

Developing Vietnam's human resources in the context of the current Industrial Revolution and international integration

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Abstract

Human resources are the foundation of a nation's success and development, reflecting social progress, equity, and sustainable growth. Vietnam has prioritized improving human resource quality as a strategic breakthrough to transform its socio-economic development model and enhance competitiveness in a globalized world. The Communist Party of Vietnam has issued policies emphasizing the integration of education and training with scientific research, technological innovation, and practical applications in production and business. Bold educational reforms aim to maximize human potential, leveraging opportunities from the Industrial Revolution 4.0 to accelerate industrialization and modernization. Key elements of human resource development in Vietnam include physical health, intellectual capacity, ethics, responsibility, professional skills, and workplace discipline. The focus is not only on technical expertise but also on fostering creativity, adaptability, and responsibility to meet the challenges of a rapidly changing world. Aligning human resource development with national goals, Vietnam aims to build a prosperous, equitable, and happy society. This article explores Vietnam's strategies for human resource development in the context of the Industrial Revolution 4.0, highlighting its role in driving sustainable growth and global integration. A mixed-methods research approach, combining qualitative interviews with policymakers and quantitative surveys, is used to evaluate the effectiveness of these strategies. This research provides a comprehensive assessment of Vietnam's human resource development initiatives, examining their alignment with national goals and their impact on socio-economic development. The findings aim to ensure that human resource development strategies are effectively implemented to foster sustainable growth and enhance Vietnam's global competitiveness.

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1. Introduction

Humans are not only the primary agents of material production but also the central drivers of historical progress and social development. In the current era, marked by a shift toward a knowledge-based economy and deepening

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globalization, the role of human resources particularly high-quality human resources has become more critical than ever. These individuals, equipped with advanced education, skills, expertise, and creativity, form the core of human capital, driving sustainable socio-economic growth. In an increasingly competitive and rapidly changing world, nations with a strong foundation of high-quality human resources hold a decisive advantage. Such nations not only possess the intellectual and innovative capacity to adapt to global shifts but also create favorable conditions for investment and maintain political and social stability. For Vietnam, this reality underscores the urgency of prioritizing human resource development in its national strategy.

The Communist Party of Vietnam recognizes that building and leveraging human resources is both a foundational goal and a central focus of development. It is the key driver, enabling condition, and determining factor for achieving progress. High-quality human resources form the bedrock for Vietnam's industrialization and modernization, supporting strategies for rapid growth, innovation, and long-term vision. This prioritization is not just about addressing immediate challenges but about positioning Vietnam to seize opportunities, overcome obstacles, and advance steadily toward socialism. In this context, studying human resource development in Vietnam amidst the Industrial Revolution holds profound theoretical and practical importance, offering insights into how the nation can navigate and thrive in a dynamic global environment.

2. Literature review

On this topic, numerous studies have provided in-depth analyses, evaluations, and interpretations concerning human resources, human resource development, industrialization, and the close relationship between human resource development and Vietnam's industrialization efforts today. These studies approach the subject from various perspectives, including philosophy, political economy, economics, history, sociology, and cultural studies.

Notable works include "Developing Vietnam's Industrial Human Resources in the Process of National Industrialization and Modernization and the Role of Trade Unions" [1]. This work builds a theoretical foundation for developing industrial human resources, detailing the current state of Vietnam's industrial workforce, including educational and technical qualifications, high-quality industrial human resources, and training and development practices [2]. This book compiles articles from various authors and is divided into three parts: general theoretical issues, domestic and international experiences in human resource development, and the current state of human resources, along with recommendations and solutions to meet the demands of industrialization, modernization, and international integration. "On Comprehensive Human Development in the Era of Industrialization and Modernization", this comprehensive and profound work addresses both theoretical aspects and an evaluation of the current state of the Vietnamese population. It comprises two parts; the first outlines the scientific basis for Vietnam's comprehensive human development strategy during industrialization and modernization, while the second provides strategic directions for achieving this goal [3]. Additionally, another notable work is "Fundamental Solutions to Link Training with the Use of Human Resources in the Era of Industrialization and Modernization in Vietnam" [4].

In the 1980s, the study of human beings and human development gained significant attention, with the first major milestone being the publication of the Human Development Report by the United Nations Development Program (UNDP). The inaugural Global Human Development Report (referred to as the Report), released in 1990, redefined "human development" by affirming and clarifying the role of humans as central subjects in sustainable development. The 1990 Report emphasized the formation of human capabilities through improvements in health and skills, alongside the effective use of these capabilities to build meaningful lives and expand access to essential resources and opportunities for human development [5]. The 2020 Report shifted focus to the relationship between humans and nature, advocating for a global and national dialogue on redesigning development pathways. This approach emphasized the need to respect the symbiotic relationship between humans and the Earth, reflecting a broader perspective on sustainable development [6]. The study "About the New Man" compiled articles from various authors, exploring human nature through the lens of Eastern and Western philosophical traditions. It affirmed that the human question has been a central theme

throughout the history of thought. As societies advance, a deeper understanding of the position, role, and purpose of individuals becomes increasingly critical. The study highlighted that the overarching goal of building a new socialist human being involves the comprehensive and balanced development of individuals, addressing all aspects of human life. However, the most pressing issue today is cultivating a new working style characterized by collective-oriented labor, discipline, technical competence, high productivity, and practicality. Transforming labor into a source of pride and obligation for all represents a profound revolution in attitudes and discipline. Achieving this requires a coordinated application of educational, economic, administrative, and legal measures to drive a fundamental shift in the consciousness and psychology of individuals and society as a whole [7].

These studies provide valuable insights for the research team, enabling them to build upon and clarify the role of human resources. They also suggest directions and solutions to further enhance the contribution of human resources to the industrialization process under the conditions of the Industrial Revolution 4.0 in Vietnam today.

3. Research method

In conducting this study, the author employed a dialectical materialist methodology, which emphasizes a comprehensive, historical, and specific perspective. This methodology views human development as a dynamic process influenced by the interplay of various social, economic, and cultural factors, ensuring a nuanced understanding of the subject matter. A systematic approach was central to the research, building upon the findings of previous studies to refine theoretical foundations and provide well-rounded evaluations. This approach ensured that the research was grounded in established knowledge while contributing new insights to the field. To achieve the research objectives, the author adopted an interdisciplinary framework within the domain of social science research. This framework facilitated the integration of diverse perspectives and methodologies, enriching the depth and breadth of the study. Key methods employed included:

- Analysis and Synthesis: Breaking down complex issues into manageable components for detailed examination and then integrating these insights to form a cohesive understanding;
- Historical and Logical Methods: Tracing the evolution of human development concepts and their practical applications while ensuring logical consistency in drawing conclusions;
- Statistical Techniques: Collecting and analyzing quantitative data to identify patterns, trends, and correlations relevant to human development;
- Comparative Methods: Juxtaposing findings from different contexts to highlight similarities, differences, and unique contributions to the discourse on human development.

These methods were systematically combined to address the research questions, validate hypotheses, and ensure a robust and comprehensive analysis. By leveraging this multifaceted approach, the study not only achieved its objectives but also provided a valuable framework for future research on human development [8].

4. Results and discussion

4.1. Overview of human resource development and Industrial Revolution 4.0

4.1.1. Human resource development

The concept of "human resources" (or human capital) has been in use since the 1960s in Western countries and some Asian nations. Although perspectives on human resources differ across countries, they are generally considered in terms of both quantity and quality of the population engaged in socio-economic activities. The United Nations defines human resources as "the total knowledge, skills, experience, capabilities, and creativity of individuals related to the development of each person and the nation". The International Labor Organization (ILO) describes human resources as "the entirety of people within the working-age population who are capable of participating in labor". The World Bank (WB) defines human resources as "the total human capital, including physical strength, intellect, and occupational skills of each individual"

In Vietnam, starting with the 6th National Congress of the Communist Party of Vietnam (1986), the Party first emphasized the importance of the human factor, positioning humans at the center of socio-economic strategies and leveraging human potential in the construction and defense of the nation. The term “human resources” is defined in the Vietnamese Dictionary as follows: “source” is “the starting point, origin, or a place capable of providing something” and “human resources” refers to “human power, particularly as applied in production labor” [9]. Based on this definition, "human resources" can be understood as the origin, nurturing, and provision of human capital for development. This interpretation highlights the natural dynamics of population changes and their impact on human resource variations. Professor Pham Minh Hac describes human resources as “the total labor potential of a nation or a locality, which is the labor force prepared (to varying degrees) and ready to participate in specific work activities” [3]. This perspective emphasizes that human resources represent latent potential within individuals, which only becomes a driving force for socioeconomic development when realized and utilized. According to Le Thi Hong Diep, “Human resources are the supply of labor for society, realized through the physical, intellectual, and emotional capacities of workers. Human resources are a component of productive forces and play a decisive role in the socio-economic development of any nation” [10]. Thus, the term "human resources" refers to successive generations of individuals within a certain working age who possess specific qualities (such as health, intellect, ethics, political awareness, expertise, skills, and experience) and are actively or ready to participate in the socio-economic development of a nation, region, or locality.

Here, it is important to consider two key aspects of the concept of human resources. First, as a source of human potential, individuals the subjects do not exist in isolation but are closely interconnected, forming a unified whole in terms of organization, thought, and action. In other words, human resources are the collective aggregation of individuals with specific qualities who have, are, and will participate in the process of social production. It is important to understand that this "aggregation of individuals" is not merely a matter of numbers but truly represents the combined capacities and strengths of the collective. This strength originates primarily from the inherent qualities of each individual and is exponentially enhanced by the unity of collective action. Second, human resources encompass not only individuals who have already participated or are currently participating in social production but also those who will take part in the future. The natural history of social life is a process of successive development across civilizations, where the values created by previous generations serve as the foundation for subsequent generations to inherit, develop, and create new values. This is a crucial factor contributing to sustainable development for every nation, region, and humanity as a whole. Among the factors that determine the quality of human resources, physical strength forms the foundation, serving as the basis for intellectual development and as a means of translating human knowledge into practical application. Meanwhile, intellect and education levels are the most critical factors in determining the quality of human resources. These elements not only form the basis for high-quality vocational skills training but also shape the character and lifestyles of individuals. Different periods, fields, and localities demand varying criteria for human resources. In the process of accelerating the industrialization and modernization of the country, specifying the quantitative and qualitative aspects of human resources to suit these contexts is a particularly important requirement in the national human resource development strategy, as well as in the strategies of specific sectors, localities, and fields.

In summary, human resources is a concept referring to the collective human potential of a nation, a region, or a locality that has been prepared to some extent and can be mobilized for development processes. Human resources can be considered as a component of national resources, alongside physical resources (excluding humans), financial resources, and intellectual resources. These resources are mobilized for socio-economic development.

In the global trend of the knowledge economy and the industrialization and modernization process of Vietnam today, recognizing the critical role of human resources in national development, the Party and the State of Vietnam place great emphasis on human resources, considering them a crucial factor in economic growth and development. The 8th National Congress of the Communist Party of Vietnam emphasized “training and

fostering human resources for the industrialization and modernization of the country” [11]. Industrialization and modernization represent a common developmental trend worldwide, and they are also key objectives for Vietnam to achieve prosperity, strength, social equity, and civilization, ultimately building a successful socialist society.

Industrialization and modernization demand a workforce that is sufficient in quantity, strong in quality, and capable of becoming a real driving force for development. Therefore, developing human resources in both quantity and quality is an essential mission of the Vietnamese revolution in the new era.

Human resource development or human development resources (HRD) are concepts formed and developed based on new perspectives on development and the role of humans in that development. To date, the concept of human resource development remains subject to various interpretations, and no unified definition has been agreed upon. Organizations often define it differently depending on their specific objectives. However, across these differing perspectives, a nearly universal criterion is the emphasis on the level of expertise and professional skills within the workforce.

4.1.2. Industrial Revolution 4.0

The Fourth Industrial Revolution, also known as Industry 4.0, is the integration of technologies across physical, digital, and biological domains, creating entirely new production capabilities and profoundly impacting the economic, political, and social life of the world. Four key characteristics of the Fourth Industrial Revolution can be summarized as follows:

- *Foundation of Advanced Technologies*: It is based on the combination of new sensor technologies, big data analytics, cloud computing, and the Internet of Things (IoT), driving the development of automation and intelligent production systems.
- *Printing Technology*: This technology enables the complete production of products through integrated production lines without the need for assembling auxiliary components. It also allows for the creation of new products using non-traditional methods, bypassing intermediary steps and minimizing production costs.
- *Nanotechnology and New Materials*: These innovations create new material structures that are widely applicable across various fields.
- *Artificial Intelligence and Cybernetics*: These technologies enable humans to control systems remotely, unrestricted by space and time, allowing for faster and more accurate interactions.

Many economic researchers have pointed out that this revolution may exacerbate inequality, particularly by disrupting the labor market. Automation replacing human workers with machines could widen the gap between returns on capital investment and returns on labor. On the other hand, knowledge will become a crucial factor in future production, leading to a labor market increasingly divided into "low-skill/low-wage" and "high-skill/high-wage" segments, thereby intensifying social stratification.

Although the Fourth Industrial Revolution raises concerns about unemployment as machines take over many tasks, some researchers believe that a net reduction in jobs is unlikely. Hyper-automation and hyper-connectivity could enhance the productivity of existing jobs and create demand for entirely new types of jobs. The emergence of "cobots" (collaborative robots capable of mobility and interaction) is expected to significantly boost the productivity of low-skill jobs. However, the workforce most heavily affected may be those with mid-level skills, as the growth of hyper-automation, hyper-connectivity, and artificial intelligence will significantly impact this group [12].

4.2. Human resource development as a strategic issue in promoting industrialization in Vietnam during the period of international integration

During the period of industrialization and modernization of the country, we increasingly recognize the importance of human resources, particularly trained human resources, in the development of productive forces

and the speed of economic growth. Therefore, human resource development has become a key factor in ensuring that Vietnam's economy develops in a modern and sustainable direction.

The 6th National Congress of the Communist Party of Vietnam (1986) marked the beginning of the renovation period, transitioning from a centrally planned economy with bureaucratic control and subsidies to a socialist-oriented market economy managed by the state, with integration and opening up. This was a completely new development period for both the entire country and individuals. The Congress affirmed the decisive role of human factors in the socio-economic development process. Since then, human resources have gradually been placed at the center of all development processes. Subsequent Congresses have continually affirmed the central position and role of human resources, stating that "people are both the goal and the driving force of socio-economic development." This is a breakthrough ideological perspective, aligned with Vietnam's current conditions during the process of industrialization and modernization, reflecting the Party's thinking and vision in response to the trend of global integration and openness, the era of knowledge-based economies.

At the 7th Congress of the Party (1996), with the Platform for National Construction during the Transition to Socialism being adopted, the Party affirmed: "Promote the human factor based on ensuring fairness and equality in citizens' rights and duties; combine economic growth with social progress; balance material and spiritual life; meet immediate needs while ensuring long-term benefits; balance individual interests with collective and social community interests" [13].

The industrialization and modernization cause was affirmed by the 8th Congress of the Party as a strategic mission, with an increasing emphasis on human resource development. Industrialization and modernization are revolutionary development missions in all aspects of social life, not something brought about by any supernatural forces, but rather the mission of the masses as the decisive resource. Industrialization and modernization require human resources that are sufficient in quantity, strong in quality, and capable of becoming the true driving force of development. This vast and decisive resource must be increasingly rich in intellect and quality to meet the needs of industrialization and modernization. Human resources are the number one factor, the origin, and the main driving force that creates the productive forces determining the speed and sustainable development of our mode of production in the context of international integration. Therefore, to accelerate the process of industrialization and modernization sustainably, it is indispensable to focus on human development. Our Party has identified: "Improving public intellectual standards, nurturing, and harnessing the vast potential of the Vietnamese people is the decisive factor in the success of industrialization and modernization" [11].

The development of the intellect of the Vietnamese people is reflected through strategies for the development of education and training, science and technology, aimed at improving public intellectual standards, training human resources, and fostering talents. Education and training must truly become the nation's top policy. Through various forms, it must ensure that everyone has the opportunity to learn, especially the poor and children from families with preferential policies. The education and training sector, which directly trains human resources, must gradually improve the quality of teaching and learning, overcome the negative aspects and weaknesses in the education sector, and complete the task of training and nurturing human resources for the industrialization and modernization of the country. Along with reforming the content of education in a fundamental and modern direction, there must be an emphasis on civic education, teaching scientific worldviews, patriotism, and the will to rise for one's future and the future of the country.

The 11th Party Congress also clearly stated that we must "develop human resources quickly, especially high-quality human resources, focusing on fundamental and comprehensive reforms of the national education system; closely link human resource development with the development and application of science and technology" [14]. Accordingly, the development and enhancement of human resource quality, especially high-quality human resources, is one of the decisive factors for the rapid and sustainable development of the country. This is a crucial aspect of the practical nature of our strategy for rapid and sustainable development in the current context.

In the Resolution of the 13th Party Congress and particularly the Sixth Conference of the 13th Central Committee on continuing to accelerate industrialization and modernization of the country by 2030, with a vision towards 2045, it is emphasized that accelerating industrialization and modernization is a national endeavor involving the entire people and the political system, with people as the center, businesses as the main actors, ensuring a harmonious balance between economic development and the achievement of social progress and equity, and environmental protection. Integrating sequential development with breakthroughs; quickly shifting from outsourcing and assembly to research, design, and production in Vietnam, focusing on developing several service sectors with competitive advantages, high knowledge and technology content, and promoting the serviceization of industrial sectors. The implementation of industrialization and modernization requires specific roadmaps and steps, with focus and prioritization; resources should be allocated efficiently, with breakthrough policies and mechanisms to develop growth poles, foundation industries, prioritized industries, spearhead industries, supporting industries, and high-value-added service sectors; enhancing inter-industry and regional linkages; domestic resources should be viewed as fundamental, strategic, long-term, and decisive, while external resources are important and breakthrough; domestic enterprises (including both state-owned and private businesses) are the main driving force, while foreign direct investment (FDI) enterprises play an important, breakthrough role.

The overall goal by 2030 is for Vietnam to largely meet the criteria of an industrialized country, being a developing nation with modern industries and high-income levels, and an improved standard of living for the people. The country aims to build a strong national industrial base with new production capacities, autonomy, high adaptability, and resilience, gradually mastering core technologies and foundational technologies in priority and spearheading industries. Agriculture should develop rapidly and sustainably with an ecological orientation and strong application of advanced science and technology. Service sectors should be restructured efficiently, based on modern digital technologies, with enhanced quality, effectiveness, and competitiveness, forming new high-value-added services.

Thus, in essence, the development of human resources is inseparable from the socio-economic development, directly linked to Vietnam's process of advancing the Fourth Industrial Revolution. The development of human resources can be summarized as the process of increasing both the quantity and quality of human resources, while simultaneously improving the efficiency of their utilization to better meet the sustainable development needs of each nation, region, or locality. The development of human resources involves developing human resources in terms of quantity, improving the quality of human resources, and enhancing the effectiveness of human resource utilization.

4.3. Current situation and issues concerning human resource development in Vietnam during the period of international integration

Human resources are a decisive factor in the success and progress of any nation, with the level of human resource development serving as a key indicator of social progress, equity, and sustainable development. Vietnam affirms that improving the quality of human resources is a breakthrough in the process of transforming the country's socio-economic development model; it also serves as the foundation for sustainable development and enhancing the national competitive advantage in the process of integration.

In recent years, Vietnam's human resources have made continuous breakthroughs, both in terms of quality and professional expertise. One of the notable achievements in developing high-quality human resources, according to the orientations of the Vietnam Human Resource Development Strategy 2011-2020, is the continuous improvement of the legal system and policy mechanisms for human resource and science-technology development, which has created favorable conditions for enhancing the quality of education, training, and scientific and technological activities. Accordingly, the education and training network in Vietnam has expanded, with both the scale and quality being raised to better meet the needs of society. The socialization of education and training has been promoted, with high enrollment rates in preschool, primary, and lower secondary education, and greater attention paid to vocational training for rural labor.

Currently, the country has 1,954 vocational education institutions, including 394 colleges, 515 intermediate schools, and 1,045 continuing education centers [15]. The quality of these training institutions has also been improved. To date, Vietnam has 5 universities ranked in the top 400 universities in Asia, and 2 universities in the top 1,000 universities in the world. Scientific research in universities has made progress, with international publications increasing. Basic sciences have also seen development. We now have two centers of excellence, the International Mathematics Center and the International Physics Center, both recognized and sponsored by UNESCO. The government's investment to enhance scientific and technological capabilities has been strengthened, increasing the ability to connect human resource development with scientific and technological development and application. Government spending on science and technology has increased by an average of 16.5% per year, reaching about 2% of the total state budget. Social investment in science and technology has increased rapidly, reaching an estimated 1.3% of GDP in 2015. The application of science and technology in fields such as agriculture, construction, healthcare, and information communication has also made remarkable progress.

The science and technology market is growing, helping to connect supply and demand in the economy, enhancing workers' access to scientific and technical knowledge, and improving the quality of the workforce for the economy. Human resources have begun to be trained based on the connection between market demand, specifically that of businesses, and aimed at meeting the requirements of the labor market in the context of the ongoing strong scientific and technological revolution [15]. Compared to other countries in the region and the world, Vietnam has an abundant workforce. In 2021, the total population of the country was 98.51 million, making it the second most populous country in Southeast Asia. Of this, 50.5 million people are of working age, accounting for 67.7% of the population. The participation rate in the labor force among those aged 25-29 is the highest. Vietnam's population growth has led to a significant increase in the human resource supply. This shows that the Vietnamese workforce is always capable of meeting the labor demands of both domestic and foreign enterprises [15].

In recent years, the quality of human resources in Vietnam has also improved significantly. According to the World Bank, Vietnam's Human Capital Index (HCI) has increased from 0.66 to 0.69 in the 2010-2020 period. Vietnam's HCI remains higher than the average of countries with similar income levels, despite lower public spending on health, education, and social protection. Vietnam is one of the countries in the East Asia-Pacific region with the highest HCI score.

According to statistics from the General Statistics Office, the percentage of workers with vocational training in Vietnam increased from 40% in 2010 to 65% in 2020. The percentage of workers aged 15 and over who are employed and have received training has continuously increased over the years, from 15.4% in 2011 to 24.1% in 2021 [16]. The increasing rate of trained workers has continuously improved the quality of Vietnam's human resources. The workforce with professional qualifications and vocational skills has been effectively utilized in various sectors such as postal and telecommunications, information technology, automobile and motorcycle manufacturing, shipbuilding, energy industries, healthcare, education, and labor export. The number of Vietnamese entrepreneurs has been growing, and their knowledge and business skills have been improving, gradually meeting the demands of international integration.

Although there have been breakthroughs in the development of human resources, meeting the requirements of industrialization remains a major challenge for Vietnam today. There is the challenge of physical strength. Generally, Vietnamese workers have smaller physiques. In 2000, the average height of Vietnamese men was 13 cm shorter, and women were 10.7 cm shorter than the standards set by the World Health Organization (WHO), with their weight falling into the lightest group in the world. By 2009, according to the results of the national population census, the average height of young men had increased by 2.1 cm, and young women by 1 cm. However, this remains far below that of many countries in the Asia-Pacific region, such as Singapore, Japan, Thailand, Malaysia, China, and especially South Korea, where young people are 9.4 cm taller [17]. This could

affect the ability to operate large machinery and equipment, work in unfavorable environments, and endure high-intensity and strenuous labor.

Vietnam's population is currently in the "golden population period," but along with this, the aging population is occurring at one of the fastest rates in the world (approximately 17 to 20 years). The aging population is reflected in the increasing percentage of people aged 65 and over. Statistics show that from 2010 to 2018, this percentage continuously increased from 6.8% in 2010 to 8.87% in 2018, at an accelerating pace. It is forecasted that by 2030, the population aged 65 and over will account for 11.48%. The aging population will inevitably lead to the aging of the workforce, causing changes in the labor structure, with a declining proportion of young workers and an increasing proportion of older workers (aged 40 to 65). This shift will lead to a shortage of skills in the workforce if not trained or updated. This is a significant challenge for human resource development today.

In terms of labor structure, there is an imbalance in the proportion of urban and rural workers. Since 2012, there has been an increase in the proportion of the labor force in urban areas, but the imbalance remains high, with 67.8% of the labor force concentrated in rural areas. The employment structure of the economic sector also shows many imbalances. The proportion of employed workers across economic sectors from 2012 to the second quarter of 2018 indicates that, while the proportion of labor in agriculture, forestry, and fisheries has declined, it still accounted for the highest share of 38.2% in the second quarter of 2018 [18]. Labor in the other two sectors has increased but remains lower than in agriculture, forestry, and fisheries. This labor structure presents challenges in improving labor quality to meet the requirements of the Industrial Revolution 4.0, as labor in agriculture, forestry, and fisheries mainly consists of manual workers who are either untrained or have low skill levels.

Regarding labor quality, the technical and professional skills of the workforce remain low, with the majority of labor in Vietnam being unskilled. According to a recent study, “[i]n the next two decades, around 56% of the workforce in five Southeast Asian countries, including Vietnam, is at risk of losing their jobs due to robots, especially in the garment industry. Additionally, the development of the digital economy will lead to the loss of a large number of jobs, replacing up to one-third of the labor force in agricultural processing and 26% of the workforce in logistics in Vietnam” [19]. The proportion of untrained workers in Vietnam is still relatively high, with low training quality and an unreasonable industry structure. The structure of the workforce by professional skills in Vietnam has not changed significantly since 2012. Although the proportion of unskilled workers has decreased, they still make up the majority of the workforce. Among trained workers, those with a university degree or higher make up the largest proportion, followed by workers with vocational secondary, college, or primary vocational qualifications. Compared to countries such as South Korea, Taiwan, and Singapore, the proportion of trained workers in Vietnam is only one-third of these countries [17]. Additionally, our workforce lacks many soft skills, such as foreign languages, IT, communication skills, teamwork, and professional attitudes.

Overall, the quality of our human resources is considered quite low and does not meet the economic and social development requirements of the country. The quality of the workforce is limited in physical, intellectual, and ethical aspects, preventing it from meeting the demands of the labor market in the era of the Industrial Revolution 4.0. In the coming years, digital transformation is an inevitable trend for Vietnam and many countries worldwide, but to develop a digital economy, Vietnam must overcome several challenges, including those related to human resources.

4.4. Solutions for developing human resources in Vietnam to meet the requirements of the Industrial Revolution 4.0 and international integration

Human resource development is the process of increasing both the quantity and quality of the workforce, while simultaneously enhancing the effectiveness of its utilization to better meet the sustainable development needs of the country. To develop human resources in Vietnam today, we believe that the following solutions should be implemented:

Effective planning and development of human resources: To build an accurate human resource development strategy, it is essential to forecast labor demand and the labor market both in the short and long term. Based on the overall strategy for human resource development, it is necessary to review and improve the planning and implementation of university, college, and vocational school networks nationwide to ensure their alignment. This should also include collaborating with high-quality universities across the country to attract, support, and select students who are willing to work in their localities.

Develop recruitment and incentive policies for educators and trainers: In the era of the Industrial Revolution 4.0, the demand for high-quality human resources has reached unprecedented levels, particularly in large urban centers and industrial zones. To meet this demand and remain competitive in attracting top talent, the recruitment and compensation of educators and trainers must become a strategic priority. Local authorities should implement robust measures to enhance recruitment processes and improve benefits for educators and trainers. This can be achieved by prioritizing recruitment efforts, expanding the talent pool, and creating a supportive environment that values and nurtures these professionals. Competitive salary structures, performance-based incentives, and opportunities for professional growth should be integral components of these policies. Additionally, it is imperative to align recruitment and incentive policies with broader strategies for training and developing human resources, especially in critical areas such as science and technology. By focusing on these fields, local governments and institutions can foster a workforce equipped with the expertise and innovation needed to thrive in a rapidly evolving technological landscape. These policies must not only address the current shortage of skilled professionals but also ensure the long-term sustainability of a highly qualified workforce. Investments in talent attraction and development will ultimately contribute to building a robust, capable, and future-ready workforce that can drive advancements in science and technology, strengthen local industries, and support national economic growth.

Active international cooperation in human resource training: Localities should take the initiative in proposing and participating in international cooperation programs to enhance specialized training capacity and facilitate the transfer of modern technologies. Emphasis should be placed on securing support for both short-term and long-term training opportunities in developed countries. These initiatives should prioritize high-level training in critical areas aligned with local workforce demands, such as priority fields, management, and advanced technical expertise.

Mobilizing budget for human resource training: In order to effectively develop a skilled and competitive workforce, it is crucial to mobilize funding for human resource training from a variety of sources. These sources should include both domestic and international funding channels, as well as socialization efforts. Governments, local authorities, educational institutions, and private sector organizations must collaborate to pool resources and ensure that training programs are adequately funded. This could involve seeking financial support from international organizations, bilateral cooperation agreements, and foreign investment, as well as leveraging local resources through public-private partnerships. In addition to these external sources, localities should encourage self-financing options for individuals and organizations. This can include creating programs that allow individuals to invest in their own skill development, particularly in areas such as advanced language proficiency, information technology, and specialized professional skills. For example, individuals could access grants, scholarships, or low-interest loans to pursue advanced training or certifications in fields critical to the workforce's future needs. Furthermore, organizations can be incentivized to invest in the continuous development of their employees, ensuring that the workforce remains adaptable and competitive in the face of rapid technological changes. This multi-faceted approach to funding human resource training not only expands access to training opportunities but also fosters a culture of self-improvement and lifelong learning. It encourages individuals to take ownership of their professional development, while also promoting the idea that continuous learning is essential for personal and societal growth. By investing in human resource training through a combination of public, private, and individual efforts, localities can build a workforce that is both highly skilled and adaptable to the evolving demands of the Industrial Revolution 4.0.

Strongly innovating content and programs following the spirit of the 9th party congress resolution: The practical experience of socio-economic development shows that only when Vietnam's human resources develop in both intellectual and physical strength, labor skills, political and social activism, as well as ethics and clear emotional commitment, can they become the most important resource for development. In the context of the Industrial Revolution 4.0, many aspects bring all universities in the country back to a common starting point. Therefore, localities can seize the opportunity to build and boldly apply training programs in modern directions, and open new fields of study to meet the demands of the current era.

Innovating training methods and approaches: Human resource training should meet the diverse and multi-level demands of technology and the development level of various fields and industries. The industrialization and modernization process that Vietnam is currently undertaking involves both gradual steps and leaps forward. At the same time, Vietnam uses a variety of technological levels, developing a diverse range of industries, including labor-intensive sectors and high-tech industries with comparative advantages that are strategically important for rapid development and deep integration into global production and distribution networks. Therefore, to meet the human resource demands for industrialization and modernization, education and training must be diverse in both levels and sectors. The focus should be placed on implementing programs and projects for training high-quality human resources in key and strategic industries and fields. To achieve this, localities need to diversify training methods.

In addition to investing in universities and colleges, there should be various training methods and flexible combinations for different fields. For example, strengthening on-the-job training, job instruction training, vocational training, including mentoring and guidance; job rotation and transfer; organizing classes; sending students to formal education institutions; lectures, conferences, or workshops; computer-assisted training programs; distance learning, etc. At the same time, it is essential to ensure strong collaboration between businesses, employers, training institutions, and the government to develop human resources based on the needs of society. It is important to raise awareness of building sustainable links between schools and businesses, ensuring cooperation at all levels, from leadership to staff, through unified regulations and general normative documents.

Moreover, increasing autonomy for training institutions is crucial. These institutions should have autonomy and initiative in terms of training scale, recruitment methods, curriculum development, financial management, etc. Encouraging competition between institutions will drive the motivation for development in schools, enhancing the quality of training products, as well as the prestige, image, and brand of the institutions.

5. Conclusions

In today's world, human resources are widely regarded as the most crucial factor influencing the scale, speed, nature, and effectiveness of economic and social development in every nation. The responsibility for nurturing these human resources falls upon society, the state, communities, and individual citizens. Building a skilled workforce requires a clear understanding of the roles played by different segments within the human resource pool, including intellectuals, politicians, and entrepreneurs. For Vietnam, the creation and development of this human resource triangle is a collective responsibility that involves the entire community and nation, with the state playing a pivotal role. The state is irreplaceable in formulating a comprehensive strategy for human resource development. From the perspective of internal national factors, a country must possess key elements such as strong institutions, advanced production relations, the rule of law, a vibrant civil society, and a market-driven economy. In Vietnam's case, it is essential to gradually strengthen the industrialization and modernization of agriculture and rural areas, foster the growth of trade, services, and tourism, and continue pursuing a high-growth, sustainable economic structure that balances industry, agriculture, and services. To effectively leverage opportunities, overcome challenges, maintain political stability, and fully harness all available resources, the role of education and training must be maximized in building and developing human resources to support the process of industrialization and modernization, while achieving socio-economic goals. The Party's directives,

resolutions, and policies, as well as the state's approach to education, training, and the development of high-quality human resources, must emphasize the proactive integration of education with scientific research, technology transfer, and the connection between education and real-world production and business practices. Moreover, bold innovations in education and training must be implemented to enhance the workforce's quality, seize the opportunities of the Fourth Industrial Revolution, and accelerate industrialization.

Declaration of competing interest

The authors declare that they have no known financial or non-financial competing interests in any material discussed in this paper.

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