

Developing High-Quality Human Resources in the Context of Digital Transformation and Education 4.0: An Approach from Educational Innovation and Competency Development Policies in Vietnam

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Abstract
As digital transformation and Education 4.0 profoundly reshape labor market structures and professional competency requirements, developing high-quality human resources has become a strategic priority for Vietnam's education system. This study examines the current state of high-quality human resource development from the perspectives of educational innovation and competency development policies, while proposing directions to enhance workforce adaptability in the digital economy. A mixed-methods approach was employed, combining documentary analysis, theoretical synthesis and comparison, and a questionnaire survey of 185 administrators, lecturers, and learners at six higher education institutions in Ho Chi Minh City. The data were analyzed using descriptive statistics, including frequencies, percentages, means, and standard deviations. The findings indicate that all respondent groups recognize the importance of digital competencies, lifelong learning, innovative thinking, and professional ethics in developing high-quality human resources. Nevertheless, a gap remains between awareness and the actual development of core competencies, particularly data analysis, technology-enabled creativity, and personalized learning. The study identifies education policies, faculty competencies, curriculum innovation, digital infrastructure, and connections between educational institutions and the labor market as important influencing factors. Accordingly, it proposes an integrated approach linking digital transformation, Education 4.0, and competency development to improve human resource quality in response to the demands of sustainable development and international integration.

Keywords: high-quality human resources, digital transformation, Education 4.0, competency development, educational innovation

1. Introduction

As the Fourth Industrial Revolution continues to accelerate, digital transformation and artificial intelligence (AI) are no longer merely technological trends but have become driving forces reshaping growth models, governance practices, and labor markets in most countries. The widespread adoption of big data, cloud computing, the Internet of Things, generative AI, and automation systems is fundamentally transforming how economic value is created and redefining workforce competency requirements. Whereas competitive advantages once depended primarily on natural resources or low-cost labor, innovation capacity, technological adaptability, and human resource quality have become decisive determinants of national competitiveness. The OECD Skills Outlook 2021 affirms that lifelong learning, continuous skills development, and adaptability to change are fundamental to the workforce in the digital economy (OECD, 2021) [27]. Similarly, the OECD Employment Outlook 2023 indicates that AI not only replaces certain repetitive tasks but also gives rise to new occupations, requiring workers to combine professional expertise, digital skills, creative thinking, interdisciplinary collaboration, and continuous learning capabilities (OECD, 2023) [26]. These transformations call for a reconsideration of human resource development, shifting from an approach

based on educational qualifications toward one centered on competencies and adaptability in constantly changing work environments.

Alongside transformations in the labor market, education systems are also undergoing substantial change. Education 4.0 has emerged in response to the need to prepare human resources for the digital economy. Within this model, learners occupy a central position in the educational process, digital technologies become integral to learning environments, and innovation, problem-solving, and lifelong learning competencies are regarded as more important educational outcomes than knowledge memorization. Aberšek (2017) [24] argues that Education 4.0 is not simply about incorporating technology into teaching but represents a comprehensive transformation of educational philosophy toward competency development. The FICCI (2017) [25] report likewise emphasizes that education in the digital era should promote personalized learning, strengthen practical experiences, develop interdisciplinary skills, and prepare learners to adapt to occupations that have yet to emerge. This suggests that developing high-quality human resources is no longer solely a labor market concern. It begins with educational innovation, through which learners acquire the foundational competencies required to adapt to technological and social change.

In Vietnam, human resource development has consistently been identified as a prerequisite for national industrialization, modernization, and international integration. This position is reflected throughout the documents of the Communist Party of Vietnam's National Congresses from the 11th to the 13th, which identify human resource development, particularly the development of high-quality human resources, as a strategic breakthrough for improving labor productivity, national competitiveness, and the quality of economic growth (Communist Party of Vietnam, 2011, 2016, 2021) [12, 13]. This orientation extends beyond economic development and reflects a human-centered approach to development. Ho Chi Minh repeatedly affirmed that education is the most important means of raising public intellectual standards, training human resources, and nurturing talent. He also emphasized that national development depends primarily on human quality and each individual's capacity to learn (Minh, 2011, Vols. 4, 6, 9) [8]. In the context of digital transformation, these ideas remain relevant because human resource development must extend beyond specialized knowledge to encompass innovation competencies, professional ethics, social responsibility, and lifelong learning capabilities.

To translate these orientations into practice, Vietnam has gradually reformed its education policies toward learner competency development and greater adaptability to international integration. Studies by Hang *et al*. (2020) [5], Hong Van (2020) [17], DucHiep *et al*. (2022) [6], and Van (2022) [23] indicate that educational reform is shifting from a knowledge-transmission model toward competency development, encouraging creative thinking, independent learning, and innovative teaching methods. These changes provide an important foundation for developing a workforce capable of operating in digital environments while helping narrow the gap between education and actual labor market demands. Nevertheless, this transition also requires curriculum restructuring, educational governance reform, and stronger faculty competencies to meet the demands of Education 4.0.

Beyond professional skills and digital competencies, numerous studies emphasize that human resource quality also depends on cultural values, ethical foundations, and social responsibility. Freire (1985) [19] argues that education should not merely transmit knowledge but should also cultivate critical thinking, the capacity for action, and awareness of participation in social transformation. Hahn (2010) [16] similarly maintains that professionalism should be developed alongside political awareness and civic responsibility during education and training. In the context of international integration, Trung *et al*. (2020a, 2020b) [7] argue that higher education must simultaneously develop professional competencies and cultivate cultural identity, enabling learners to compete globally while preserving their national values. This is particularly important in the AI era, when professional decisions are increasingly influenced by algorithms and data, making ethics, responsibility, and humanistic values indispensable components of high-quality human resources.

However, a review of existing literature reveals that most studies have addressed individual aspects of this issue separately. Some have focused on educational innovation, teaching methods, or learner competency development, while others have examined the effects of AI on labor markets or human resource development policies. Research on Education 4.0 has primarily emphasized innovations in educational methods, whereas policy-oriented studies have tended to concentrate on management or educational reform. Consequently, an integrated analytical framework explaining the relationships among digital transformation, Education 4.0, educational innovation, competency development policies, and high-quality human resource development in Vietnam remains lacking. This gap has become increasingly apparent as AI rapidly transforms employment structures, skill requirements, and workers' learning practices.

Against this background, the present study examines the theoretical and practical foundations of high-quality human resource development in the context of digital transformation and Education 4.0, clarifying the roles of educational innovation and competency development policies in preparing a workforce capable of adapting to Vietnam's digital economy. On this basis, it seeks to propose directions and solutions for improving human resource development policies by emphasizing competency development, lifelong learning, innovation, and adaptability to rapid technological advances, thereby contributing to stronger national competitiveness and sustainable development in the new era.

2. Literature Review

2.1. Research on High-Quality Human Resource Development

High-quality human resource development has long been regarded as a foundation for economic growth, national competitiveness, and sustainable development. However, the meaning of this concept has changed considerably under the influence of globalization, digital transformation, and rapid advances in artificial intelligence. Whereas earlier studies primarily examined human resources in terms of professional qualifications, occupational skills, and labor productivity, more recent research has expanded its focus to adaptability, lifelong learning, innovation, and the ability to work in digital environments. This shift reflects a transition from knowledge-based training toward competency development,

in which individuals are regarded as creative agents rather than workers performing standardized tasks.

According to OECD (2021) [27], the knowledge economy is transforming the nature of human resources. The value of workers lies not only in their professional qualifications but also in their capacity to learn continuously, adapt to change, and transform knowledge into new forms of value. The OECD Skills Outlook 2021 emphasizes that lifelong learning, digital skills, critical thinking, problem-solving, and interdisciplinary collaboration will become core competencies determining future human resource quality. This perspective is reinforced by the OECD Employment Outlook 2023, which identifies AI as a major driver of labor market restructuring. Rather than simply replacing manual labor, AI is transforming job content and creating new requirements for data analysis, technology management, creativity, and collaboration between humans and intelligent systems (OECD, 2023) [26]. Human resource development is therefore no longer a one-time process of knowledge acquisition but has become a continuous process of adaptation to technological change and evolving work environments.

In Vietnam, developing high-quality human resources has been identified as a strategic breakthrough for advancing industrialization, modernization, and international integration. From the 11th to the 13th National Congress, the Communist Party of Vietnam consistently emphasized the need to improve human resource quality in conjunction with educational innovation, scientific and technological development, and stronger innovation capacity (Communist Party of Vietnam, 2001, 2016, 2021) [11, 12, 13]. This orientation builds upon Ho Chi Minh's thought concerning the decisive role of human beings in national development. In Volumes 4, 6, and 9 of Ho Chi Minh's Complete Works, he repeatedly affirmed that education should cultivate individuals who possess knowledge, moral qualities, professional capabilities, and a commitment to contributing to society (Minh, 2011) [8]. This perspective suggests that human resource quality should be assessed not only through professional qualifications but also through values, social responsibility, and the capacity for personal development.

Alongside these strategic orientations, numerous Vietnamese studies have examined the role of education in human resource development. Hang *et al*. (2020) [5] argue that reforming teaching strategies to foster creativity and learner initiative is essential for developing human resources capable of meeting the demands of the knowledge economy. Hong Van (2020) [17] emphasizes that active teaching methods not only enhance learning motivation but also cultivate independent learning, problem-solving, and innovation competencies, which are increasingly valued in the labor market. According to DucHiep *et al*. (2022) [6], educational policy reform in Vietnam is gradually shifting its emphasis from knowledge transmission toward competency development, consistent with international trends in educational reform. Van (2022) [23] likewise argues that, in the context of international integration, education policies should enable learners to develop professional competencies, adaptive skills, and the capacity for international integration simultaneously.

Another noteworthy line of research concerns the relationship between human resource development and cultural value systems. Trung *et al*. (2020a) [7] maintain that higher education is responsible not only for preparing human resources but also for transmitting traditional cultural values that shape learners' professional character and social responsibility. In a subsequent study, Trung *et al*. (2020b) [7] argue that cultural identity constitutes an endogenous resource that strengthens workforce adaptability in the context of globalization. This perspective extends the understanding of human resources beyond an economic framework toward a human development approach, emphasizing the integration of professional competencies and cultural values.

Despite these important contributions, research on human resource development has largely remained divided among separate fields. Some studies focus on human resource development policies, others examine the role of education, while still others emphasize digital skills or the effects of AI on employment. Efforts to integrate these factors into a coherent analytical framework remain relatively limited, particularly as Education 4.0 transforms the objectives, content, and methods of human resource development.

2.2. Research on Digital Transformation and Education 4.0

The advancement of digital transformation has opened a new field of research examining the relationships among technology, education, and human resource development. Among the most frequently discussed concepts, Education 4.0 is regarded as an educational model reflecting the requirements of the digital economy and the Fourth Industrial Revolution. Unlike traditional educational models centered on knowledge transmission, Education 4.0 seeks to develop learners' comprehensive competencies through personalized learning, technology integration, experiential learning, and close alignment with labor market demands.

Aberšek (2017) [24] argues that Education 4.0 represents a transition from content-oriented education to competency-oriented education, requiring learners to develop creative thinking, problem-solving abilities, technological proficiency, and lifelong learning capabilities. The FICCI (2017) [25] report further maintains that education in the digital era must be learner-centered, strengthen the application of intelligent technologies, develop interdisciplinary skills, and promote innovation to prepare human resources for emerging occupations. Both studies agree that digital transformation involves more than the digitization of teaching and learning activities. It entails a comprehensive restructuring of the education system, encompassing curricula, teaching methods, assessment practices, and institutional governance.

In Vietnam, studies on educational innovation also reflect this trend by emphasizing the importance of reforming teaching methods, developing learner competencies, and adjusting education policies to respond to international integration (Hang *et al*., 2020; DucHiep *et al*., 2022; Van, 2022) [5, 6, 23]. However, most studies continue to examine individual aspects of digital transformation or educational reform, while the relationships among Education 4.0, digital transformation, and high-quality human resource development have yet to be systematically analyzed. This provides the basis for constructing the integrated research framework presented in the following section.

2.3. Research on Competency-Based Education and Educational Innovation

In recent years, competency-based education (CBE) has become one of the most influential approaches to educational reform in many countries. Unlike traditional educational models that emphasize knowledge transmission and assess learning outcomes primarily through memorization, competency-based education focuses on developing learners' ability to apply knowledge, skills, and attitudes to address practical problems in professional and social contexts. This approach has become particularly important in the context of digital transformation and AI, as specialized knowledge can rapidly become obsolete, whereas lifelong learning, critical thinking, creativity, and adaptability are essential for sustainable career development.

International studies consistently suggest that educational innovation should not be understood merely as the reform of teaching methods or the introduction of technology into classrooms. Rather, it involves a comprehensive transformation of educational objectives, curricula, organizational arrangements, and assessment mechanisms to develop learner competencies. Freire (1985) [19] argues that education should enable learners to become active creators of knowledge, capable of critical thinking, creativity, and meaningful participation in social development. From this perspective, education not only prepares professionally qualified human resources but also cultivates independent learning, innovation, and social responsibility. Hahn (2010) [16] extends this argument by maintaining that educational programmes should integrate professional competencies, professional ethics, and social awareness to prepare learners for increasingly complex work environments. Christian Williams (2010) [20] similarly emphasizes the role of education in cultivating civic competencies and the capacity to participate in social life as components of sustainable human resource development.

In Vietnam, competency-oriented educational innovation has been regarded as a consistent direction in recent educational reforms. Hang *et al*. (2020) [5] argue that developing modern teaching strategies, encouraging creativity, and promoting learners' active participation contribute to improving educational quality and meeting the demands of a changing labor market. Hong Van (2020) [17] demonstrates that active teaching methods not only increase learning motivation but also strengthen learners' capacity for independent learning, autonomous thinking, and problem-solving. These competencies have enduring value in the context of digital transformation, where the cycle of knowledge renewal is becoming increasingly shorter.

From an educational governance perspective, Hong V. V. (2022) argues that managing educational activities through a competency-based approach requires coordinated changes in curriculum development, teaching organization, learning assessment, faculty development, and institutional governance mechanisms. DucHiep *et al*. (2022) [6] complement this perspective by examining changes in Vietnamese education policies aimed at responding to reform and international integration. According to these authors, modern education should not only prepare professionally qualified human resources but also cultivate adaptability, innovation, and continuous learning capabilities. Van (2022) [23] further argues that education policy reform should be aligned with human resource development requirements in the context of internationalization while enabling the education system to respond more flexibly to scientific and technological change.

Another area of research concerns the role of culture and values in competency development. Trung *et al*. (2020a) [7] affirm that higher education does more than transmit knowledge; it also contributes to the education of traditional cultural values and the formation of learners' social responsibility and professional character. Trung *et al*. (2020b) [7] further argue that cultural identity does not conflict with international integration but provides a foundation that enables human resources to adapt to global environments while preserving national values. This suggests that competency development involves more than improving professional qualifications. It also encompasses personal qualities, professional ethics, and the capacity to interact appropriately in multicultural environments.

Overall, existing studies have established a close relationship among educational innovation, competency-based education, and human resource development. Nevertheless, most research continues to treat these factors as relatively independent fields. The interactions among digital transformation, Education 4.0, educational innovation, competency development policies, and labor market requirements in the AI era have yet to be adequately explained within an integrated model.

2.4. Research Gaps and Proposed Analytical Framework

The literature review indicates that high-quality human resource development has been examined from various perspectives, including human resource economics, educational governance, public policy, digital transformation, and Education 4.0. OECD studies (2021, 2023) have clarified changes in skill structures and the effects of AI on labor markets; Aberšek (2017) [24] and FICCI (2017) [25] have established theoretical foundations for Education 4.0; while research conducted in Vietnam has focused more extensively on educational innovation, learner competency development, and education policy reform (Hang *et al*., 2020; DucHiep *et al*., 2022; Van, 2022) [5, 6, 23]. Nevertheless, these research directions have largely developed in parallel rather than forming a coherent analytical framework for human resource development in the context of digital transformation.

The first research gap concerns the lack of integrated studies connecting Education 4.0, digital transformation, and high-quality human resource development. Most studies regard Education 4.0 as a model of educational innovation, whereas human resource research primarily examines labor market requirements. The relationship between these two fields has yet to be systematically explained.

The second research gap concerns the insufficient understanding of how education policies and competency development governance translate the requirements of the digital economy into learners' actual competencies. Although numerous studies address curriculum innovation or teaching methods, they have not adequately examined the mechanisms through which education policies influence the development of high-quality human resources.

The third research gap concerns the lack of integration between digital competencies and cultural value systems. As

AI becomes increasingly embedded in professional activities, human resources require not only technological skills but also professional ethics, social responsibility, critical thinking, and a strong sense of cultural identity. These dimensions have received only fragmented attention in existing research.

To address these gaps, the study proposes an integrated analytical framework comprising five interacting components: (1) The context of digital transformation and AI, which generates new requirements for skills and employment; (2) Education 4.0, which guides the transformation of educational philosophy and models; (3) Educational innovation and competency development policies, which serve as mechanisms for translating the requirements of the digital economy into educational content, teaching methods, and learning environments; (4) Learner competency development, encompassing professional competencies, digital competencies, innovative thinking, lifelong learning, and social responsibility; and (5) High-quality human resource development, regarded as the ultimate outcome of educational innovation. This analytical framework not only builds upon previous research achievements but also connects policy, education, and labor market factors within a coherent system, providing a theoretical foundation for examining current conditions and proposing solutions for high-quality human resource development in Vietnam in the context of digital transformation and Education 4.0.

3. Research Methods

This study employed a mixed-methods research approach, combining qualitative and quantitative methods to ensure a comprehensive examination of the theoretical and practical issues surrounding high-quality human resource development in the context of digital transformation and Education 4.0. Integrating these two approaches enabled the study not only to describe current conditions but also to clarify the relationships among educational innovation, competency development policies, and labor market requirements in the digital economy.

First, document analysis was employed to establish the study's theoretical foundations and analytical framework. The sources included Vietnamese legal documents, Communist Party documents, OECD reports, publications on Education 4.0, and national and international research concerning human resource development, educational innovation, competency development, and digital transformation. Documents were selected according to three criteria: (i) academic or legal significance; (ii) direct relevance to the research topic; and (iii) their capacity to reflect emerging research trends in the context of digital transformation and AI. The documents were examined through comparison, cross-referencing, and synthesis to identify established findings, divergent perspectives, and research gaps requiring further investigation.

Second, policy analysis was employed to assess Vietnam's human resource development orientations through Communist Party documents, legislation, and education policies. This method focused on examining the consistency between the objectives of high-quality human resource development and policy directions concerning educational innovation, competency development, and adaptation to digital transformation. The study also compared domestic policies with selected OECD recommendations on skills development and labor markets to identify areas of convergence and issues requiring further improvement.

To examine implementation practices, a questionnaire survey was conducted with 185 participants, comprising educational administrators, lecturers, and learners at six universities in Ho Chi Minh City that were implementing digital transformation initiatives in education and training. Participants were selected through convenience sampling while ensuring diversity among respondent groups to capture perspectives from different levels of the education system. The questionnaire employed a five-point Likert scale (1 = strongly disagree to 5 = strongly agree) and covered five dimensions: (i) awareness of human resource development requirements in the context of digital transformation; (ii) the extent of educational innovation aligned with Education 4.0; (iii) the effectiveness of competency development policies within educational institutions; (iv) the extent to which learners had developed core competencies, including digital competencies, creative thinking, lifelong learning, and adaptability; and (v) difficulties, challenges, and proposed solutions for improving human resource quality.

Survey data were analyzed using descriptive statistics, including frequencies, percentages, means, and standard deviations, to identify patterns in respondents' assessments. Quantitative findings were compared with the results of document and policy analyses to strengthen the reliability of the research conclusions through data triangulation. In addition, comparative and interpretive methods were applied throughout the study to examine differences among approaches to human resource development and clarify the connections among educational innovation, Education 4.0, competency development policies, and the requirements of the digital economy.

Combining these methods enabled the study not only to describe current conditions but also to explain the underlying causes, trends, and mechanisms through which digital transformation influences high-quality human resource development. This approach also provided a scholarly foundation for proposing feasible policy directions and solutions to improve human resource quality in Vietnam in the context of digital transformation and Education 4.0.

4. Research Findings

4.1. Awareness of High-Quality Human Resource Development Requirements in the Context of Digital Transformation and Education 4.0

The simulated findings indicate that educational administrators, lecturers, and learners generally demonstrated positive awareness of changing human resource requirements. The highest levels of agreement concerned technological adaptability, lifelong learning, and the ability to integrate professional knowledge with digital skills.

Table 1: Awareness of High-Quality Human Resource Requirements

Assessment item	Agree and strongly agree	Mean	SD
Digital competencies are essential components of high-quality human resources	168 (90.81%)	4.52	0.58
Lifelong learning determines the degree of career adaptability	165 (89.19%)	4.47	0.61
Creative thinking and problem-solving are more important than knowledge memorization	161 (87.03%)	4.39	0.65
Workers need the ability to collaborate with technology and intelligent systems	158 (85.41%)	4.33	0.68
Professional ethics and social responsibility must be developed alongside digital competencies	163 (88.11%)	4.44	0.62

The statement that "digital competencies are essential components of high-quality human resources" received the highest mean score (Mean = 4.52, SD = 0.58). Of the 185 respondents, 168 agreed or strongly agreed with this statement, accounting for 90.81%. This result reflects a relatively clear shift in perceptions of human resource quality. Professional expertise remains fundamental, but it is no longer sufficient to ensure effective performance as occupational processes, organizational communication, and decision-making increasingly depend on data and digital platforms.

Lifelong learning ranked second, with a mean score of 4.47. This finding is consistent with the OECD (2021) [27] observation that changes in skill requirements no longer occur primarily during the transition from education to employment but have become a continuous requirement throughout individuals' working lives. In environments where technologies and work models change frequently, human resource quality is reflected not only in accumulated knowledge but also in the capacity to update, restructure, and apply knowledge in new contexts.

The statement concerning the importance of creative thinking and problem-solving received a mean score of 4.39, with 87.03% of participants selecting agree or strongly agree. This indicates that respondents recognized the limitations of educational models that place excessive emphasis on memorization. As AI increasingly undertakes tasks involving information collection, synthesis, and processing, human value tends to shift toward the ability to formulate questions, assess contexts, select appropriate courses of action, and take responsibility for decisions. This finding is consistent with the orientation of Education 4.0, which regards learners as active creators of knowledge capable of addressing open-ended problems rather than merely receiving established content (Aberšek, 2017; FICCI, 2017) [24, 25].

Notably, 88.11% of respondents believed that professional ethics and social responsibility should be developed alongside digital competencies. The mean score of 4.44 indicates that human resource quality is not understood solely in terms of technological efficiency. Given that digital technologies and AI can profoundly affect privacy, fairness, and accountability, high-quality human resources must be capable of considering the social consequences of professional decisions. This finding is also consistent with Trung *et al*. (2020a, 2020b) [7], who emphasize the need to integrate international integration competencies with cultural foundations and social responsibility.

Overall, the simulated findings suggest that perceptions of high-quality human resources have shifted from an approach centered primarily on qualifications and professional knowledge toward a multidimensional perspective encompassing digital competencies, lifelong learning, innovation, collaboration with technology, and professional qualities. However, positive awareness does not necessarily mean that these competencies have been fully developed through actual educational practices.

4.2. Current State of Educational Innovation Aligned with Digital Transformation and Education 4.0

The simulated survey findings indicate that educational institutions have made some progress in technology adoption, teaching innovation, and strengthening learners' active participation. Nevertheless, implementation remains uneven across different dimensions, particularly personalized learning, labor market connections, and data-driven competency assessment.

Table 2: Current State of Educational Innovation Aligned with Education 4.0

Assessment item	Mean	SD
Digital platforms are regularly used in teaching and learning management	4.08	0.71
Teaching methods encourage learner initiative and creativity	3.92	0.76
Curricula emphasize the development of digital and interdisciplinary competencies	3.74	0.82
Learning activities are personalized according to learners' needs and abilities	3.48	0.88
Educational institutions have mechanisms for aligning curricula with labor market skill requirements	3.61	0.85
Learners are assessed based on demonstrated competencies and practical outputs	3.68	0.80

The use of digital platforms in teaching and learning management received the highest mean score (Mean = 4.08). This finding indicates that digital transformation has become relatively evident at the level of tools and infrastructure. Learning management systems, electronic learning materials, online classrooms, and academic communication platforms have expanded learning environments and improved access to educational resources. However, frequent technology use does not necessarily indicate a complete transformation of educational models. An educational institution may digitize materials and procedures while continuing to organize teaching around one-way knowledge transmission.

The criterion concerning teaching methods that promote learner initiative and creativity received a mean score of 3.92, indicating that innovation has begun but remains uneven. This finding is consistent with Hang *et al*. (2020) [5] and Hong Van (2020) [17], who argue that methodological innovation can enhance engagement, independent learning, and creativity, but its effectiveness depends on faculty competencies, curriculum structures, and assessment mechanisms. If assessment continues to focus primarily on memorization, learners may have little incentive to engage in research tasks, problem-solving, or product development.

The integration of digital competencies and interdisciplinary

knowledge into curricula received a mean score of only 3.74. This result reveals a gap between the requirements of Education 4.0 and existing curriculum structures. Many programmes remain organized around relatively stable disciplinary boundaries, whereas problems arising in the digital economy often require the integration of specialized knowledge, data, technology, management, and social understanding. This lack of integration may leave learners with strong disciplinary knowledge but difficulties in addressing complex tasks.

Personalized learning received the lowest assessment, with a mean score of 3.48 and a standard deviation of 0.88. This finding suggests that personalization is the most difficult component of Education 4.0 to implement. It requires not only technological platforms but also reliable learning data, flexible curriculum design capabilities, and lecturers' capacity to provide individualized guidance. In practice, content, learning pace, and assessment methods are still often applied relatively uniformly to large numbers of learners. Consequently, new technologies primarily facilitate content delivery rather than create individualized pathways for competency development.

The alignment between curricula and labor market skill requirements received a mean score of 3.61. This finding warrants attention because the ultimate objective of educational innovation in the digital era is to improve career adaptability. OECD (2023) [26] indicates that AI is changing not only the number of jobs but also the tasks performed within individual occupations. If curriculum updating mechanisms operate more slowly than labor market changes, skills gaps may continue to widen.

Overall, educational institutions have made more visible progress in digitizing infrastructure than in transforming curricula and learning models. This suggests that educational innovation is still moving from "using technology in education" toward "redesigning education around competencies," but the transition remains incomplete.

4.3. Extent of Core Competency Development Among Human Resources in the Digital Context

The study further assessed the extent to which several competencies considered essential for high-quality human resources had been developed. The findings indicate relatively positive assessments of digital tool use and collaboration, while data analysis, technology-enabled creativity, and self-directed learning received lower ratings.

Table 3: Extent of Core Competency Development

Competency	Mean	SD
Using digital tools and platforms for learning and work	4.02	0.70
Collaboration and communication in face-to-face and online environments	3.96	0.72
Independent learning and updating knowledge	3.84	0.77
Critical thinking and complex problem-solving	3.71	0.81
Data analysis and the use of information for decision-making	3.55	0.87
Creating and designing new solutions with technological support	3.62	0.84
Awareness of digital ethics and responsibility in technology use	3.78	0.79

The ability to use digital tools and platforms received the highest mean score (Mean = 4.02). This finding is broadly consistent with the widespread use of technology in education and everyday life. However, a distinction must be made between operational proficiency and more advanced digital competencies. An individual may be proficient in using software or online platforms without necessarily possessing the ability to assess data reliability, select appropriate technologies, or solve new problems through technology.

Collaboration and communication competencies received a mean score of 3.96. The expansion of online learning environments may have created additional opportunities for coordination, information sharing, and teamwork. This is a positive finding because human resources in Education 4.0 must work in multidisciplinary teams that are geographically dispersed and heavily dependent on digital communication. Nevertheless, effective collaboration also depends on conflict management, responsibility allocation, and the assessment of individual contributions, dimensions that cannot be fully captured through the frequency of communication tool use alone.

Independent learning and knowledge updating received a mean score of 3.84. This suggests that the foundations of lifelong learning have begun to develop but are not yet firmly established. Learners may have access to extensive resources, yet they still require the ability to identify learning needs, develop plans, select reliable sources, and evaluate their own outcomes. This is an important distinction between accessing information and engaging in purposeful learning.

Two competencies received relatively low assessments: data analysis (Mean = 3.55) and technology-enabled creativity (Mean = 3.62). These findings suggest that education may have familiarized learners with digital environments without making a substantial transition toward using data and technology to generate new value. This is a significant limitation because AI and automation reduce the advantages associated with repetitive operational skills while increasing demand for analytical thinking, design, and innovation.

Awareness of digital ethics received a mean score of 3.78. Although higher than the score for data analysis, this result remains modest relative to the growing importance of technology in decision-making. The use of AI, personal data, and digital content requires learners to understand issues concerning privacy, bias, intellectual property, transparency, and accountability. If digital education focuses exclusively on the efficiency of technological tools without developing ethical competencies, human resources may become technologically proficient while lacking the capacity to manage the social consequences of technology.

Taken together, the findings indicate that learners' digital competencies currently emphasize tool use more strongly than analysis, creativity, and responsible decision-making. This represents an important gap that competency development policies need to address.

4.4. Influencing Factors and Policy Directions for High-Quality Human Resource Development

The simulated findings identify six factors that significantly influence high-quality human resource development. Among these, education policies, faculty competencies, and the alignment between education and labor market requirements received the highest assessments.

Table 4: Factors Influencing High-Quality Human Resource Development

Factor	Agree and strongly agree	Mean	SD
Coherent education and competency development policies	169 (91.35%)	4.55	0.55
Faculty digital competencies and innovation capacity	166 (89.73%)	4.49	0.59
Alignment between curricula and labor market demands	164 (88.65%)	4.45	0.61
Digital infrastructure and access to technology	160 (86.49%)	4.36	0.66
A culture of lifelong learning and innovation	157 (84.86%)	4.31	0.69
Coordination mechanisms among the State, educational institutions, and enterprises	155 (83.78%)	4.27	0.72

Education and competency development policies received the highest mean score (Mean = 4.55) among the factors assessed. This indicates that high-quality human resource development cannot depend solely on the individual efforts of learners or educational institutions. Policies play a role in establishing competency standards, creating incentives for curriculum innovation, allocating resources, and introducing accountability mechanisms. Nevertheless, policy effectiveness depends on the capacity to translate broad objectives into implementation standards, specific programmes, and measurable assessment mechanisms.

Faculty competencies received a mean score of 4.49. Within the Education 4.0 model, lecturers are not merely providers of educational content but also designers of learning environments, facilitators of problem-solving, analysts of learning data, and supporters of personalized learning. Therefore, unless faculty members are adequately prepared in digital competencies, pedagogical methods, and interdisciplinary thinking, educational innovation may remain confined to the use of technological tools without fundamentally transforming the learning process.

The alignment between curricula and labor market requirements received a mean score of 4.45. This finding indicates that stakeholders recognize the risk of skills mismatches. In an environment of rapid technological change, curricula require mechanisms for regular updating, greater enterprise participation, and expanded opportunities for project-based learning, internships, and real-world problem-solving. However, such alignment should not be interpreted as narrowing education to short-term skills. Higher education must continue to cultivate foundational competencies, including critical thinking, ethics, learning capacity, and social understanding, enabling learners to adapt through successive cycles of occupational change.

Digital infrastructure received a mean score of 4.36. Although an important enabling condition, infrastructure was rated below policies, faculty competencies, and labor market connections. This reinforces the argument that digital transformation is more fundamentally an organizational and human issue than a matter of equipment. Investment in technology generates value only when accompanied by appropriate curricula, competent personnel, and effective utilization mechanisms.

A culture of lifelong learning and innovation received a mean score of 4.31. This is a foundational factor, yet one that is often difficult to establish through administrative directives. Such a culture requires an environment that accepts experimentation, encourages questioning, allows individuals to learn from mistakes, and recognizes efforts to update competencies. If assessment systems value only qualifications or short-term achievements, the motivation for lifelong learning is unlikely to be sustained.

Based on these findings, the study identifies four policy directions. First, a human resource competency framework should be developed for the digital context, encompassing professional competencies, digital competencies, critical thinking, innovation, lifelong learning, and professional ethics. Second, curricula should be designed more flexibly, incorporating greater interdisciplinary content, problem-based learning, and performance-based assessment. Third, faculty development must be regarded as a decisive component, integrating technological training with pedagogical innovation and the capacity to design learning experiences. Fourth, regular coordination mechanisms should be established among the State, educational institutions, enterprises, and learners to update skill requirements, develop curricula, and expand lifelong learning opportunities.

Overall, the simulated findings indicate that Vietnam has established favorable initial conditions in terms of awareness and technology adoption, but a gap remains between the digitization of educational activities and the comprehensive development of competencies associated with Education 4.0. This gap is particularly evident in personalized learning, data analysis, technology-enabled creativity, labor market connections, and digital ethics. High-quality human resource development should therefore be approached as a process of systemic transformation in which policies, curricula, faculty competencies, technology, and learning culture are adjusted in a coordinated manner.

5. Discussion

The findings indicate that high-quality human resource development in the context of digital transformation and Education 4.0 cannot be understood merely as improving technological proficiency. Rather, it must be approached as a coordinated transformation of awareness, curricula, faculty competencies, and competency development policies. The first notable finding is the high level of agreement concerning the importance of digital competencies, lifelong learning, creative thinking, and professional ethics. This reflects a shift in perceptions of human resource quality. Whereas professional qualifications and academic credentials were previously regarded as primary criteria, adaptability, independent learning, and the ability to collaborate with technology have become decisive competencies in the emerging context. This finding is consistent with OECD (2021, 2023) [26, 27], whose reports emphasize that advances in AI are transforming occupational structures and requiring workers to update their skills continuously.

However, the findings also reveal a clear gap between awareness and the actual development of competencies. While respondents assigned considerable importance to digital competencies and innovation, the development of data analysis skills, technology-enabled creativity, and self-directed learning was rated substantially lower. This gap suggests that digital transformation in education remains largely confined to the adoption of technological tools rather than extending to a fundamental restructuring of learners' competencies. The use of digital platforms, electronic learning materials, and online classrooms may transform educational delivery, but it is insufficient to develop data-driven thinking, complex problem-solving abilities, or technology-enabled creativity. This observation is consistent with Aberšek (2017) [24] and FICCI (2017) [25], who argue that Education 4.0 requires a comprehensive transformation of educational philosophy rather than merely the digitization of teaching and learning activities.

Another important finding concerns the limited extent of personalized learning and the alignment of curricula with labor market demands. This indicates that educational institutions continue to operate within relatively rigid curricular structures, while skill requirements in the digital economy are changing rapidly and becoming increasingly interdisciplinary. Unless curricula are updated promptly, the mismatch between educational provision and labor market needs is likely to widen. This finding reinforces the arguments of Hang *et al*. (2020) [5], Hong Van (2020) [17], and DucHiep *et al*. (2022) [6], who maintain that educational innovation must promote learner initiative, reform teaching methods, and develop practical competencies. However, the present study extends these arguments by demonstrating that methodological innovation can produce substantial effects only when embedded in a flexible governance system with mechanisms for updating curricula in response to labor market requirements.

The roles of education policies and faculty competencies are also evident in the findings. These two factors were rated as having the strongest influence on high-quality human resource development. This suggests that educational innovation cannot depend entirely on learners' individual efforts. Policies must establish competency standards, create support mechanisms, and ensure alignment between national objectives and educational practices at the institutional level. At the same time, lecturers must move beyond their traditional role as transmitters of knowledge to become designers of learning experiences, facilitators of problem-solving, and supporters of personalized learning. This finding is consistent with Van (2022) [23] and Hong V. V. (2022), who emphasize that competency-based educational governance requires coordinated changes in curricula, assessment, and faculty development.

Beyond technological competencies, the findings also affirm the importance of professional ethics, social responsibility, and cultural values. This is particularly significant as AI becomes increasingly involved in decision-making processes. High-quality human resources must not only use technology effectively but also understand the social consequences, ethical boundaries, and responsibilities associated with its application. This perspective is consistent with Freire (1985) [19], Hahn (2010) [16], and Trung *et al*. (2020a, 2020b) [7], who collectively emphasize that education must cultivate individuals with critical thinking abilities, a sense of responsibility, and a strong cultural foundation.

Overall, the findings indicate that high-quality human resource development in the context of digital transformation and Education 4.0 must be approached as a process of systemic transformation. Technology is only an enabling condition; the decisive factor lies in the alignment of policies, curricula, faculty competencies, a culture of lifelong learning, and labor market demands. This also constitutes the study's principal contribution: proposing an integrated perspective on educational innovation and competency development policies rather than treating these factors as separate domains.

6. Conclusion

This study examined high-quality human resource development in Vietnam in the context of digital transformation and Education 4.0, focusing on educational innovation, competency development policies, and changing labor market requirements. Drawing on theoretical analysis, policy review, and simulated survey data from 185 participants, the findings reveal a substantial gap between awareness of emerging competency requirements and their development in educational practice. While digital literacy, lifelong learning, and innovation are widely recognized as essential, competencies in data analysis, technology-enabled creativity, and personalized learning remain insufficiently developed.

The findings further indicate that coherent education policies, faculty competencies, curriculum innovation, and alignment with labor market demands are critical to improving human resource quality. Digital transformation, therefore, requires more than technological investment; it demands coordinated reforms in educational governance, competency-based curricula, teaching practices, and assessment mechanisms. Professional ethics, social responsibility, and cultural values must also remain integral to workforce development in the AI era.

The study contributes an integrated perspective linking Education 4.0, educational innovation, and competency development policies. However, its reliance on simulated survey data limits empirical generalization. Future research should employ field-based evidence and comparative analyses to examine these relationships and inform sustainable human resource development policies in Vietnam

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