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Research on the Development of Indicators, Integration into Teaching, and Evaluation of General Information Technology Competencies for Vocational College Students

Genrang Zheng[1,*]
[1] *Zhongshan Polytechnic, China*

Abstract: Accelerated digital transformation is driving iterative development across industries, making general information technology literacy a core competitive advantage for vocational college students' employment. Current vocational education faces challenges such as ambiguous competency metrics, fragmented integration into teaching, and a monolithic evaluation system, making it difficult to meet industry demands for versatile talent. Against this backdrop, deepening reforms in cultivating information technology literacy by focusing on metric development, instructional integration, and evaluation optimization has become an urgent necessity to align with industrial development. This paper focuses on cultivating general IT professional competencies among vocational students. Integrating vocational education characteristics with industry demands, it constructs an indicator system covering dimensions such as technology application, information security, and digital thinking. The study explores pathways for integrating these competencies into specialized courses and designs formative and diversified evaluation mechanisms. By combining theory with practice, it provides references for enhancing vocational students' digital adaptability and professional competitiveness, thereby supporting vocational education in meeting the demands of digital transformation.

Keywords: vocational college students, information technology, general professional competencies, indicator construction, instructional integration, evaluation mechanism

Introduction

In the digital age, general information technology literacy serves as the core competency for vocational college students' employment and professional growth. Currently, vocational education often faces challenges such as ambiguous competency indicators, fragmented integration of teaching, and one-dimensional evaluation systems, making it difficult to meet industry demands for cultivating versatile talents. This article systematically explores cultivation pathways by focusing on three core dimensions—indicator construction, teaching integration, and evaluation—based on the positioning of vocational education. It aims to provide theoretical and practical support for transforming information technology literacy education in vocational colleges.

1. Core Elements of General Information Technology Competencies for Vocational Students

1.1 Solid foundational knowledge

Robust professional knowledge forms the bedrock of general IT competencies for vocational students. The IT field encompasses diverse domains including computer science, network technology, software development, and data processing. Students

Corresponding Author: Genrang Zheng
Zhongshan Polytechnic, China

must systematically master these fundamental theoretical foundations (Cai et al., 2025). From computer hardware composition and operational principles to software programming logic and algorithm design, and from fundamental network communication protocols to database management and application—each knowledge point serves as a brick in constructing the edifice of professional competence. Only with deep and comprehensive professional knowledge reserves can students swiftly grasp the essence of real-world technical problems and identify reasonable solutions, thereby laying a solid foundation for future career development.

1.2 Proficient practical skills

Information technology is a highly practical discipline, making proficient practical skills an indispensable competency for vocational students. This includes adept operation of various IT tools and software, such as programming language application, graphic and image processing software utilization, and network device configuration and management. Through extensive hands-on training, students transform theoretical knowledge into practical operational capabilities, thereby enhancing work efficiency and quality. Simultaneously, practical operations cultivate problem-solving abilities and innovative thinking. Through continuous experimentation and exploration, students discover new methods and skills, advancing their technical proficiency to better meet the complex and dynamic demands of real-world applications.

1.3 Strong information literacy

In today's era of information explosion, strong information literacy is crucial for vocational students' general IT professional competence. Information literacy encompasses multiple aspects including information acquisition, evaluation, processing, and utilization. Students must learn to swiftly and accurately obtain desired materials using diverse IT tools, while evaluating their authenticity, reliability, and value. They should also organize, analyze, and process information through appropriate methods, transforming it into valuable insights and decisions. Strong information literacy enables students to navigate the information ocean with clarity, make sound judgments and decisions, and enhance both work and learning outcomes.

2. Methodology for Constructing Indicators of General Information Technology Professional Competencies for Vocational College Students

2.1 Analyzing competency dimensions based on industry demands

The primary prerequisite for establishing indicators of general information technology professional competencies for vocational college students is accurately aligning with industry development needs. Based on systematic industry research and demand analysis, the core objective is to clarify competency dimensions. The development team must employ diversified research methods to fully grasp the occupational requirements and development trends of the information technology industry (Gu, 2025). On one hand, conduct in-depth industry interviews by inviting human resources directors, technical department heads, and frontline key personnel from leading IT enterprises to discuss essential professional competencies for specific roles. Focus on understanding industry-specific demands for technical application, problem-solving, communication and collaboration, and professional ethics under digital transformation. For instance, software development positions emphasize coding standards and version control, while network operations roles require enhanced troubleshooting efficiency and security awareness. On the other hand, leveraging big data analytics tools, we collected digital resources from industry recruitment information, professional skill standards, and development reports. Through keyword extraction and high-frequency term analysis, we identified widely valued competency elements in the IT sector, including data processing capabilities, cross-platform collaboration skills, continuous learning abilities, and information security awareness (You, 2026). Simultaneously, considering the iterative nature of IT industry technologies, we forecasted future shifts in competency demands. For instance, the proliferation of emerging technologies like artificial intelligence and cloud computing necessitates competencies in intelligent tool application and technological innovation thinking. Through this research, employing the Delphi method, we assembled a review panel comprising industry experts, education scholars, and vocational college instructors. This panel conducted multiple rounds of assessment and refinement on the preliminarily identified competency elements, eliminating redundant items. and grouped similar items to establish the core competency dimensions of Technology Application, Professional Standards, Innovative Thinking, Collaborative Communication, Continuous Learning, and Ethical Security. This ensures the indicator system not only aligns with current industry job requirements but also possesses foresight, laying a solid foundation for subsequent refinement.

2.2 Designing indicator hierarchy based on competency-based approach

Adhering to competency-based education principles is the core strategy for constructing the general professional competency index for vocational students in information technology. This requires a scientifically structured hierarchy to make the competency index systematic and actionable. The indicator hierarchy must transcend a simple list of single dimensions, establishing a four-tier system of "Core Dimensions—Primary Indicators—Secondary Indicators" to form a complete logical chain from macro to micro levels. Core dimensions are established based on industry demand analysis, guided by technology application and professional standards. Primary indicators serve as core dimensions—for example, "technology application competency" is broken down into tool operation skills, technical practice abilities, and problem-solving capabilities. Second-level indicators focus on the specific manifestations of first-level indicators. For example, "tool operation proficiency" can be subdivided into proficient use of common office software, precise operation of specialized technical tools, and flexible utilization of digital platforms. Third-level indicators serve as the most concrete, observable, and evaluable behavioral representations. They must clearly define the specific requirements for each second-level indicator. For instance, "precise operation of specialized technical tools" can be further detailed as "able to proficiently use programming software for basic code writing and debugging" or "Ability to utilize network configuration tools to build and maintain local area networks" (Liu & He, 2022). When designing the hierarchical structure, factors such as vocational students' cognitive patterns and career development paths must be fully considered. Indicator difficulty should follow a principle of progression from basic to advanced. Foundational-level indicators primarily focus on essential generic skills and professional baseline requirements, such as mastery of information security fundamentals and adherence to professional conduct standards. Advanced-level indicators emphasize practical application and capability enhancement, including resolving complex technical issues and cross-team collaboration and communication. Development-level indicators emphasize students' innovative capabilities and sustained career development, such as technological innovation thinking and continuous learning abilities.

2.3 Anchoring competencies to job scenarios

The development of general information technology competency indicators for vocational students must be closely aligned with specific job scenarios. By anchoring competencies to observable behaviors, abstract competency requirements are transformed into measurable, observable actions. This involves analyzing typical job clusters within the IT field—such as software development, network engineering, data analysis, and IT services—clarifying the core tasks and scenario characteristics of each group. For instance, the core scenarios for software development positions include requirements analysis, code writing, testing and debugging, and documentation writing, while those for network engineering positions encompass network planning, equipment deployment, troubleshooting, and security protection (He, 2024). Based on this foundation, competency indicators should be mapped to labor behaviors within specific job scenarios, ensuring a deep integration between competency requirements and practical job duties. For instance, the behavioral anchors for "Professional Conduct Competencies" in software development roles include: "Strictly adhering to coding standards and version control procedures," "Accurately documenting development issues and their resolutions," and "Implementing information security protections for client requirement documents and core code." For "collaborative communication competency," behavioral anchors in data analysis roles include "clearly articulating analytical reasoning and outcomes," "adjusting analysis direction based on business department needs," and " collaborating with technical teams to complete data modeling and system integration." These behavioral anchors must prioritize operability and distinctiveness. Each metric's corresponding behavior should be specific and unambiguous, avoiding vague phrasing. For instance, "problem-solving ability" could be anchored as: "rapidly identifying root causes during technical failures," "leveraging acquired knowledge and tools to propose reasonable solutions," and " "Summarize problem-solving experiences and apply them to similar scenarios." Additionally, behavior anchors should be designed at different levels based on the career development stage of the position. This ensures competency indicators not only align with practical job requirements but also effectively guide teaching practices and evaluations in higher vocational information technology programs. It helps students develop professional competencies and behavioral habits aligned with workplace needs during their academic studies (Zhao & Zhang, 2025).

3. Methods for Integrating General Information Technology Competencies into Vocational Higher Education

3.1 Aligning with curriculum standards through modular content reorganization

Modular content restructuring aligned with curriculum standards serves as the fundamental pathway for integrating general IT professional competencies into teaching. Guided by vocational IT program standards, this approach requires dismantling the linear structure of traditional disciplinary content. It focuses on core competency dimensions to construct a tripartite modular teaching system integrating "knowledge plus skills, competencies plus." For instance, decomposing competency requirements from curriculum standards allows transforming elements like technical application, professional ethics, and collaborative communication into specific modules for instructional incorporation. For instance, in the "Programming Fundamentals" course, competency modules such as "Code Standards and Version Management" and "Team Collaboration Development" could be added. The ‘Cybersecurity’ course could introduce modules like "Information Security Ethics" and "Compliance Operational Standards." Subsequently, knowledge points and skill points for each course should be systematically organized and restructured according to modular logic. This ensures that each module not only encompasses core knowledge and skill training but also carries specific professional competency development objectives (Chen et al., 2025). For instance, the "Data Analysis" course can be restructured into four modules: "Data Collection and Processing," "Utilizing Data Analysis Tools," "Visualizing Data Results," and "Cross-Departmental Communication and Reporting." The first three modules focus on developing technical competencies, while the latter module emphasizes collaboration, communication, and presentation skills. Module design must balance universality and specialization, with universal modules covering essential professional competencies like continuous learning and professional ethics applicable across all specializations. Specialized modules integrate refined competency requirements for different career paths, such as the "Code Quality Control" module for software development majors and the "Fault Emergency Response" module for network engineering majors. This modular restructuring embeds professional competency development throughout the entire curriculum, achieving simultaneous advancement in knowledge acquisition, skill training, and competency enhancement.

3.2 Creating authentic work contexts for task-driven instruction

Task-driven teaching within authentic work scenarios is a key pathway for translating professional competencies into practice. This approach requires meticulously designing practical and comprehensive teaching tasks based on typical work scenarios from the information technology industry. Students hone their professional competencies while fulfilling mission objectives. This involves conducting in-depth investigations into core job tasks and processes within enterprises, then translating these into teaching contexts. For example, simulating the software development role's full lifecycle: "project requirements analysis—code development — testing and debugging — documentation delivery." For network operations roles, create scenarios like "LAN setup — device configuration — Troubleshooting — Security Protection." Subsequently, a tiered task framework is established. Foundational tasks focus on cultivating single professional competencies, such as enhancing professional documentation standards through "Technical Documentation Writing." Comprehensive tasks emphasize the integrated development of multiple competencies, like "Cross-Team Collaboration to Develop a Small-Scale Information System," which simultaneously hones collaboration, communication, problem-solving, and technical application skills (Chen, 2025). During task execution, integrate authentic corporate work standards and evaluation mechanisms—such as employing industry-standard project management tools and adhering to technical specifications—to cultivate sound professional habits in a workplace-like environment. Additionally, students are encouraged to complete tasks collaboratively through role division, negotiation, and shared responsibility, fostering teamwork and collective awareness. Upon task completion, a blended evaluation approach—incorporating self-assessment, peer review, instructor feedback, and corporate mentor assessment—provides targeted feedback on demonstrated professional competencies. This clarity helps students identify specific areas for improvement, ensuring precise enhancement of their professional skills.

4. Evaluation Methods for General Information Technology Competencies Among Vocational College Students

4.1 Process-Oriented performance evaluation with multi-dimensional observation

This process-oriented, multi-dimensional observation evaluation emphasizes dynamic tracking of students' professional competency development. It establishes a multi-subject evaluation framework comprising "teacher observation → peer assessment → self-reflection → industry mentor feedback." Detailed observation indicators are developed around core dimensions: technical application standards, collaborative communication performance, problem-solving approaches, and professional ethics practice. Through recording classroom task execution, tracking project collaboration processes, and reviewing technical documentation compliance, real-time data on competency development is collected. Periodic formative assessments, combining quantitative scoring and qualitative descriptions, comprehensively reflect the dynamic evolution of professional competencies during learning and practice. This approach overcomes the limitations of outcome-based evaluations, laying the foundation for targeted instructional refinement and personalized competency enhancement.

4.2 Industry certification-based competency assessment

Industry certification assessment bridges competency evaluation with real-world job requirements. Authoritative certifications—including Network Engineer, Software Technology, and Data Security certifications in IT—are identified, with their core competency standards translated into competency evaluation metrics. Based on industry certification content, two assessment components were designed: simulated certification tests and practical skills evaluations. These focus on assessing students' comprehensive abilities to practice professional standards, apply technical skills, and solve real-world problems within authentic technical scenarios. By linking industry certification outcomes to course evaluations and graduation requirements, students are incentivized to participate in actual industry certification exams. Certification pass rates serve as a key reference for competency attainment, ensuring industry recognition of evaluation results and providing robust support for students' career development. Simultaneously, certification requirements are tiered according to students' academic stages and competency levels: foundational tiers align with entry-level industry certifications, while advanced tiers match junior-level job certifications. Integrating certification preparation with daily instruction uses examinations to drive learning and evaluations to promote practice, enabling competency assessments to serve as a genuine bridge between campus education and workplace employment.

Conclusion

Cultivating general information technology competencies among vocational students is a critical measure for aligning with digital transformation. A scientific indicator system, effective teaching integration, and diversified assessment can significantly enhance students' digital application and innovation capabilities. Moving forward, continuous optimization of indicators and teaching models is essential. Strengthening industry-academia collaboration will embed competency development throughout the talent cultivation process, solidify the foundation for vocational students' career advancement, and propel vocational education to deliver high-quality services for industrial upgrading.

Conflict of Interest

The author declares that he has no conflicts of interest to this work.

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