Nova Science Press

Journal of Psychology & Education

Vol. 1, No. 6 (2026)

Ethical Risks and Collaborative Governance in the Digital-Intelligent Transformation of Vocational Education Driven by New Quality Productive Forces

Yuan Wang[1]*

1 Tongren Polytechnic University, Tongren, Guizhou, China

*Corresponding author: Yuan Wang; Email: 15985112091@163.com

Journal of Psychology & Education • Vol. 1, No. 6 (2026)

DOI:https://doi.org/10.66581/hhngk783

Received: 09 May 2026 • Accepted: 28 June 2026 • Published: 31 July 2026

CITATION

Wang, Y. (2026). Ethical Risks and Collaborative Governance in the Digital-Intelligent Transformation of Vocational Education Driven by New Quality Productive Forces. Journal of Psychology & Education, 1(6), 18-48. https://doi.org/10.66581/hhngk783

Published by Nova Science Press, HK

Abstract

The development of new quality productive forces is accelerating the reorganization of industrial structures, work processes, and skill requirements in China. Vocational education is therefore under strong pressure to integrate artificial intelligence, learning analytics, big data, virtual simulation, and platform-based school-enterprise cooperation. These technologies can improve access, instructional efficiency, practical training, and responsiveness to labor-market change; however, they also redistribute information, authority, and responsibility within educational systems. This conceptual article examines the ethical risks of digital-intelligent transformation in vocational education and develops a context-sensitive governance framework. It integrates risk society theory, a socio-technical systems perspective, the complementarity of rule-based and virtue ethics, and collaborative governance. Five interconnected risk domains are identified: datafication and privacy intrusion; algorithmic bias and deficits in procedural justice; erosion of teacher and student agency; displacement of craftsmanship by narrow efficiency metrics; and asymmetries of power, data ownership, and accountability in industry-education partnerships. These risks are generated through four mutually reinforcing mechanisms: technical opacity and model uncertainty, institutional lag and fragmented responsibility, incentive and power asymmetries among stakeholders, and a culture of technological instrumentalism. On this basis, the article proposes a four-dimensional governance framework comprising value alignment, institutional regulation, technical assurance, and ethical capability development. Scenario-specific safeguards are further specified for classroom teaching, practical training and assessment, industry-education integration, and student administration. The article contributes by linking macro-level productive transformation to meso-level institutional change and micro-level educational ethics, while translating general AI principles into operational requirements for vocational education.

Keywords: new quality productive forces; vocational education; digital-intelligent transformation; artificial intelligence ethics; ethical risk; collaborative governance

1. Introduction

The concept of new quality productive forces has become a central policy vocabulary for describing innovation-led, digitalized, intelligent, and green development in China. In practical terms, the concept refers not merely to the adoption of advanced equipment but to a broader reconfiguration of production technologies, labor processes, organizational forms, and the knowledge base of economic development. The national planning framework for the 15th Five-Year Plan further places scientific and technological innovation, modern industrial systems, and the coordinated development of education, science, and talent at the center of economic transformation (National Development and Reform Commission, 2026; Zhu et al., 2026). These changes alter both the quantity and the quality of demand for technical and skilled workers.

Vocational education occupies a distinctive position in this transition because it is institutionally close to workplaces, occupational standards, apprenticeship arrangements, and regional industrial systems. Digital platforms can connect curricula to changing occupational profiles; virtual simulation can extend access to expensive or hazardous training environments; learning analytics can support timely feedback; and artificial intelligence (AI) can assist instruction, assessment, and career guidance. Recent international guidance on technical and vocational education and training (TVET) similarly emphasizes that digital transformation affects institutional governance, curriculum design, pedagogy, assessment, teacher development, and industry partnerships rather than a single technological component (International Labour Organization, 2020; UNESCO-UNEVOC, 2026).

The educational value of these technologies is nevertheless conditional. Digital systems do not enter a neutral environment: they encode assumptions about what counts as achievement, which data are relevant, how risks should be classified, and whose judgment is authoritative.

Once embedded in admission, training, evaluation, or employment recommendation, technical systems can shape students' opportunities and teachers' professional discretion. Ethical analysis must therefore extend beyond system accuracy or cybersecurity to questions of dignity, autonomy, fairness, contestability, professional formation, and the public mission of education (Floridi et al., 2018; UNESCO, 2021).

Existing research on AI ethics in education has generated important principles concerning transparency, privacy, non-discrimination, accountability, human oversight, and learner rights (Jobin et al., 2019; Wang et al., 2026; Wu et al., 2026). Yet three limitations remain when these principles are applied to vocational education. First, many frameworks are derived from general or higher education and do not fully address the practical-training orientation, safety-critical occupations, apprenticeship structures, and school-enterprise data flows that characterize vocational education. Second, risk taxonomies often list harms without explaining the causal chain that connects industrial transformation, institutional incentives, technical design, and educational outcomes. Third, governance recommendations frequently remain at the level of general principles and do not specify who must act, at which stage of the technology lifecycle, under what evidence standard, and through which remedy.

This article addresses these gaps through a conceptual and normative analysis. It asks three questions: (1) What ethical risks are distinctive or especially salient in the digital-intelligent transformation of vocational education? (2) Through which technical, institutional, strategic, and cultural mechanisms are these risks generated and amplified? (3) How can a collaborative governance system convert abstract ethical principles into scenario-specific and operational safeguards? The central argument is that ethical risks are not produced by technology alone. They emerge from the interaction between technical affordances, institutional arrangements, stakeholder incentives, and the moral culture of vocational education. Consequently, effective governance must combine rules, technical controls, professional virtues, and cross-boundary coordination.

2. Conceptual Boundaries and an Integrated Theoretical Framework

2.1 New Quality Productive Forces as a Structural Driver

New quality productive forces can be treated analytically as a structural driver that links technological innovation to changes in work, skills, and educational organization. The concept emphasizes higher technological intensity, more efficient combinations of production factors, and development oriented toward quality rather than extensive expansion. For vocational education, its significance lies in three transmission channels. The occupational channel changes task composition and increases demand for digital fluency, problem solving, and the capacity to work with intelligent systems. The organizational channel changes how firms coordinate production, evaluate performance, and share data across supply chains. The temporal channel shortens the useful life of occupational knowledge and places institutions under pressure to update curricula more rapidly.

These pressures create a legitimate case for digital transformation, but they also produce ethical tension. When institutional responsiveness is measured primarily by speed, equipment investment, or employment indicators, educational purposes that develop slowly - judgment, responsibility, craftsmanship, and professional identity - may be treated as secondary. The concept should therefore not be used as a technological imperative that automatically legitimizes every form of automation. It is more productively understood as a demand for adaptive capacity that must remain bounded by the educational commitment to human development and socially responsible work.

2.2 Digital-Intelligent Transformation as Socio-Technical Restructuring

Digital-intelligent transformation refers to the systematic integration of digital infrastructures and intelligent technologies into teaching, practical training, assessment, administration, and industry-education cooperation. The term is broader than digitization, which converts analogue information into digital form, and broader than isolated technology adoption. Transformation occurs when technologies alter decision rights, data flows, professional roles, organizational routines, and relationships among institutions.

A socio-technical perspective is essential because the same algorithm can produce different consequences in different institutional settings. A predictive model used as a low-stakes advisory tool may support teachers, whereas the same model used automatically to allocate internships can constrain students' opportunities. Similarly, virtual simulation can safely prepare students for high-risk operations, but it can also displace the tacit, embodied, and context-sensitive learning that occurs with real equipment and experienced instructors. Ethical assessment must therefore examine the complete system of technology, users, organizational incentives, rules, and affected communities rather than the technical artifact in isolation (Selbst et al., 2019).

2.3 Ethical Risk in Vocational Education

In this article, ethical risk is defined as the possibility that a digital-intelligent application will unjustifiably harm rights, distribute benefits and burdens unfairly, weaken human agency, undermine professional formation, or displace the public purposes of vocational education. This definition distinguishes ethical risk from three adjacent concepts. Technical failure concerns whether a system performs as specified. Legal non-compliance concerns whether conduct violates binding rules. Educational ineffectiveness concerns whether an intervention improves learning. Ethical risk may exist even when a system is technically functional, legally permissible, and statistically effective, because the system may still be intrusive, non-contestable, or inconsistent with the cultivation of responsible professionals.

Vocational education intensifies several risks because it combines education with production-like environments. Students may work with industrial devices, enterprise platforms, biometric safety systems, or real production data. Performance assessments can affect qualification, apprenticeship placement, and employment. School-enterprise cooperation also creates complex chains of data processing and responsibility. The ethical threshold for such systems should therefore reflect both educational vulnerability and the consequences of occupational decisions.

2.4 Theoretical Integration

Four theoretical perspectives are integrated, each addressing a different analytical question. Risk society theory explains why technologically produced risks can be diffuse, cumulative, difficult to attribute, and visible only after widespread adoption (Beck, 1992). It supports anticipatory and lifecycle governance rather than reliance on post hoc remediation.

The socio-technical systems perspective explains where risk is generated. It rejects the assumption that fairness or accountability can be secured solely through technical optimization and directs attention to the institutional context in which systems are designed, procured, interpreted, and contested (Mittelstadt et al., 2016; Selbst et al., 2019).

Rule-based ethics and virtue ethics explain what governance is intended to protect. Rules establish enforceable limits concerning privacy, non-discrimination, due process, and accountability. Virtue ethics emphasizes the formation of practical wisdom, integrity, care, responsibility, and craftsmanship. In vocational education, this complementarity is critical: rules prevent abuse, while professional virtues guide judgment in situations that cannot be fully specified in advance (Hou, 2026; Vallor, 2016; Yan & Shi, 2026).

Finally, stakeholder incentive analysis and collaborative governance explain how implementation can be sustained. Government agencies, institutions, technology providers, employers, teachers, and students possess unequal resources and different incentives. Ethical governance is credible only when roles, evidence duties, liabilities, and benefits are structured so that responsible conduct is not systematically disadvantaged. Collaborative governance research indicates that shared problem definition, institutionalized participation, trust-building, and joint capacity are necessary for cross-boundary action (Ansell & Gash, 2008; Emerson et al., 2012).

Together, these perspectives yield a causal sequence: structural pressure for rapid digitalization leads to socio-technical embedding; embedding redistributes data, authority, and evaluation; technical and institutional asymmetries activate ethical risks; and governance must intervene across values, rules, system design, and human capabilities. Table 1 summarizes this integrated model.

Table 1. Integrated Analytical Model of Ethical Risk in Digital-Intelligent Vocational Education

Analytical level	Primary driver	Risk-generating mechanism	Ethical outcome	Governance implication
Macro-structural	Industrial and labor transformation	Speed pressure and skill volatility	Narrow responsiveness metrics; mission drift	Align digitalization with human development and decent work

Analytical level	Primary driver	Risk-generating mechanism	Ethical outcome	Governance implication
Meso-institutional	Procurement, platforms, and school-enterprise cooperation	Fragmented responsibility and dependence on vendors	Accountability gaps; loss of educational autonomy	Lifecycle review, contractual duties, and joint accountability
Micro-pedagogical	Automated teaching, assessment, and recommendation	Opacity, datafication, and authority transfer	Privacy intrusion, unfairness, and weakened agency	Human oversight, contestability, and proportional use
Moral-cultural	Technological instrumentalism	Efficiency becomes the dominant value	Erosion of craftsmanship, care, and practical wisdom	Virtue formation, reflective practice, and plural evaluation

3. Ethical Risk Domains

3.1 Datafication, Privacy, and Surveillance

Data are the operational substrate of intelligent education. Learning management systems, smart classrooms, simulation platforms, wearable devices, and apprenticeship systems can collect identity information, attendance records, interaction logs, performance trajectories, location data, and, in some cases, biometric or physiological signals. The ethical problem is not collection per se but the expansion of collection beyond a clearly defined educational purpose. A system may gradually move from measuring task completion to inferring attention, emotion, employability, or disciplinary risk without a valid basis or meaningful consent.

Vocational education creates additional exposure because data may cross institutional boundaries. Student records can be combined with enterprise production data, safety monitoring, internship evaluations, or employment platforms. Once data are shared, students may have limited knowledge of secondary use, retention, model training, or commercial monetization.

Consent is especially weak when participation is functionally required for course completion or internship access. Formal acceptance under these conditions should not be treated as sufficient ethical authorization.

Datafication also transforms how students are understood. When practical ability, professional attitude, teamwork, and learning potential are compressed into standardized indicators, the record can become a substitute for the person. Data profiles may follow students across courses and placements, creating path dependency: an early low score can shape later resource allocation and reinforce the original classification. Ethical governance must therefore address purpose limitation, data minimization, retention, access rights, correction, deletion, and the prohibition of function creep, while preserving space for qualitative and contextual judgment (UNESCO, 2021, 2023).

3.2 Algorithmic Bias and Procedural Justice

Algorithms increasingly support admissions screening, adaptive learning, practical-skill assessment, internship matching, and employment recommendation. Bias can arise from unrepresentative data, historically unequal occupational patterns, proxy variables, label construction, or differences in measurement quality. For example, an employment recommendation system trained on past placements may reproduce gender segregation across manufacturing, construction, care, or service occupations. A performance model may also interpret differences in prior educational opportunity as differences in inherent potential.

Fairness cannot be reduced to a single statistical metric because vocational decisions involve contested values and context-specific trade-offs. Equal error rates, equal selection rates, and individualized accuracy can conflict. Moreover, a system can satisfy a chosen metric while preserving an unfair institutional process. The central requirement is therefore procedural as well as distributive: affected persons should know when an automated system is materially involved, understand the main factors relevant to a decision, obtain meaningful human review, and challenge inaccurate or unjust outcomes (Mittelstadt et al., 2016; Selbst et al., 2019).

The problem is particularly acute when commercial confidentiality is invoked to deny explanation. Intellectual property protection does not eliminate the institution's duty to provide reasons for high-impact educational decisions. Procurement arrangements must require vendors to supply documentation, validation evidence, subgroup performance, known limitations, and audit access sufficient for institutional accountability. Comparative regulatory developments, including the European Union's risk-based treatment of certain AI systems used in education and vocational training, demonstrate the increasing recognition that these applications require heightened safeguards (European Parliament & Council of the European Union, 2024).

3.3 Human Agency, Professional Deskilling, and the Pedagogical Relationship

Digital tools can augment professional judgment, but over-automation can weaken the capacities they are intended to support. Teachers who routinely accept generated lesson plans, automated feedback, or system-defined training sequences may gradually lose opportunities to exercise diagnostic judgment, adapt demonstrations, and respond to unanticipated learner difficulties. This is not simply a problem of employment substitution; it is a problem of professional deskilling and responsibility displacement. When a recommendation fails, responsibility may be ambiguously transferred between the teacher, institution, and vendor.

Students face a parallel risk. Recommendation systems can reduce the need to plan learning, compare sources, or tolerate productive uncertainty. Virtual simulation can provide safe rehearsal and repeated practice, but excessive substitution for real equipment can produce a gap between screen-based proficiency and embodied occupational competence. In safety-critical fields, students must learn how materials, tools, environments, and human teams behave under imperfect conditions. These forms of tacit knowledge cannot be fully represented by standardized interfaces.

The pedagogical relationship is also a medium of moral and professional formation. Apprenticeship and practical instruction transmit not only procedures but habits of care, responsibility, patience, communication, and judgment. If human interaction is treated as an inefficiency to be minimized, vocational education may preserve observable performance while weakening the social process through which professional identity is formed. Human oversight must therefore be substantive rather than ceremonial: teachers need authority, time, competence, and organizational support to disagree with systems and to explain their decisions.

3.4 Instrumental Rationality and the Erosion of Craftsmanship

Vocational education is often described through the ideal of integrating technical competence with moral cultivation. In this context, craftsmanship includes precision and mastery but also responsibility for quality, respect for materials and users, perseverance, honesty, and commitment to socially valuable work. Digital transformation can support these qualities when it enables reflection, feedback, and safe experimentation. It becomes ethically problematic when efficiency, speed, and measurable output are treated as exhaustive definitions of excellence.

Algorithmic management can encourage students to optimize for visible indicators rather than for the quality of practice. Standardized scoring may reward procedural conformity while overlooking innovation, context-sensitive adjustment, teamwork, and professional care. Similarly, institutional digitalization targets may prioritize hardware coverage or platform usage without evidence of educational value. The result is a form of value narrowing in which what is easily counted becomes what is educationally important.

Virtue ethics clarifies why this risk cannot be solved only by adding another compliance checklist. Craftsmanship is cultivated through repeated practice, exemplary relationships, critical reflection, and situations that require practical judgment. Governance should protect these formative conditions and evaluate technologies by whether they enlarge or diminish opportunities for responsible agency (Hou, 2026; Vallor, 2016).

3.5 School-Enterprise Asymmetry and the Public Mission of Education

Industry-education integration gives vocational education access to current technologies, occupational standards, equipment, and employment pathways. Yet the partnership also joins organizations with different mandates. Enterprises legitimately pursue productivity and commercial advantage; educational institutions have a public duty to protect learners and support long-term development. Ethical risk arises when production logic becomes the default definition of educational relevance.

Power asymmetry can appear in curriculum design, platform choice, data ownership, and evaluation standards. A dominant technology provider may make the institution dependent on proprietary infrastructure, restrict audit access, or shape curricula around its own ecosystem. Enterprises may also seek broad rights to use training data for product development. Students, who are the data subjects and primary affected group, may have little bargaining power. Ambiguous contracts then allow both parties to disclaim responsibility after a breach or harmful decision.

The public mission of vocational education requires that institutional leaders retain final authority over educational objectives, assessment validity, learner rights, and the use of student data. Partnership agreements should specify purpose, ownership, access, retention, cybersecurity duties, model training restrictions, incident response, audit rights, and exit arrangements. Ethical collaboration does not reject enterprise participation; it structures participation so that commercial capability remains accountable to educational purposes (Zhang et al., 2026).

4. How Ethical Risks Are Generated and Amplified

4.1 Technical Opacity, Uncertainty, and Contextual Misfit

AI systems are probabilistic, data-dependent, and vulnerable to distributional change. A model validated in one institution, region, occupation, or cohort may perform differently when transferred. In vocational education, local equipment, teaching routines, linguistic practices, and labor-market conditions can materially affect performance. Technical opacity compounds this uncertainty because users may not understand why a result was produced or when the model is operating outside its reliable range.

The common response is to seek more data or greater model complexity, but this can intensify surveillance and dependence without resolving the normative problem. The appropriate question is not only whether a model predicts accurately, but whether the prediction target is educationally legitimate, whether errors are acceptable, and whether an automated intervention is necessary. NIST's AI Risk Management Framework similarly treats governance, context mapping, measurement, and risk management as interdependent rather than purely technical tasks (National Institute of Standards and Technology, 2023).

4.2 Institutional Lag and Fragmented Responsibility

Technology procurement and deployment often move faster than institutional policy. Schools may have cybersecurity rules but no process for algorithmic impact assessment, no inventory of AI applications, and no clear threshold for high-risk use. Ethics review may be confused with research ethics even though operational systems affect students outside research projects. Responsibility is further fragmented across academic departments, information technology offices, student affairs units, legal staff, and external vendors.

Fragmentation creates predictable gaps. The purchaser assumes that the vendor has validated the system; the vendor assumes that the institution will control use; teachers assume that administrators have approved the system; and administrators assume that frontline users will identify problems. A credible governance model must assign decision rights and evidence duties before deployment, not after harm occurs.

4.3 Incentive and Power Asymmetries

Stakeholders face different incentives. Vendors benefit from rapid adoption and data access. Institutions may seek visible modernization, lower administrative costs, and improved employment metrics. Teachers may use automation to manage workload. Students may accept intrusive systems because participation affects grades or placements. These incentives do not imply misconduct, but they can systematically favor deployment over caution and make refusal costly for the least powerful participants.

An incentive-compatible system changes the payoff structure. Vendors should bear documentation, audit, remediation, and breach responsibilities. Institutions should be evaluated not only on adoption but on demonstrated educational value and rights protection. Teachers should receive time and training for oversight. Students should have protected complaint channels and meaningful alternatives when a system is not essential. Collaborative governance is effective only when participation changes decisions rather than merely legitimizing predetermined choices (Ansell & Gash, 2008; Chen & Cui, 2025).

4.4 Technological Instrumentalism and Cultural Normalization

A deeper mechanism is cultural: repeated emphasis on technological modernization can normalize the assumption that more data, more automation, and more standardization are inherently better. This assumption narrows the vocabulary through which educational quality is discussed. Concerns about privacy, autonomy, or professional judgment may then be portrayed as resistance to innovation rather than as conditions for legitimate innovation.

Cultural normalization also affects self-understanding. Teachers may interpret system outputs as more objective than their own judgment, and students may treat algorithmic profiles as fixed descriptions of ability. Ethical governance must therefore cultivate critical technological literacy: the capacity to understand what systems can and cannot know, to identify embedded values, and to preserve responsibility in human-machine collaboration (Li, 2025; UNESCO, 2023).

4.5 Recursive and Cumulative Risk

The preceding mechanisms interact through feedback loops. Data are used to classify students; classifications shape opportunities; opportunities affect later performance; and later performance is used to confirm the original classification. A similar loop can occur at the institutional level: platform adoption produces dependence, dependence reduces bargaining power, and reduced bargaining power limits access to information needed for oversight. Risks that appear minor at the level of a single decision can therefore become cumulative and structural.

This recursive model explains why periodic technical testing is insufficient. Governance must monitor downstream effects, distributional patterns, user behavior, and institutional dependency. It must also include sunset clauses and withdrawal procedures so that a system can be suspended when its educational value is not demonstrated or when risks cannot be adequately controlled.

5. A Four-Dimensional Collaborative Governance Framework

5.1 Foundational Principles

The governance framework is guided by six principles. First, human development and learner rights take priority over technical convenience. Second, proportionality requires that data collection and automation be limited to what is necessary for a legitimate educational purpose. Third, risk-tiering requires stricter evidence and oversight when systems affect admission, assessment, qualification, placement, employment, discipline, health, or access to essential support. Fourth, contestability requires notice, reasons, correction, and appeal. Fifth, lifecycle responsibility extends from problem definition and procurement to retirement and data deletion. Sixth, inclusive participation requires the involvement of teachers, students, employers, technical experts, and ethics or legal specialists.

These principles align with major international frameworks that emphasize human rights, transparency, fairness, accountability, safety, and human oversight, while remaining adaptable to the institutional context of Chinese vocational education (Floridi et al., 2018; OECD, 2024; UNESCO, 2021; Wu et al., 2026).

5.2 Value Alignment: Protecting Educational Purpose and Professional Virtue

Value alignment begins before technology selection. Institutions should specify the educational problem, the public value to be advanced, the rights potentially affected, and the non-technological alternatives. This prevents solutions from being defined by available products.

A proposed system should be rejected when its primary benefit is administrative visibility but its educational necessity is weak.

Professional ethics and craftsmanship should be embedded in curriculum, assessment, and system design. Assessment frameworks should include quality, safety, responsibility, collaboration, creativity, and reflective judgment rather than only speed and standardized correctness. Students should practice ethical deliberation within occupational scenarios, including data handling, AI-assisted decisions, safety trade-offs, and responsibility to clients or the public. Teachers and enterprise mentors should model how technical excellence is integrated with integrity and care.

5.3 Institutional Regulation: From General Principles to Enforceable Process

Each institution should establish a digital-intelligent governance mechanism with authority to review high-impact systems. This function may be assigned to a dedicated committee or an expanded technology ethics committee, but it must include expertise in vocational pedagogy, data protection, cybersecurity, AI evaluation, law or ethics, and student representation. The committee should maintain an application inventory and classify systems by risk.

High-risk applications should undergo an algorithmic and educational impact assessment before procurement or deployment. At minimum, the assessment should address purpose, necessity, affected groups, data sources, validity, subgroup performance, human oversight, explanation, appeal, security, vendor dependency, and exit arrangements. Decisions and reasons should be documented. Material system changes should trigger re-review.

Accountability also depends on contracts. Procurement clauses should require data minimization, prohibition of unauthorized secondary use, incident notification, audit cooperation, performance documentation, security controls, correction obligations, model update procedures, data return or deletion, and clear allocation of liability. Institutions should avoid contracts that prevent meaningful explanation or independent evaluation.

5.4 Technical Assurance: Ethics by Design and Evidence-Based Control

Technical assurance operationalizes ethical requirements. Systems should be tested not only for average accuracy but for reliability across relevant student groups, occupations, campuses, and conditions of use. Validation should use local data where appropriate and should distinguish development, validation, and operational monitoring. Performance thresholds must reflect the consequences of error.

Data governance should include classification, access control, encryption, logging, retention schedules, de-identification where feasible, and strict controls on biometric and psychological data. Privacy-enhancing techniques can reduce exposure, but they do not replace purpose limitation or governance. For high-impact decisions, institutions should preserve audit trails that record data provenance, model version, human intervention, and the final decision.

Explainability should be matched to the user and decision. Technical staff need detailed documentation; teachers need actionable information about limitations and relevant factors; students need understandable reasons and correction routes. Human review must be capable of changing the outcome. A review process that merely confirms the automated result is not meaningful oversight.

5.5 Ethical Capability: Building Organizational and Individual Competence

Rules and tools cannot function without competent users. Ethical capability should be developed at three levels. All students need foundational data and AI literacy, including privacy, bias, verification, and responsible use. Programs should then integrate occupation-specific ethical problems, such as safety-critical automation in health care, manufacturing, transportation, or information services. Practical training should require students to justify decisions and reflect on consequences.

Teachers and instructors need more than operational training. They must understand system limitations, data quality, appropriate reliance, bias indicators, and procedures for escalation. Administrators and procurement staff require competence in impact assessment, contracting, and accountability. Periodic exercises based on realistic incidents can test whether the institution can identify, report, and remedy problems.

6. Scenario-Specific Governance Pathways

6.1 Classroom Teaching and Adaptive Learning

In classroom teaching, AI should remain an assistive resource under teacher authority. Systems may support lesson preparation, formative feedback, accessibility, and differentiated learning, but they should not autonomously determine a student's educational trajectory. Collection of facial, emotional, or physiological data should be prohibited unless a compelling educational or safety purpose is demonstrated and less intrusive alternatives are inadequate. Students should be informed when AI-generated materials or automated analytics are used.

Recommendation systems should preserve learner choice and expose students to diverse resources rather than optimizing only for predicted engagement. Teachers should periodically review whether personalization narrows content, reinforces prior performance differences, or changes student motivation. Generated content should be verified for accuracy, occupational relevance, and safety.

6.2 Practical Training, Simulation, and Assessment

Practical training requires a balance between simulation and authentic performance. Virtual simulation is appropriate for initial familiarization, rare events, hazardous procedures, and repeated practice, but institutions should define which competencies require real equipment, workplace interaction, or direct observation. No learner should obtain a safety-critical qualification solely on the basis of simulation or automated scoring.

Automated assessment should be combined with expert qualitative judgment. Validation must include different student groups and realistic operating conditions. Students should receive criteria, error information, and an opportunity for reassessment or human review. The assessment framework should recognize adaptive problem solving, quality, safety, communication, and professional responsibility, not only standardized execution.

6.3 Industry-Education Integration and Apprenticeships

School-enterprise projects should begin with a joint ethical and educational impact assessment. A dedicated agreement should define the purpose and scope of data sharing, legal roles, security duties, intellectual property, restrictions on model training, and procedures for breach response. Student participation in non-essential data use should be genuinely voluntary and should not affect access to training.

Educational institutions must retain final authority over curriculum, assessment, qualifications, and learner protection. Enterprises should contribute occupational expertise and technology without unilaterally defining educational value. Joint governance bodies should include teachers, enterprise representatives, and student or apprentice representation, with transparent procedures for conflicts of interest and complaints.

6.4 Student Administration and Support Services

Administrative applications such as attendance, financial-aid targeting, dormitory management, career guidance, and well-being support should follow strict necessity and proportionality. Continuous, indiscriminate monitoring should not be normalized as a condition of enrollment. Data collected for safety or support should not be repurposed for discipline, ranking, or employment recommendation without a separate legitimate basis.

Systems that infer psychological state or risk require exceptional caution because false positives can stigmatize students and false negatives can create misplaced confidence. Such tools should not diagnose or trigger punitive action. They may only support trained professionals within a clearly governed care pathway, with confidentiality, human assessment, and access to appropriate services.

Table 2. Scenario-Based Ethical Governance Matrix

Scenario	High-impact uses	Primary ethical risks	Minimum safeguards	Accountable actors
Classroom teaching	Adaptive learning, behavior analytics, generative content	Intrusive data collection, narrowed learning, teacher displacement	Data minimization, teacher control, content verification, learner notice	Academic unit, teacher, IT/data office, vendor
Practical training and assessment	Simulation, automated skill scoring, safety monitoring	Invalid assessment, bias, virtual-real skill gap, automation bias	Local validation, real-practice requirements, human review, appeal	Program faculty, assessors, safety officers, vendor
Industry-education integration	Shared platforms, apprenticeships, employment matching	Commercial data use, power asymmetry, mission drift, unclear liability	Joint impact assessment, contractual controls, audit and exit rights	Institutional leadership, enterprise, legal/data officers

Scenario	High-impact uses	Primary ethical risks	Minimum safeguards	Accountable actors
Student administration	Attendance, aid, dormitory, well-being and risk prediction	Surveillance, stigma, function creep, punitive use	Necessity test, restricted access, non-punitive use, correction and deletion rights	Student affairs, data protection function, counselors, oversight committee

7. Implementation, Monitoring, and Remedy

7.1 A Lifecycle Governance Process

Operational governance can be organized as a seven-stage cycle: inventory, classify, assess, procure or design, validate, monitor, and retire. The inventory identifies every system that processes learner data or influences educational decisions. Classification determines risk based on the sensitivity of data, degree of automation, scale, and consequence. Assessment examines necessity, alternatives, evidence, and rights. Procurement embeds duties in contracts. Validation tests the system in context. Monitoring examines both technical performance and downstream educational effects. Retirement includes data deletion, migration, and review of residual obligations.

This process should be proportionate. Low-risk administrative tools may receive simplified review, while systems affecting qualification, placement, employment, discipline, or psychological support require independent scrutiny and senior authorization. Pilot deployment should be time-limited, use the smallest necessary population, and include predefined stopping criteria.

7.2 Monitoring Indicators and Independent Audit

Monitoring should combine technical, procedural, educational, and rights-based indicators. Technical indicators include error rates, subgroup performance, drift, security incidents, and system availability. Procedural indicators include completed impact assessments, documentation quality, response time to complaints, and frequency of human overrides. Educational indicators include learning quality, transfer to authentic practice, teacher workload, and effects on student motivation. Rights-based indicators include consent quality, data access requests, corrections, appeals, and evidence of unequal burden.

Institutions should publish an annual summary of high-impact systems, their purposes, responsible units, review status, and major incidents, while protecting security-sensitive information. Independent audits are appropriate where decisions have substantial consequences, vendors control critical evidence, or stakeholders contest institutional impartiality. Audit findings should lead to assigned corrective actions, deadlines, and verification rather than symbolic reporting.

7.3 Complaint, Appeal, and Remediation

Ethical governance is incomplete without remedy. Students and teachers need accessible channels to report inaccurate data, biased outcomes, privacy concerns, or inappropriate pressure to use a system. Complaints should not affect academic evaluation or employment opportunities. The institution should provide a timely explanation, human review, correction of records, and reconsideration of consequential decisions.

Remediation may require more than correcting an individual case. When a pattern is identified, the institution should suspend the relevant function, notify affected persons, reassess previous decisions, and revise the system or process. Serious incidents should trigger escalation to senior leadership and, where applicable, external regulators. Lessons should be incorporated into training and procurement.

7.4 Organizational and Resource Conditions

Implementation requires stable resources. Institutions need designated personnel for data governance, cybersecurity, AI evaluation, and ethics coordination; faculty need workload recognition for review and oversight; and students need representation and support. Regional or sector-level resource centers can provide model policies, shared audit tools, training cases, and expert support for institutions with limited capacity.

Governance effectiveness should be included in institutional evaluation, but it should not be reduced to the number of policies or committees. The relevant outcome is whether systems are justified, documented, monitored, contestable, and capable of being changed or withdrawn. A mature institution is not one that eliminates all risk; it is one that identifies uncertainty early, distributes responsibility clearly, learns from evidence, and preserves educational agency.

8. Discussion

This article makes three theoretical contributions. First, it connects the policy discourse of new quality productive forces with a specific ethical transmission mechanism. Industrial transformation changes skill demand and creates pressure for educational digitalization; digitalization then reorganizes information, authority, and evaluation; and these changes generate ethical consequences through institutional and cultural conditions. This avoids treating macro-level policy and micro-level educational ethics as separate topics.

Second, the analysis reframes digital-intelligent risk as a socio-technical and recursive phenomenon. Privacy, bias, deskilling, value narrowing, and partnership asymmetry are not isolated categories. They reinforce one another through data and decision feedback loops. This explains why single interventions - for example, a privacy notice or an accuracy test - cannot provide adequate governance.

Third, the framework links external regulation with internal moral formation. Vocational education cannot rely exclusively on compliance because occupational practice contains uncertainty and context-sensitive judgment. Nor can it rely exclusively on virtue because unequal power and commercial incentives require enforceable limits. The combination of rule-based protections, technical assurance, professional virtues, and collaborative governance is therefore not additive but structurally necessary.

The article also has limitations. It is conceptual and does not empirically estimate the prevalence or severity of the identified risks. The governance framework has not yet been tested across regions, institutional types, or occupational programs. Some concepts, including craftsmanship and educational public value, may require operational definitions that vary by industry. Future research should develop and validate risk assessment instruments, compare stakeholder perceptions, conduct audits of real systems, and examine how governance arrangements affect learning, equity, and professional agency over time.

Further work should also distinguish among technologies rather than treating AI as a homogeneous category. Generative systems, predictive analytics, computer vision, simulation, and automated assessment have different failure modes and evidence requirements. Comparative research can clarify which safeguards are universally necessary and which must be adapted to legal, cultural, occupational, and institutional contexts.

9. Conclusion

Digital-intelligent transformation is becoming integral to the capacity of vocational education to respond to industrial change and evolving work. Its legitimacy, however, depends on whether technology strengthens rather than displaces the educational purposes of developing competent, responsible, and autonomous professionals. The principal ethical risks are not limited to privacy breaches or biased algorithms. They include cumulative datafication, deficits in procedural justice, erosion of human judgment, narrowing of craftsmanship to measurable efficiency, and the subordination of public education to platform or production interests.

A defensible governance response must therefore be multi-dimensional. Value alignment protects educational purpose; institutional regulation assigns enforceable responsibility; technical assurance produces evidence and controls; and ethical capability enables informed human judgment. These dimensions should be applied through risk-tiered, lifecycle, participatory, and scenario-specific processes. The goal is not to slow innovation indiscriminately, but to distinguish innovation that expands human and educational capability from automation that merely transfers power while obscuring responsibility. Only under these conditions can digital-intelligent technology contribute to high-quality vocational education and to the development of new quality productive forces in a socially responsible manner.

Declarations

Author Contributions: Yuan Wang was responsible for conceptualization, literature review, theoretical analysis, framework development, writing the original draft, and reviewing and editing the manuscript.

Funding: No external funding was reported for this conceptual study.

Conflict of Interest: The author declares no conflict of interest.

References

Ansell, C., & Gash, A. (2008). Collaborative governance in theory and practice. Journal of Public Administration Research and Theory, 18(4), 543-571. https://doi.org/10.1093/jopart/mum032

Beck, U. (1992). Risk society: Towards a new modernity. Sage.

Chen, C., & Cui, H. (2025). Governance dilemmas and resolution strategies for ethical risks of artificial intelligence in education from a game-theoretic perspective. Journal of China University of Geosciences (Social Sciences Edition), 25(3), 131-144. (In Chinese).

Emerson, K., Nabatchi, T., & Balogh, S. (2012). An integrative framework for collaborative governance. Journal of Public Administration Research and Theory, 22(1), 1-29. https://doi.org/10.1093/jopart/mur011

European Parliament & Council of the European Union. (2024). Regulation (EU) 2024/1689 laying down harmonised rules on artificial intelligence. Official Journal of the European Union, L, 2024/1689.

Floridi, L., Cowls, J., Beltrametti, M., Chatila, R., Chazerand, P., Dignum, V., Luetge, C., Madelin, R., Pagallo, U., Rossi, F., Schafer, B., Valcke, P., & Vayena, E. (2018). AI4People - An ethical framework for a good AI society: Opportunities, risks, principles, and recommendations. Minds and Machines, 28(4), 689-707. https://doi.org/10.1007/s11023-018-9482-5

Hou, B. (2026). Integrating Confucian ethics of dedication into the cultivation of craftsmanship in vocational education. Education and Vocation, (8), 96-104. (In Chinese).

International Labour Organization. (2020). The digitization of TVET and skills systems. International Labour Organization.

Jobin, A., Ienca, M., & Vayena, E. (2019). The global landscape of AI ethics guidelines. Nature Machine Intelligence, 1, 389-399. https://doi.org/10.1038/s42256-019-0088-2

Li, L. (2025). The value, direction, and pathway of curriculum-based science and technology ethics education in higher education. China Higher Education, (13/14), 60-64. (In Chinese).

Mittelstadt, B. D., Allo, P., Taddeo, M., Wachter, S., & Floridi, L. (2016). The ethics of algorithms: Mapping the debate. Big Data & Society, 3(2), 1-21. https://doi.org/10.1177/2053951716679679

National Development and Reform Commission. (2026). Outline of the 15th Five-Year Plan for National Economic and Social Development of the People's Republic of China. Government of the People's Republic of China.

National Institute of Standards and Technology. (2023). Artificial Intelligence Risk Management Framework (AI RMF 1.0) (NIST AI 100-1). U.S. Department of Commerce. https://doi.org/10.6028/NIST.AI.100-1

Organisation for Economic Co-operation and Development. (2024). Recommendation of the Council on Artificial Intelligence (OECD/LEGAL/0449). OECD.

Selbst, A. D., Boyd, D., Friedler, S. A., Venkatasubramanian, S., & Vertesi, J. (2019). Fairness and abstraction in sociotechnical systems. In Proceedings of the Conference on Fairness, Accountability, and Transparency (pp. 59-68). Association for Computing Machinery. https://doi.org/10.1145/3287560.3287598

UNESCO. (2021). Recommendation on the ethics of artificial intelligence. UNESCO.

UNESCO. (2023). Guidance for generative AI in education and research. UNESCO.

UNESCO-UNEVOC. (2026). Integrating AI in TVET: A practical guide for institutions. UNESCO.

Vallor, S. (2016). Technology and the virtues: A philosophical guide to a future worth wanting. Oxford University Press.

Wang, Y., Huang, F., & Liu, C. (2026). Construction and application of an ethical risk assessment index for artificial intelligence in education. Journal of East China Normal University (Educational Sciences), 44(6), 92-102. https://doi.org/10.16382/j.cnki.1000-5560.2026.06.006 (In Chinese).

Wu, D., Gui, X., Bai, J., & Chen, X. (2026). An ethical framework for artificial intelligence in education: Evolution and principles for construction. E-Education Research, 47(1), 40-48. https://doi.org/10.13811/j.cnki.eer.2026.01.005 (In Chinese).

Yan, J., & Shi, D. (2026). The return of virtue in contemporary medical ethics education. Medicine & Philosophy, 47(8), 65-69, 74. https://doi.org/10.12014/j.issn.1002-0772.2026.08.13 (In Chinese).

Zhang, J., Lu, Y., & Li, Y. (2026). The logic, challenges, and strategies of digitally enabled green-skills development in higher vocational colleges. Education and Vocation, (9), 15-24. (In Chinese).

Zhang, W., & Feng, Y. (2026). From constraint to justification: An innovation-oriented approach to ethical governance. Studies in Dialectics of Nature, 42(2), 81-87. (In Chinese).

Zhu, Q., Wan, C., & Hou, X. (2026). Restructuring intelligent labor-production relations under new quality productive forces during the 15th Five-Year Plan period. On Economic Problems, (1), 1-9. (In Chinese).