

Digital Transformation Empowering the Development of Undergraduate Vocational Education: Practical Examples and Optimization Paths in Guangdong Higher Vocational Colleges

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Abstract: With the rapid development of information technology, digital transformation has become a crucial driving force for the development of undergraduate vocational education in higher vocational colleges. However, the existing teaching and management models have problems that incorporate fragmentation of course contents, uneven digital capabilities among the teachers, and lack of cooperation in the teaching management systems. In turn, the paper builds a comprehensive picture of the ways of digitally empowering undergraduate vocational education, as the higher vocational colleges of Guangdong Province do. First, the units of the courses are separated into modules of modular knowledge and modules of skills and modules of case studies. Second, blended learning, and intelligent learning platforms are used to obtain learning data on students in order to enable the teachers to facilitate learning through adjusting their teaching methods. Third, there is a hierarchical and progressive system of developing and rewarding digital skills of teachers. Fourth, a comprehensive platform of teaching, management, and research in digital format is developed. The rate of completion of online learning was 94%, mastery rate of 87% at the aspect of knowledge and the average score of 90 points at the aspect of practical. One can also conclude that when it comes to increasing the efficiency of the use of the teaching materials, digital capabilities of the teachers, and the outcome of the learning process in students, the digital transformation of the teaching process has a good chance to make the undergraduate vocational education in the higher vocational colleges an efficient channel of improvement.

Keywords: Vocational Undergraduate Education Development; Digital Transformation; Blended Learning; Intelligent Learning Platform; Teacher Training

1. Introduction

Since the information technology is continuously developing, and the needs within the realm of education become increasingly more varied, the digital transformation process can be viewed as one of the noteworthy tendencies in the higher education environment. Digital technologies are significantly changing the education models of the world particularly in the vocational education and the undergraduate education in higher vocational colleges where digital transformation is bringing new opportunities and challenges never seen before. As a forefront province in developing the economy of China, Guangdong Province is particularly interested in the role of higher vocational colleges in the economic development; therefore, the undergraduate vocational education development, as well as the digital transformation, is one of the key concerns of the local educational reform.

To address the above issues, this paper analyzes practical cases from higher vocational colleges in Guangdong Province and proposes an optimized path for the construction of undergraduate vocational education based on digital transformation. Specifically, this paper aims to comprehensively improve course quality, management efficiency, and teachers' digital teaching capabilities by introducing modular curriculum design, blended learning models, intelligent learning platforms, and data-driven teaching management systems. Through the analysis of experimental data, this study further verifies the positive impact of digital transformation on improving student learning outcomes, teachers' teaching abilities, and the sharing of teaching resources.

2. Related Research

In recent years, with the rapid development of digital technology and the concept of industry-education integration, global vocational education has faced new opportunities and challenges. Related research has explored the path and mechanism of high-quality development of vocational education from multiple dimensions such as policy practice, digital empowerment, online learning experience and skills training. Zhang H reported on the content of the parallel forum "Industry-Education Integration Promotes High-Quality Development of Vocational Education" at the 2024 World Conference on the Development of Vocational and Technical Education which explored the internal logic and practical path of industry-education integration to promote the high-quality development of vocational education, shared international experience and typical cases, and showed the new trends of industry-education integration in global vocational education and the latest progress of international cooperation, providing a reference for deepening industry-education integration and promoting the high-quality development of vocational education [1]. Saini and Kharb studied the key driving factors of India's "Digital India" plan in achieving sustainable development goals. Through literature review, they identified 10 key promoting factors and used The Totally Explained Structural Model (TISM) to analyze their hierarchical relationship, supplemented by the MICMAC method to evaluate the driving force and dependence of each factor. The study found that government support policies are the most driving strategic facilitator, located at the bottom of the model, emphasizing that the government needs to promote digital empowerment, ensure that the public has access to information to make reasonable decisions, and provide a theoretical basis for digital India's transformation and sustainable development [2]. Wong et al. investigated the experience of 400 Hong Kong university students in the process of rapidly transitioning to online learning. The results showed that most students had the equipment, but network instability and home environment interference affected their learning, and low-income students were more affected. Teachers' digital skills were generally good, but there is still room for improvement in teaching [3]. Adejoke explored a transformation strategy to empower young people in Lagos through the development of entrepreneurial skills, aiming to help young people acquire the necessary skills, ways of thinking and knowledge to cope with the complexity of the global economy by integrating entrepreneurial education into formal and informal learning frameworks. The study found out that entrepreneurial development can make a contribution to sustainability in economic growth and social cohesion, in terms of entrepreneurial capacity to enhance employability, creativity, critical thinking and problem-solving capacity, financial literacy, resilience and leadership [4]. Amiri explored how the digital revolution can remake the teaching and learning process, assessment method and student interaction method, and addressed particular issues, including the systematic barriers, including the digital divide, data privacy and ethical concerns. The world case studies of the Estonian system of digital education and Singapore Smart Nation program can help to see the successful implementation of technology and warn about the overestimation [5]. Although there has been some achievement in digital transformation, industry-education integration and vocational education practice; a problem of geographical or sample limitation, insufficient empirical information, lack of systematic integration and lack of sufficient concern on long term implications still abounds in most of the studies.

3. Methods

3.1 Current Status of Digital Transformation in Vocational Undergraduate Education Construction

3.1.1 Current Status of Digital Construction in Higher Vocational Colleges

Regarding the management systems, most college have evolved information-based systems of student registration, course selection, examinations and teaching assessment, which enable simple teaching-related matters to be conducted online, and improves efficiency in the management processes. General information literacy of the teachers is gradually growing in terms of capacity of faculty. Some of the teachers are successful in the development of instruction and interaction with the digital tools in the classroom. Meanwhile, the colleges provide regular training on the use of information technology to improve the roles of the teachers with respect to the digital teaching.

3.1.2 Existing Problems and Challenges

Despite incremental progress, several structural impediments hinder the comprehensive digitalization of vocational undergraduate education. Primarily, instructional materials exhibit fragmentation and lack contemporary relevance, failing to accommodate evolving curricular demands

and the diverse learning requirements of a multicultural student body. Furthermore, the current ecosystem of educational management systems suffers from insufficient interoperability, resulting in persistent data silos that obstruct seamless information exchange and collaborative governance across departments[6]. Additionally, faculty members demonstrate heterogeneous competencies in digital pedagogy, with a notable subset encountering significant barriers in adopting and integrating technological tools into their instructional practices. Lastly, existing frameworks for data security and privacy protection remain underdeveloped, wherein potential vulnerabilities pose substantial risks that curtail the aggressive expansion of informatization initiatives within academic institutions[7].

3.2 Practical Models for Digital Transformation-Driven Vocational Undergraduate Education Construction

3.2.1 Innovation in Teaching Models

In response to the imperatives of digital transformation, higher vocational institutions have proactively experimented with pedagogical paradigm shifts. Blended learning modalities have gained widespread traction, enabling learners to engage with online curricular content at their individual pace while subsequently participating in face-to-face classroom interactions[8]. The deployment of intelligent learning technologies has demonstrated considerable efficacy in enhancing learner engagement and instructional outcomes through sophisticated mechanisms including progress monitoring, algorithmic notification systems, and personalized learning pathway recommendations. Concurrently, academic institutions are increasingly leveraging digital assessment instruments and learning analytics to systematically examine student behavioral patterns and knowledge acquisition levels, thereby generating actionable insights for continuous curricular refinement.

3.2.2 Management Model Optimization

The digital transformation has catalyzed substantial refinements in pedagogical administration frameworks. Through the progressive implementation of interoperability protocols among disparate information systems, institutions have successfully dismantled informational barriers, thereby streamlining administrative workflows and enhancing operational efficiency. The adoption of remote classroom observation mechanisms facilitates real-time monitoring of instructional dynamics, teaching progression, and student engagement levels, furnishing empirical foundations for evidence-based quality assurance interventions[9]. Simultaneously, the infrastructure for instructional resource sharing has undergone significant consolidation, wherein platform-centric governance models and cross-departmental synergies have optimized the allocation and utilization of educational assets throughout the institution.

3.2.3 Faculty Development

Vocational colleges have prioritized the cultivation of digitally proficient academic personnel. Systematic, tiered professional development programs delivered in sequential phases have substantively elevated faculty capabilities in technology-mediated instruction and tool utilization. To stimulate active participation in digital pedagogical innovation, administrative bodies have instituted comprehensive incentive architectures encompassing recognition awards, project funding opportunities, and platforms for showcasing scholarly achievements[10]. Moreover, the documentation and dissemination of exemplary digital teaching practices have created robust mechanisms for intra-institutional knowledge transfer, furnishing novice educators with benchmark models and contributing to the holistic elevation of pedagogical standards across the organization.

3.3 Optimization Path of Digital Transformation Empowering the Construction of Vocational Undergraduate Education

3.3.1 Optimization of Teaching Resources and Curriculum Development

To effectively harness the potential of digital transformation, institutions must architect reusable, modular curricular ecosystems. Course architectures should be deconstructed into discrete knowledge units, competency modules, and case study repositories, thereby establishing standardized, transferable, and adaptable content structures. The digitization and centralized hosting of textbooks, case databases, and multimedia resources on unified platforms warrant immediate implementation to ensure cross-disciplinary and inter-departmental resource accessibility. Furthermore, the integration of virtual simulation technologies, augmented and virtual reality experimental environments, and web-based training protocols can substantially enhance the interactivity and operational authenticity of

practice-oriented courses, thereby augmenting student technical competencies and practical application capabilities[11].

3.3.2 Optimization of Teaching Management and Operation Mechanisms

Institutions should architect data-driven educational management ecosystems that facilitate comprehensive digitization of administrative processes spanning student enrollment, course selection, examination administration, teaching evaluation, and quality control protocols. Advanced analytics capabilities should be deployed to discern patterns in student learning trajectories, instructor pedagogical efficiency, and instructional resource utilization rates, generating quantifiable metrics to inform evidence-based decision-making. Additionally, bureaucratic workflows necessitate streamlining to enhance inter-departmental collaboration, resource sharing, and process reengineering, thereby amplifying administrative productivity. Real-time early warning systems should be established to detect pedagogical anomalies, student academic difficulties, and resource utilization inefficiencies, enabling timely intervention and systematic optimization.

3.3.3 Optimization of Faculty and Capacity Building

Educators constitute the fundamental catalysts for digital transformation success. Institutions must implement stratified, sequential digital competency development frameworks: foundational tiers should encompass online course development, interactive classroom tool deployment, and office automation proficiency; intermediate levels should focus on digital curricular innovation, intelligent platform collaboration, virtual course creation, and interdisciplinary pedagogical research integration; advanced strata should emphasize sophisticated digital course design and interactive classroom facilitation. Correspondingly, evaluation and incentive mechanisms grounded in pedagogical innovation should be established, explicitly correlating digital literacy competencies with professional rank advancement, teaching workload allocation, and project funding eligibility. Furthermore, institutional repositories of best practices and digital knowledge-sharing platforms should be developed to accelerate the replication and dissemination of exemplary teaching methodologies.

3.3.4 Optimization of Digital Support Platform

Vocational institutions must develop integrated digital infrastructures consolidating instructional delivery, administrative operations, research activities, and student services within unified ecosystems characterized by single sign-on authentication, seamless data interoperability, and comprehensive resource sharing. These platforms should incorporate intelligent analytics and decision support subsystems capable of synthesizing multi-dimensional data streams—including student learning analytics, instructor pedagogical metrics, and resource utilization patterns—to generate evidence-based recommendations for instructional enhancement. Concurrently, robust data governance frameworks and information security protocols must be fortified through stringent access control mechanisms, privacy protection safeguards, and network security measures to ensure the sustained, secure, and stable operation of digital infrastructure in the long term.

4. Results and Discussion

4.1 Experimental Subjects and Sample Selection

This paper selects vocational undergraduate training courses from multiple higher vocational colleges in Guangdong Province as the experimental research objects, covering multiple disciplines such as engineering technology, information technology, economic management, and modern services to ensure the sample has strong representativeness and practicality. The experimental sample consists of two groups: students and teachers.

A total of 308 students were included, all of whom were vocational undergraduate students participating in digital or blended teaching courses. To enhance the comparability of the experimental results, students were stratified by grade and major, with first-year students accounting for 36% (n = 111), second-year students accounting for 35% (n = 108), and third-year students accounting for 29% (n = 89). By major type, engineering technology accounted for 42%, information technology for 31%, and economic management and services for 27%. All students had basic information technology learning conditions, were able to use online learning platforms stably, and completed no less than 80% of the course learning tasks during the experiment.

The teacher sample consisted of 206 teachers from different professional course teams, with

different teaching experience and information technology application levels. Among them, 80 teachers hold senior professional titles, 110 hold intermediate professional titles, and 16 hold junior professional titles, with teaching experience ranging from 3 to 22 years.

4.2 Experimental Environment and Platform

The experiment was on the current digital pedagogy platform of the school including the online course system, the virtual simulation training platform and the smart classroom. The system comprises of course management, learning behavior and interactive teaching functions data collection and analysis. It can also record the learning tracks of students, the condition of homework completed, online exams and interactive information which, in their turn, can facilitate complete data analysis.

4.3 Experiment Content and Process

The steps used in the experiment material include:

Adoption of the Course in the digital format: Transforming the conventional courses into the digital course modules; i.e., video lectures, case study, online test, and virtual training.

Blended Learning Application: The learners are provided with self-study works in the platform and experience offline classroom communications and practical works.

Learning Data Collection: The system automatically records the behavior of the students with respect to online learning such as duration of learning, rate of mastering of knowledge points, test score, and submission of assignment.

Digital Teaching Operation to Teachers: The teachers use the platform to organize their classrooms, give assignments and analyze data and adjust their teaching process based on learning data.

The experiment execution is as follows; Digital Course Development - Platform Implementation - Student Learning and Teacher Teaching in sync – Data recording and Data management -Subsequent analysis.

4.4 Data Indicators and Analysis Methods

The data that is gathered in the course of the experiment is composed mostly of:

Student Learning Indicators: The time of online education, the percentage of its completion, the speed at which students have mastered the knowledge points, the marks of the practical works.

Teacher Teaching Indicators: Could be determined by how well the courses are released, how efficiently the assignments are graded, and how often the analysis of data is conducted.

System Operation Indicators: Platform stability, rate of functionality utilization and integrity.

The methods of data analysis include descriptive statistics, correlation analysis, and multidimensional comparative analysis that can be applied to identify the successfulness of the digital curriculum design, blended learning models, and digital operations of the teachers.

The sample students' study time was concentrated between 10.8 and 14.0 hours, with an average of about 12.3 hours, and the overall participation was relatively stable. The completion levels were 88 percent to 100 percent with an average of 94 percent, thus showing that the digital learning activities were structured and quite feasible to encourage the students to continue with the learning activities. Regarding the quality indicators of learning, knowledge point mastery was at between 80 to 92 with average value of about 87 pointing at a positive correlation between the learning time and its mastery. The mastery rate and grades were better among those students who were more engaged in learning (S003 and S005). The practical operation scores were 84 and 95 with an average of roughly 90 points which exceeded the normal range of the traditional classroom based practical assessment suggesting that online case materials and digital training modules played a significant role in helping to acquire skills (see Figure 1).

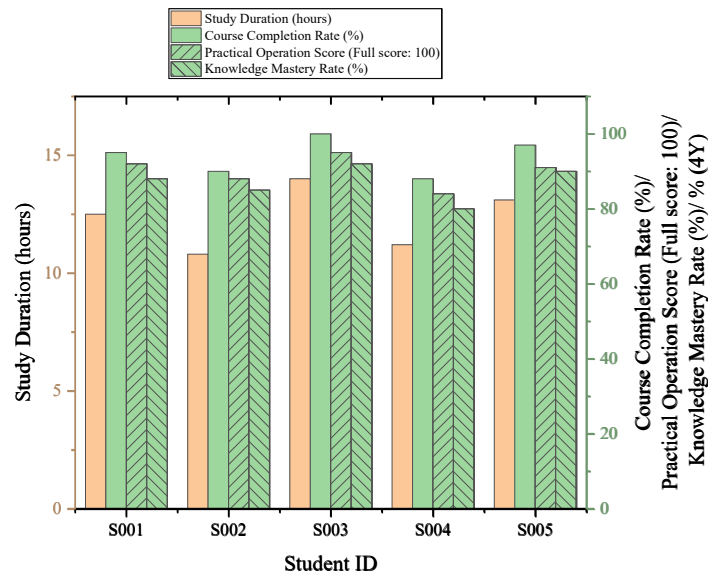


Figure 1. Student Learning Indicators

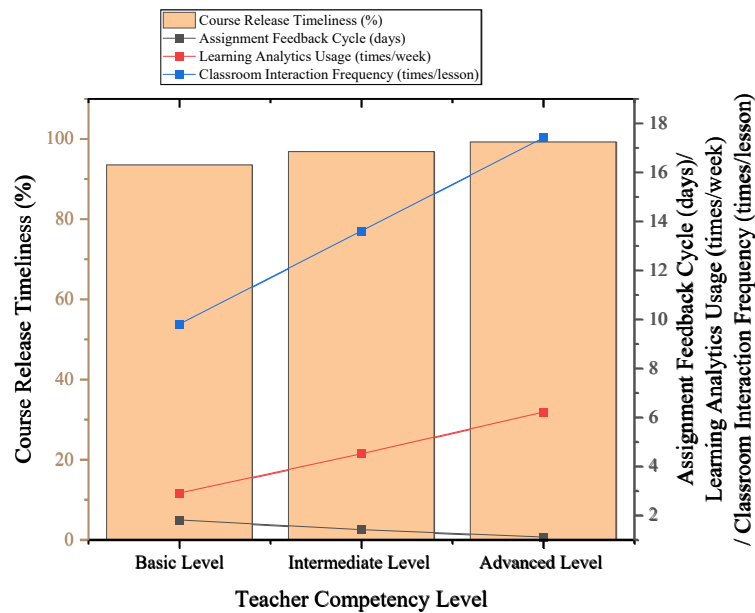


Figure 2. Teacher Teaching Indicators

The results presented in Figure 2 demonstrate clear differences in teaching performance across teachers with varying levels of digital competency. In terms of course release timeliness, the average values increase progressively from 93.5% at the basic level to 96.8% at the intermediate level and 99.2% at the advanced level, indicating that higher digital proficiency contributes to more efficient and punctual course management. This suggests that the digital teaching platform provides stronger support for teachers with higher levels of technological integration ability. Regarding assignment feedback efficiency, the grading cycle decreases from 1.8 days for basic-level teachers to 1.4 days for intermediate-level teachers and further to 1.1 days for advanced-level teachers. This trend reflects a substantial improvement in feedback timeliness, implying that proficient use of platform-based tools such as online annotation and automated management significantly enhances grading efficiency compared with traditional methods. In terms of learning analytics usage, the frequency rises from 2.9 times per week at the basic level to 4.5 times at the intermediate level and 6.2 times at the advanced level. This indicates that teachers with stronger digital capabilities are more likely to adopt data-driven instructional strategies, enabling continuous adjustment of teaching approaches based on students' learning behaviors and performance data. At the classroom level, interaction frequency also shows a consistent upward trend, increasing from 9.8 times per lesson for basic-level teachers to 13.6 times for intermediate-level teachers and 17.4 times for advanced-level teachers. This demonstrates that the integration of digital tools—such as real-time questioning, instant quizzes, and task-based

activities—effectively enhances classroom engagement and promotes active student participation. Overall, the findings reveal a clear positive correlation between teachers' digital competency levels and key teaching performance indicators, highlighting the critical role of digital capability development in improving instructional efficiency, feedback quality, and classroom interaction in undergraduate vocational education.

5. Conclusion

The paper is a systematic review of the empowering role of digital transformation in vocational undergraduate education construction, as per a case study of vocational colleges in Guangdong Province, considerations are made regarding the construction of teaching resources, management systems, teacher capabilities, and digital support platforms. With the teaching management, the colleges using the data-driven management systems and multi-departmental collaboration systems achieved interoperability between the student registration, course selection, examination administration and evaluation systems because of the highly promoting impact of the system under the digital curriculum system on the learning outcomes. The tiered training and incentive schemes enhanced the digital capacity of the instructors in accordance with which they could easily learn to utilize intelligent platforms to alter the instructional approaches and induce the exchange of exemplary practical experiences in the colleges. A sound rationale of the curriculum resource integration, data analysis and decision-making and teaching, management, and research optimization were good reasons to develop the system of a full-fledged digital platform.

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