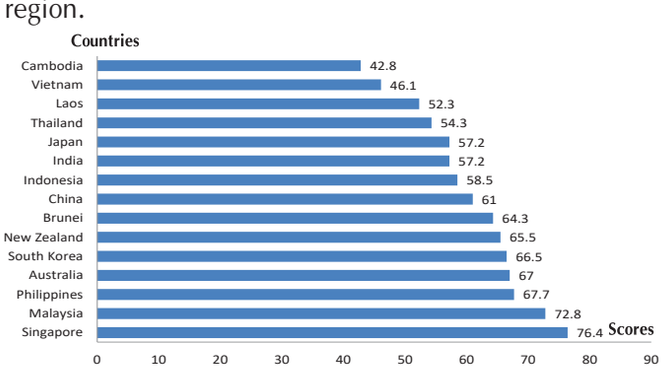

Fig. 3. Digital skills scores of the workforce in some Asia-Pacific countries. Source: World Economic Forum (2019) [45].

According to the Global Talent Competitiveness Index (GTCI) report, compiled by the Adecco Group, Google and INSEAD, Vietnam is ranked 96th out of 132 countries on the GTCI 2020. This signifies a drop of five places compared to 2019 and nine places compared to 2018. The disparity between Vietnam and other high-income countries in terms of digital capabilities, especially AI, is markedly expanding. Digital literacy represents a significant gap between training and corporate needs within Vietnam's human resources. The advent of AI necessitates the training of new skills for the workforce.

As for Vietnam's IT human resources: In the early '90s, Vietnam's IT human resources were scarce in both research and training as well as implementation and application. Notably, the core IT workforce, possessing profound knowledge and command of key technologies, appeared sporadically and fragmented. The number of professional staff working in the IT field was minimal, with no alignment or coordination towards a unified goal to create synergy. Universities only trained a small number of students in IT-related fields. However, after implementing the "National Program on IT" in 1995, the number of IT human resources began to grow. Following the investment and development from the Party and State, by 2019, the total number of IT industry employees reached 1,055,000 [39], exceeding one million for the first time, thereby achieving the goal of having one million IT human resources by 2020 one year ahead of schedule.

However, current IT human resources do not yet meet labour market demands. According to a Vietnamworks forecast, the country presently lacks about 400,000 IT workers and needs to supply 78,000 new employees annually [46]. The demand for recruiting in this sector increases as the Government pushes digital transformation and technology 4.0, and as new IT businesses emerge, leading to heightened competition for human resources. Although the demand for IT human resources is immense, domestic IT human resource training institutions have not met societal development needs, particularly in the training of high-quality engineers. Currently, only about 27% of IT workers meet the requirements; the remaining 72% need additional training for at least three months [34]. Hence, in terms of the quality of human resources, we have not yet achieved the set target.

Furthermore, digital transformation, which encompasses three main pillars: building a digital government, developing the digital economy, and forming a digital society, requires a large IT workforce with profound expertise in digital technology and digital skills. At present, there is a severe shortage of human resources for digital transformation across all three pillars in Vietnam. The digital transformation demands a substantial number of human resources trained in new and specialised areas such as AI; big data; cloud computing; IoT; virtual reality/augmented reality (VR/AR); blockchain; 3D printing, but very few training institutions offer these new majors. Most universities, colleges and vocational schools providing IT training to meet the requirements of digital transformation face challenges due to a lack of teaching staff; unstandardised training programmes and contents; and inadequate facilities and practice rooms for research training.

IT enterprises have not collaborated closely with state management agencies and training institutions in the training of IT human resources. Some businesses, while having affiliate programmes with training institutions that accept interns and support jobs for students after graduation, tend to focus only on the most promising students, neglecting long-term development, leading to output imbalance.

Compared to the global stage, the IT capacity of Vietnamese human resources has yet to be adequately recognised.

Table 6 shows, Vietnam's telecommunications standing is primarily assessed via the ICT Development Index published by the International Telecommunication Union. The index is evaluated based on three criteria: accessibility to ICT services (40%), utilisation of ICT services (40%), and ICT skills (20%). Regrettably, Vietnam often finds itself positioned at the lower end of this ranking. Out of the three assessed criteria, the index of ICT skills of human resources is consistently the weakest. According to ITU data from 2017, Vietnam ranks 108th out of 176 countries worldwide and 6th among 11 ASEAN countries (behind Singapore, Brunei, Malaysia, Thailand, and the Philippines). The ICT skills index shows a continued lag compared to previous years and holds a low position globally, ranking 113/176 in 2017.

Table 6. ICT ranking of Vietnam by a number of international indicators (ranking results/total countries).

Year	Assessment by the International Telecommunication Union		Assessment by the United Nations	Assessment of the World Economic Forum
	ICT Development Index	*Skills of ICT Human Resources Index*	*E-Government Development Index*	*Networked Readiness Index*
2001	-	-	-	74/75
2002	107/154	95/154	-	-
2003	-	-	97/173	-
2005	-	-	105/191	75/115
2007	92/154	102/154	-	-
2008	86/154	105/154	91/192	-
2009	-	-	-	70/134
2010	94/166	109/166	89/190	55/133
2011	-	-	-	55/138
2012	81/161	101/161	83/190	83/142
2013	-	-	-	84/144
2014	-	-	99/193	-
2015	102/167	108/167	-	85/143
2016	-	-	89/193	79/139
2017	108/176	113/176	-	-
2018	-	-	88/193	-
2020	-	-	86/193	85/148

Source: Author's compilation from Ministry of Information and Communications (2019b) and International Telecommunication Union (2007-2017) [47-53].

In 2020, Vietnam's E-government ranking was 86 out of 193 countries (23 out of 47 in Asia and 6 out of 11 in Southeast Asia), improving by 2 places compared to 2018. However, within the component indices (Human Resources Index, Telecommunications Infrastructure Index, Online Services Index, Electronic Participation Index, Open Government Data Index), the Human Resources Index occupies the lowest ranking, placing 117 out of 193 countries.

Additionally, the World Economic Forum determines the Networked Readiness Index of countries based on the evaluation of ICT readiness and exploitation, focusing on three primary factors: environment for ICT development (policy, infrastructure, political stability), ICT readiness (of citizens, businesses and governments) and ICT usage (by individuals, businesses and governments). In this regard, Vietnam maintains a relatively low average global ranking, placed 85 out of 148 countries in 2020. Consequently, the digital literacy of human resources remains a weak point for Vietnam.

5. Discussion

The preceding analysis indicates that, given the inevitable trend of digital transformation, it is exceedingly important and urgent to upgrade both knowledge and skills, particularly in digital literacy for human resources. Enhancing the quality of human resources not only facilitates job stability for employees, but also contributes to improving labour productivity, reducing costs, bolstering competitiveness for Vietnamese enterprises, and increasing income to attract foreign investment. The construction of a high-quality workforce prepared for digital transformation primarily requires close cooperation and coordination between the Government, training service providers, employers, and the workers themselves.

The Government has a significant role in forming a legal framework as well as establishing digital infrastructure for digital transformation and digital capacity development for the workforce. In addition, the Government can plan budgets and support policies for businesses, particularly small and medium-sized enterprises in the digital transformation process, as well as provide training and upgrade digital skills for workers. Through online training portals, the Government and

stakeholders can establish short and long-term training programmes and courses, permitting businesses and workers to utilise them for free. The Australian portal, SkillFinder, which connects the workforce and SMEs with digital skills training, serves as a good example. This platform offers thousands of digital competency training courses designed and developed by leading technology enterprises (AWS, IBM, Microsoft, Google...). In Vietnam, there exists a Digital Citizen platform (https://www.congdanso.edu.vn/) offering training courses on digital skills, soft skills, entrepreneurship skills..., supported by Google and Microsoft corporations. However, these have not been widely promoted for employees and citizens to access. Furthermore, policymakers need to develop solutions to enhance the flexibility of the labour market, allowing workers to transition jobs easily in accordance with their professional skills.

Training service providers must attract highly qualified human resources to instruct, train, and disseminate digital skills. Strong application of digital technology in training digital skills, such as online learning, and sharing digital resources in teaching and learning, is essential. Additionally, training units need to collaborate with experts in technology training and professionals currently employed at reputable technology enterprises to stay abreast of new technology trends and design courses in line with practical needs and technological standards.

For businesses, it is necessary to clearly identify the digital literacy requirements to equip employees in alignment with their strategy, business model, and digital transformation orientation. They should then offer training options, upgrade skills for the existing workforce, as well as recruit new workers with appropriate professional skills. Strengthening connections with the Government, regulatory bodies, and training service providers should also be prioritised.

Workers need to enhance their initiative and adaptability. With the rapid development of digital technology, a range of digital skills training courses are freely available through online training portals such as Digital Citizen of Vietnam, Vietnam Digital 4.0 Launchpad - a Google initiative supporting Vietnam, AWS Skill Builder by AWS, or Google Digital Garage. Vietnamese workers, particularly Generation Z, forecasted to constitute one third of the working-age population by 2025, can master the process of cultivating and upgrading their digital skills to adapt to the ever-increasing demand for digital workers in the labour market.

It can be affirmed that the development of human resources, especially those with high-quality labour skills closely linked with the development and application of science and technology, is considered a strategic breakthrough. This is a key decisive factor for restructuring the economy, transforming the growth model and competitive advantage, and ensuring rapid, effective, and sustainable development. Amid international integration and the Fourth Industrial Revolution, the emergence of new technology, automation and numerous development trends profoundly affect the labour market, changing the job structure and setting new requirements for labour skills. The higher the skill level of employees, the faster the application of modern scientific and technological achievements will assist enterprises in exploiting resources effectively, innovating business models, improving labour productivity and competitiveness. Consequently, in the context of implementing digital transformation, apart from technology and capital investment, human resources with digital capabilities become a crucial determinant for the sustained growth and success of enterprises.

6. Conclusions

Digital transformation is becoming an inevitable trend in the process of the Fourth Industrial Revolution and this process is taking place strongly in many countries around the world. Vietnam is also in the process of digital transformation, which requires Vietnam to prepare a human resource with commensurate digital literacy to adapt and master technology in the fields of socio-economic life.

In Vietnam, many studies show that the Vietnamese workforce has many limitations in terms of digital literacy. Therefore, to succeed, Vietnam needs to especially improve the digital skills of its workforce, otherwise, we will not achieve the expected success, which is a shortcut, and many Vietnamese workers will not be able to find jobs through the process of digitisation.

In that context, Vietnam needs to act sooner and more drastically to solve the current problems of labour for digital transformation, to supply enough in quantity, and to meet the increasing quality requirements of employees in the enterprise.

The study of the digital literacy of Vietnamese human resources is one of the bases for training and fostering digital capabilities for employees. Digital literacy needs to be included in the curricula at all levels of education, with many different levels of access, and regularly survey and evaluate the digital capacity of human resources based on digital competency frameworks corresponding to specific target groups.

COMPETING INTERESTS

The author declares that there is no conflict of interest regarding the publication of this article.

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