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The Issue of Human Resource Training to Meet the Requirements of Developing the Productive Forces in the Current Context of Digital Transformation in Vietnam

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Abstract

Digital transformation is bringing about a qualitative transformation of the productive forces in Vietnam, in which data are becoming a new object of labor, digital platforms and artificial intelligence are emerging as important means of labor, and knowledge is increasingly functioning as a direct productive force. In this transformation, workers continue to occupy a decisive position, while facing competency requirements that differ substantially from those of previous periods. Therefore, hu-

man resource training is not merely a social policy accompanying modernization; rather, it constitutes an integral component of the development of the productive forces themselves. This article examines how human resource training can meet the requirements for developing the productive forces within the current context of digital transformation in Vietnam.

Keywords: Human resource training; productive forces; digital transformation; workers; science and technology; Vietnam.

1. INTRODUCTION

Within the system of categories of historical materialism, the productive forces constitute the most dynamic and revolutionary element of the mode of production. Within their structure, workers are the agents who create and operate tools, drawing on knowledge and skills accumulated over successive generations. Karl Marx illustrated the relationship between the development of productive instruments and social relations with a concise comparison: the hand-mill is associated with a society of feudal lords, whereas the steam-mill is associated with a society of industrial capitalists [1, p. 166]. This proposition contains a methodological implication: every leap in the level of technology requires a corresponding transformation in the capabilities of the working population.

Digital transformation is generating a comparable technological shift. Unlike previous waves of mechanization and automation, which primarily amplified physical strength and the precision of operations, digital technologies, big data, and artificial intelligence directly intervene in functions previously regarded as the domain of intellectual labor: analyzing information, identifying patterns, and even recommending possible courses of action. The boundary between simple labor and complex labor is therefore being redrawn; many skills that once ensured stable employment for decades are at risk of losing their value after only a few technological cycles.

In Vietnam, this issue has been recognized at the strategic level. Resolution No. 57-NQ/TW dated December 22, 2024, of the Politburo identifies science and technology, innovation, and digital transformation as the primary breakthrough and a major driving force behind the development of modern productive forces and the improvement of relations of production, with the objective that the digital economy will account for 30% of GDP by 2030 [2]. Subsequently, Resolution No. 71-NQ/TW dated August 22, 2025, on breakthroughs in education and training, emphasizes the development of high-quality human resources [3]. The two documents address complementary policy priorities: the first establishes objectives for modernizing the productive forces, while the second focuses on the human capabilities required to achieve those objectives.

However, the gap between objectives and practice remains considerable. In 2025, the share of value added generated by the digital economy in GDP was estimated at 14.02%, equivalent to approximately USD 72.1 billion [4], compared with the national target of 20% of GDP for 2025 [5]. At the same time, the proportion of workers with formal degrees or certificates from training programs nationwide reached only 29.2% [6]. Consequently, more than seven-tenths of the labor force lacked formally recognized professional or technical qualifications, although the absence of certification does not necessarily imply an absence of practical skills. This distinction matters as Vietnam seeks to move toward a more knowledge-intensive growth trajectory. The mismatch between the pace of digitalization of the means of labor and the pace of upgrading workers' capabilities represents a substantial challenge to the current transition.

This article addresses three questions: How is digital transformation changing the productive forces, and what new requirements does it impose on human resource training? To what extent does existing training in Vietnam meet these requirements? What measures are needed to narrow the gap between workers' current capabilities and the demands of digital production? The analysis draws on dialectical and historical materialism, supported by documentary analysis, synthesis, statistical comparison, and policy analysis of Party resolutions, legal instruments, official statistics, and established international reports.

2. DIGITAL TRANSFORMATION AND THE REQUIREMENTS FOR HUMAN RESOURCE TRAINING IN DEVELOPING THE PRODUCTIVE FORCES

It is necessary to distinguish digital transformation from digitization and the application of digital technologies: only when the entire model of production organization and management methods are restructured on a data-driven foundation can it be understood as a comprehensive transformation of the productive forces. In this process, digital transformation simultaneously affects all three components. Regarding the means of labor, tools are no longer individual machines but digital platforms, automated control systems, and artificial intelligence models capable of self-learning. Regarding the objects of labor, data becomes a new type of object of labor, which can be reused without being physically consumed, although its economic value depends on quality, access, context, and effective application. Regarding workers, competency requirements shift from operational precision to the ability to work with data and solve problems that algorithms cannot yet handle.

This transformation demonstrates in practice C. Marx's proposition concerning the potential for knowledge to become a direct productive force. In digital production, knowledge exists not only in the form of workers' individual experience but is also encoded into algorithms, processes, and models and embedded directly in the means of labor. This creates a paradox: the more knowledge is embodied in machinery, the higher the level of competence required of operators, because they must understand system operations, exercise oversight, and remain accountable for consequential decisions. Resolution No. 57-NQ/TW identifies institutions, human resources, infrastructure, data, and strategic technologies as central priorities for national development [2].

During the 2021–2025 period, the share of value added generated by the digital economy in GDP increased from 12.87%

to 14.02%, averaging approximately 13.2% over the period. Over this period, core digital-economy sectors accounted for an average of 8.13% of GDP, while the digitalization of other sectors accounted for an average of 5.05% [4]. These figures indicate two things. On the one hand, the digital economy has become a substantive component of the national economy rather than a peripheral phenomenon. On the other hand, the increase of approximately 1.15 percentage points over five years remains modest relative to the targets of 20% of GDP by 2025 and 30% of GDP by 2030, suggesting that wider adoption of digital technologies has not necessarily translated into equally substantial productivity improvements across all traditional sectors [5].

The differentiation among localities is also pronounced. According to the National Statistics Office, four of the 34 provincial-level localities recorded a digital-economy share exceeding 20% of GRDP, with Bac Ninh reaching 46.30%, Hanoi 17.34%, and Ho Chi Minh City 13.43% [4]. Several leading localities have substantial foreign-invested electronics manufacturing activity. This pattern raises questions about the extent to which digital-economy growth reflects domestic technological capabilities rather than activity within international production networks; the available figures alone do not establish the occupational skill composition of those activities. If domestic human resources are not upgraded in a timely manner, Vietnam risks remaining at the lower stages even within the very sector regarded as a strategic priority.

At the social level, digital transformation creates a requirement to universalize digital capabilities throughout the population. Plan No. 01-KH/BCĐTW dated March 21, 2025, of the Central Steering Committee for the Development of Science, Technology, Innovation, and Digital Transformation launched the “Digital Literacy for All” movement with the spirit of nationwide and comprehensive participation, leaving no one behind [7]. The movement’s deliberate reference to the mass-literacy initiatives associated with 1945 is more than symbolic: it reflects the recognition that a lack of digital capabilities in modern society is equivalent to a form of functional exclusion that can limit full participation in economic, civic, and administrative life.

First, there are requirements concerning the distribution of training fields. The shift of the productive forces toward a digital foundation requires a significant increase in the proportion of human resources in the fields of basic sciences, engineering, and technology. Resolution No. 71-NQ/TW sets the target that by 2030, the proportion of learners in basic sciences, engineering, and technology will reach at least 35%, while the proportion of workers with college or university qualifications or higher will reach 24% [3]. At the sectoral level, the Human Resource Development Program for the Semiconductor Industry sets the target of training at least 50,000 personnel with university-level qualifications or higher by 2030, including 15,000 personnel in design and 5,000 personnel with specialized expertise in artificial intelligence [8].

Second, competency standards must evolve. Digital competence is no longer a supplementary skill reserved for information technology personnel but has become a foundational competence across all occupations, analogous to the role of literacy in industrial production. Accountants, farmers, administrative officials, and teachers all need the ability to work with data and digital tools at a level appropriate to their respective positions. In addition, as repetitive tasks become automated, the value of workers shifts toward competencies that machines are difficult to replace: critical thinking, the ability to formulate problems, creativity, collaboration, adaptability, and ethical judgment in situations for which algorithms have no predetermined solution.

Third, training must become more timely and continuous. The World Economic Forum’s *Future of Jobs Report 2025* projects that approximately 39% of workers’ core skills will change or become outdated during the 2025–2030 period, and that, if the global workforce is represented by 100 people, 59 will require upskilling or reskilling by 2030 [9]. Compared with formal training cycles of three to five years, an education system operating solely according to the model of “training once for a lifetime” will always lag behind labor market demand. The objective requirement is therefore to shift toward a lifelong learning model with short-term, modular forms of training that can be accumulated and mutually recognized.

Fourth, the organization of training must evolve. Because technology in enterprises often advances ahead of technology in educational institutions, the model of training confined within school campuses increasingly reveals its limitations. Resolution No. 71-NQ/TW calls for the completion of mechanisms to promote school–enterprise linkages, strengthen training within enterprises, and organize training commissioned and assigned according to learning outcomes. In essence, this policy seeks to return part of the training process to the production environment itself, where learners have direct exposure to the most advanced means of labor.

Fifth, training must remain inclusive. Digital technologies spread very rapidly, whereas human capabilities can only be enhanced through a training cycle that necessarily involves a certain time lag. This time lag creates a risk of new stratification: a minority masters technology and captures most of the added value, while a majority is pushed into jobs that are highly susceptible to replacement. If training focuses only on elite groups, the digital divide will widen, and the modernization of the productive forces will be accompanied by increasing inequality, thereby generating tensions within production relations that modernization is itself expected to improve. An efficiently functioning digital production system requires not only several tens of thousands of highly skilled engineers but also tens of millions of workers with basic digital capabilities to absorb technology across all stages of the economy.

3. THE CURRENT STATE OF HUMAN RESOURCE TRAINING IN VIETNAM

3.1. ACHIEVEMENTS

First, the scale and quality of the labor force have continued to improve. According to the Statistics Office, in the fourth quarter of 2025, the number of employed workers nationwide was estimated at 52.7 million, while the proportion of workers with degrees or certificates from training programs reached 29.5% during the quarter and 29.2% for the year as a whole, an increase of 0.8 percentage points compared with the previous year. The continuous upward trend across quarters indicates growing demand for further education and skills upgrading. At the same time, labor productivity in 2025 was estimated at VND 245 million per worker, equivalent to approximately USD 9,809, representing an increase of 6.83% at constant prices and significantly exceeding the average level recorded in the early years of the current term [6, 10].

Second, the institutional framework for digital human resource training has been established relatively comprehensively within a short period. Resolution No. 57-NQ/TW establishes strategic orientations for science, technology, and digital transformation; Resolution No. 71-NQ/TW establishes a breakthrough in education and training, accompanied by specific resource commitments, including state budget expenditure on education and training of at least 20% of total state budget expenditure, with expenditure on higher education alone reaching at least 3%; Decision No. 1017/QĐ-TTg concretizes the objective of training human resources for a strategic industry. The shift from policy orientations to time-bound quantitative targets represents a noteworthy advancement in governance thinking.

Third, the higher education system has rapidly adjusted the structure of its training fields. Many institutions have introduced new programs or restructured existing programs in microchip design, artificial intelligence, data science, and information security; a list of institutions prioritized for investment in semiconductor laboratories has been identified to address bottlenecks in practical infrastructure. At the same time, the policy of incorporating digital competencies and artificial intelligence into general education curricula has created a foundation for developing digital capabilities from the foundational levels of education.

Fourth, the dissemination of digital skills has been implemented on a broad scale. In Ho Chi Minh City, during the 2025–2026 period, 546 training courses were organized, with nearly 78,000 participants, including 7,900 cadres, civil servants, and public employees who completed the digital skills literacy program under the “Digital Literacy for All” platform [11]. Linking learning outcomes with the national electronic identification platform enables digital capabilities to be managed, measured, and recognized systematically, something that previous training programs had difficulty achieving.

3.2. MAJOR LIMITATIONS AND SHORTCOMINGS

First, the proportion of workers with formal degrees or certificates remains low and has not met the planned target. At 29.2% in 2025, Vietnam fell slightly short of the Government’s 30% target for workers with formal degrees or certificates [12]. More important than the shortfall relative to the target is its structural significance: approximately 70% of the labor force lacks formally certified professional and technical qualifications. This does not establish that these workers lack relevant skills, but many may face obstacles to further training arising from limitations in time, cost, and access to prerequisite education. Including the informal labor sector, the size of the group requiring skills upgrading reaches tens of millions of people.

Second, the imbalance between the supply and demand for digital human resources has persisted and has not narrowed. TopDev’s 2023 Vietnam IT Market Report projected a shortage of approximately 150,000–200,000 programmers and engineers per year during 2023–2025. It forecast demand for approximately 700,000 IT personnel in 2025, compared with an estimated supply of around 530,000 at the time of the report [13]. These projections should not be interpreted as verified labor-market outcomes; the challenge described by TopDev is not limited to graduate numbers: the annual number of students enrolling in information technology programs remains high, but a significant proportion does not meet recruitment requirements because of the gap between actual competencies and occupational standards. This suggests a mismatch between the supply of entry-level qualifications and employer demand for specialized, job-ready technical competencies.

Third, the quality and currency of training programs have not kept pace with the speed of technological innovation. Resolution No. 71-NQ/TW frankly assesses that the higher education and vocational education systems remain fragmented and outdated and have not met the requirements for training high-quality human resources, particularly in certain key sectors. There are three manifestations of this situation: programs are designed according to multi-year cycles, making a time lag relative to technological developments in practice inevitable; practical facilities, particularly laboratories for high-technology fields, remain insufficient because of their high investment requirements; and a large proportion of lecturers were trained within previous technological paradigms and have limited opportunities to update their knowledge through practical production experience.

Fourth, linkages between training institutions and enterprises remain weak and, in many places, are often limited in

practical scope. Most cooperation agreements remain limited to receiving students for internships or organizing field visits and have not reached the level at which enterprises jointly design learning outcomes, participate in teaching, and jointly evaluate results. The underlying cause lies in the incentive structure: enterprises are concerned that training costs will be lost when workers change jobs, while cost-sharing mechanisms and incentives for enterprise-based training are not sufficiently strong to compensate for this risk. As a result, post-recruitment retraining has become a common burden that each enterprise must bear on its own.

Fifth, vocational education has not yet effectively fulfilled its pivotal role in developing a highly skilled labor force. The effectiveness of educational streaming after lower secondary education remains low; many vocational education institutions are small and fragmented, with outdated equipment. The causes also lie in the mechanisms for labor utilization: Resolution No. 71-NQ/TW points out that the social preference for status and credentials remains strong and that personnel utilization policies continue to place greater emphasis on degrees than on actual competence. When the labor market signals that university degrees provide greater advantages than substantive occupational skills, all efforts to implement educational streaming through administrative measures are difficult to sustain.

Sixth, retraining for the existing workforce remains largely unaddressed, while regional disparities in access to training remain substantial. The current system is organized primarily around initial training for young people; many mid-career and older workers, including those aged 35 and above who may be affected by automation, have limited access to formal learning opportunities compatible with employment and family responsibilities. At the same time, highly qualified human resources tend to be concentrated in a small number of centers, leaving other localities without a core workforce to implement digital transformation and consequently making them even less attractive to high-quality human resources.

3.3. CAUSES OF THE LIMITATIONS

From an objective perspective, Vietnam entered the current phase of digital transformation with substantial differences in technological capacity across industries, with an economic structure still heavily dependent on processing and assembly and the intensive use of low-cost labor. Labor productivity in 2023, measured in purchasing power parity terms, was equivalent to only approximately 11.2% of Singapore's, 64.6% of Thailand's, and 57.3% of China's [14]. The technological level of most domestic enterprises remains moderate, meaning that demand for highly skilled human resources is not yet sufficiently strong to generate reform pressure from the demand side. In addition, the pace of global technological innovation, particularly generative artificial intelligence, is faster than the capacity of any education system to respond.

From an institutional and organizational perspective, four principal causes can be identified. First, educational management thinking has been slow to shift from administrative management toward developmental governance, limiting the substantive autonomy of training institutions in opening new fields, designing curricula, and recruiting experts. Second, resources are allocated primarily according to inputs and scale rather than being linked to output effectiveness, leaving institutions with insufficient incentives to invest in fields with high training costs. Third, labor market information systems are not yet interconnected with education data, meaning that forecasts of human resource demand continue to rely heavily on estimates. Fourth, the responsibilities of enterprises in training have not yet been fully institutionalized, with insufficient financial instruments such as training funds or tax incentives.

4. SOLUTIONS FOR HUMAN RESOURCE TRAINING TO MEET THE REQUIREMENTS OF DEVELOPING THE PRODUCTIVE FORCES DURING DIGITAL TRANSFORMATION

4.1. RENEWING THINKING AND IMPROVING INSTITUTIONS FOR DIGITAL HUMAN RESOURCE TRAINING

The 13th National Congress of the Communist Party of Vietnam identified human resource development, particularly high-quality human resource development, as one of the three strategic breakthroughs [15]. A prerequisite solution for realizing this orientation is to decisively shift the perception of expenditure on training from "consumption expenditure" to "investment in the development of the productive forces." This understanding determines the position of education in the order of budget allocation priorities and in the development planning of each locality. On this basis, it is necessary to fully institutionalize and establish a roadmap for monitoring the implementation of the resource commitments identified in Resolution No. 71-NQ/TW, particularly the minimum allocation of 20% of total state budget expenditure to education and training.

In parallel, a unified national digital competency framework should be promulgated at an early stage, stratified according to groups of subjects including citizens, workers, and experts, as a common basis for curriculum design, training organization, and assessment and recognition. Accompanying this should be a mechanism for recognizing short-term certificates and micro-credentials, allowing learners to accumulate them progressively and articulate them toward higher levels of qualification. It is this mechanism, rather than the expansion of schools and classrooms, that constitutes the

technical condition for realizing the policy of building an open, interconnected education system and a lifelong learning society.

4.2. RESTRUCTURING THE NETWORK AND DIFFERENTIATING THE TRAINING SYSTEM

The training system needs to be reorganized toward a clear functional stratification rather than allowing institutions to compete on a uniform basis. At the top tier, targeted investment should be made to establish three to five internationally oriented research universities responsible for talent development and research leadership. At the middle tier, a system of high-quality applied universities and colleges linked to key economic regions should be developed. At the foundational tier, vocational education institutions should be reorganized toward a streamlined and standardized system, with greater decentralization to local governments, while also adding an intermediate vocational secondary level to create a clear pathway for educational streaming.

For strategic technology sectors with high investment requirements, such as semiconductors, a regional cluster-based shared laboratory model should be applied instead of spreading investment across individual institutions. This model allows equipment costs to be shared, technical operating personnel to be concentrated, and utilization capacity to be ensured, while also creating a natural space for cooperation among training institutions, research institutes, and enterprises within the same locality.

4.3. INNOVATING CURRICULA, METHODS, AND COMPETENCY-BASED ASSESSMENT

In terms of content, data and artificial intelligence competencies should be integrated into the curricula of all training fields rather than being limited to technical disciplines. Economics students need to know how to read and verify the results of data analysis; social sciences and humanities students need to understand the operational logic and limitations of algorithms in order to critically assess and evaluate the social impacts of technology; and teacher education students need the capacity to organize teaching and learning in digital environments. The competency model should move toward a T-shaped structure: disciplinary depth in one field combined with breadth in digital and interdisciplinary competencies.

In terms of methods, project-based teaching and learning based on real-world problems should be expanded, with problems drawn directly from enterprises or from local digital transformation tasks. In terms of assessment, the emphasis should shift from testing the ability to reproduce knowledge toward assessing problem-solving competencies and outputs. This is also an appropriate response to the widespread use of generative artificial intelligence tools: when the reproduction of information can already be performed by machines, the criteria for assessing human capabilities must inevitably shift toward the ability to exercise judgment, evaluate, and create.

4.4. DEVELOPING THE TEACHING WORKFORCE TO MEET THE REQUIREMENTS OF DIGITAL TRANSFORMATION

Learners cannot develop digital competencies if teachers themselves do not possess such competencies. Therefore, mandatory and periodic training programs on digital competencies, digital teaching methods, and the application of artificial intelligence in teaching should be implemented for the entire teaching workforce, linked to professional standards and evaluation cycles. For higher education and vocational education in technology-related fields, specialized training programs with specific targets are required, such as the target of providing specialized semiconductor industry training for 1,300 lecturers established in Decision No. 1017/QĐ-TTg.

In addition to retraining the existing teaching workforce, channels should be established to attract personnel from outside educational institutions. Mechanisms for co-affiliated lecturers, policies for mobilizing highly qualified individuals outside the teaching workforce to participate in teaching, and the recruitment of outstanding lecturers from abroad with exceptional incentives are important instruments for narrowing the gap between knowledge within educational institutions and knowledge currently utilized in production. These policies can only be effective if accompanied by the simplification of procedures for recognizing qualifications and the granting of substantive decision-making authority to training institutions.

4.5. ESTABLISHING SUBSTANTIVE LINKAGES AMONG THE STATE, EDUCATIONAL INSTITUTIONS, AND ENTERPRISES

To transform tripartite linkages from formal arrangements into substantive cooperation, it is necessary to address the incentive structures of the stakeholders. On the part of the State, there should be a strong shift toward commissioning and assigning training tasks according to output outcomes in key sectors, with payment criteria linked to the employment rate and employment quality of graduates rather than merely to enrollment numbers. On the part of enterprises, mechanisms for enterprise human resource training funds and tax incentives for the costs of training and retraining workers should be established at an early stage, in order to compensate for the risk of training costs being lost and to transform enterprises

into training actors rather than merely users of training outcomes.

The technical condition for this entire mechanism is the establishment and operation of a national education and human resources information system interconnected with the labor market and employment information system. When data on enrollment, graduation, employment, wages, and recruitment demand are interconnected, training institutions have an objective basis for adjusting the structure of training fields, learners have a basis for making choices, and management agencies have a tool for monitoring the effectiveness of public investment in training.

4.6. PROMOTING RETRAINING AND UNIVERSALIZING DIGITAL SKILLS ACROSS THE LABOR FORCE

This group of solutions is of decisive significance for the majority of the current labor force. A national program for retraining and skills upgrading for workers currently in employment should be established, with short, modular courses delivered flexibly at the workplace or online, with recognized certification and financial support for disadvantaged groups. Priority should be given to workers in highly automated sectors, informal workers, older workers, and workers in rural and mountainous areas.

For the “Digital Literacy for All” movement, the key requirement is to shift from measuring participation by the number of participants to measuring the level of competencies achieved, reflected in the ability to use online public services, make cashless payments, protect personal data, and identify misinformation. At the same time, preferential educational credit should be expanded for learners according to the principle that no pupil or student should have to drop out because of financial conditions. When the training costs of engineering and high-technology fields are higher than the general average, educational credit is an essential instrument to ensure that the structure of training fields is not determined by the ability of learners’ families to pay.

5. CONCLUSION

The analysis of the current situation shows that Vietnam has established a relatively comprehensive institutional framework and achieved initial results in terms of scale, productivity, and social awareness. However, the limitations remain structural: the proportion of workers with formal degrees or certificates has reached only 29.2%; shortages of digital human resources persist in both quantity and quality; training programs are slow to update; school–enterprise linkages remain formalistic; and, particularly, there is a major gap in retraining the existing workforce. The root causes of these limitations lie in financial mechanisms, labor utilization mechanisms, and the incentive structures of the stakeholders involved in training.

The proposed system of solutions is therefore comprehensive and consists of six interconnected groups: renewing thinking and perfecting institutions; restructuring and stratifying the training system; innovating curricula, methods, and competency-based assessment; developing the teaching workforce; establishing substantive linkages among the State, educational institutions, and enterprises; and promoting retraining and universalizing digital skills. Among these, two groups are breakthrough measures: an output-based financial mechanism and a national program for retraining workers, because these are the two bottlenecks that practice over recent years has not yet resolved.

Ultimately, the success of the digital transformation revolution in Vietnam will not be determined by the speed of technology imports or the scale of infrastructure investment, but by the capacity to simultaneously upgrade the capabilities of tens of millions of workers. Although an economy can acquire modern machinery within a relatively short period, developing a workforce capable of using technology effectively requires a sustained, adequately resourced, and inclusive training strategy. This is central to the requirement to develop modern productive forces identified in Vietnam’s national development strategy for the next stage of economic transformation. The effectiveness of this strategy will also depend on equitable access to training across industries, employment categories, and regions.

Author contributions

Both authors contributed equally to this work.

Conflict of interests

The authors declare that they have no conflicts of interest related to the research presented in this manuscript.

Data availability

The statistical and policy materials analyzed in this article are drawn from publicly accessible reports and documents cited in the references. No new individual-level dataset was generated for this documentary analysis.

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