

GUIDELINES FOR THE DEVELOPMENT OF TEACHER TRAINING MANAGEMENT IN GUANGXI TALENT INTERNATIONAL COLLEGE

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ABSTRACT

This study aims to investigate the current level of teacher training management at Guangxi Talent International College and to propose development guidelines for improvement. Using a mixed-method approach including questionnaire survey and in-depth interview, data were collected from 127 teachers and 5 key informants at the college. Results show that the overall level of teacher training management is at a moderate level ($M=2.90$, $S.D.=0.90$), with Training Quality receiving the highest mean score ($M=3.05$) and Training Effectiveness Evaluation the lowest ($M=2.72$). Main problems include incomplete policy implementation with lack of detailed rules, homogenized training content lacking regional industrial characteristics and ASEAN-oriented elements, weak digital training management capacity, insufficient support conditions with unbalanced resource allocation, and an imperfect evaluation mechanism lacking closed-loop management. Based on Human Resource Development Theory, Adult Learning Theory, Kirkpatrick's Four-Level Model, and Organizational Support Theory, five targeted development guidelines are proposed: improving the training policy system and strengthening implementation mechanisms; optimizing training content design and enhancing pertinence and practicality; strengthening digital training management and promoting platform upgrading; enhancing training support conditions and optimizing resource allocation; and improving the training evaluation mechanism and achieving closed-loop management. This study provides empirical references for optimizing teacher training management in private vocational colleges in the context of educational digital transformation and regional economic development.

Keywords: Teacher Training Management; Training Policy; Digital Training Management; Training Effectiveness Evaluation; Private Vocational Higher Education

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INTRODUCTION

Research Background

At present, educational management in China is at a critical stage of digital transformation and quality improvement. Globally, technological innovations such as artificial intelligence and big data, coupled with the deepening of concepts like lifelong education and the integration of production and education, have profoundly influenced the development of vocational education (Xu Duo, 2024). China has established an education management policy system characterized by national leadership, local refinement, and institutional implementation. The Opinions on Promoting the High-Quality Development of Modern Vocational Education issued in 2021 clearly puts forward core requirements such as strengthening the construction of a team of double-qualified teachers (Ministry of Education, 2021). At the local level, Qinzhou City's 15th Five-Year Plan and the 2026 Education Work Conference proposed building a high-quality team of double-qualified teachers, forming a regional policy orientation.

Under the dual pressures of global educational competition and regional industrial upgrading, teacher training management has become the core carrier for vocational colleges to adapt to local development. Currently, teacher training management in private vocational colleges in China generally faces prominent problems: the disconnection between training content and policy requirements, the mismatch between supply and demand, and inadequate guarantee mechanisms (Zhang Jing, 2023; Tang Xiaoming, 2023). As a representative private higher vocational college in Qinzhou, Guangxi Talent International College (GXYH) not only faces the common dilemmas of private colleges but also needs to adapt to the needs of regional industrial development in the Beibu Gulf Economic Zone and China-ASEAN cooperation. Its training management has problems such as homogenized content, inflexible organizational mechanisms, and insufficient application of digitalization, which restrict teachers' professional growth and the college's ability to serve regional development. There is a lack of systematic empirical research on how regional private higher vocational colleges like GXYH can accurately align with policy requirements and solve practical dilemmas, highlighting the necessity of this study.

RESEARCH SIGNIFICANCE

Theoretically, this study constructs a five-dimensional analytical framework of training policy, training quality, digital training management, training support conditions, and training effectiveness evaluation for teacher training management in private vocational colleges. It verifies the applicability of Human Resource Development Theory, Adult Learning Theory, Kirkpatrick's Four-Level Model, and Organizational Support Theory in the context of Chinese private vocational higher education, and enriches theoretical research on teacher training management in the field of vocational education.

Practically, this study takes GXYH as a typical case, identifies key problems in the current training management system, and proposes operable development guidelines. The findings can provide replicable experience and path support for other private vocational colleges in Guangxi to improve their teacher training management systems, and can also provide reference for education administrative departments to formulate regional teacher development policies.

RESEARCH OBJECTIVES

1. To study the level of teacher training management in Guangxi Talent International College.
2. To propose the guidelines for the development of teacher training management in Guangxi Talent International College.

METHODOLOGY

Research Design

This study adopts a mixed research method combining quantitative questionnaire survey and qualitative in-depth interview. Quantitative research obtains large-scale data to reflect the overall status of teacher training management, while qualitative research digs deep into the underlying reasons and practical problems. The combination of the two methods makes the research results more comprehensive, in-depth and credible through data triangulation.

Population and Sample

The research population of this study is 185 full-time teachers from Guangxi Talent International College. Based on the Krejcie and Morgan (1970) sampling method, 127 teachers were selected as the survey sample through simple random sampling, ensuring each teacher had an equal chance of being selected. In terms of qualitative research, 5 key informants were selected by purposive sampling for in-depth interviews, including a Course Leader, Deputy Head of Department, Administrative Staff of the Academic Affairs Office, Full-time Teacher, and Department Director. All interviewees have more than 3 years of work experience at the college, are familiar with the teacher training management system, and can provide in-depth and effective interview information.

RESEARCH TOOLS

Questionnaire

The questionnaire is designed based on literature research and core research variables, with a total of 40 items divided into five dimensions: Training Policy (8 items), Training Quality (8 items), Digital Training Management (8 items), Training Support Conditions (8 items), and Training Effectiveness Evaluation (8 items). The questionnaire adopts a 5-point Likert scale, with 5 representing the highest level and 1 representing the lowest level. Before the formal survey, the questionnaire was tested for content validity and reliability. The Item Objective Congruence (IOC) of all items is between 0.67 and 1.00 after evaluation by 3 experts, which meets the validity standard. The Cronbach's alpha coefficient of the total scale is 0.741, indicating that the questionnaire has acceptable internal consistency and good reliability.

Semi-structured Interview Outline

The interview outline is designed around the five core dimensions of the research, focusing on the existing problems, root causes and improvement suggestions of the teacher training management system. The interview content covers policy operability, training content alignment, digital platform issues, support condition adequacy, and evaluation effectiveness.

Data Collection and Analysis

The questionnaire was distributed and collected through both online and offline channels, and 127 valid questionnaires were recovered with an effective recovery rate of 100%. The in-depth interviews were conducted face-to-face. Interviewees were informed of the research purpose and confidentiality principle in advance. The interview process was recorded with consent and sorted out in a timely manner. Quantitative data were analyzed using statistical software, mainly using descriptive statistics (mean and standard deviation) to reflect the current status level of each dimension. Qualitative data were analyzed by content analysis method, involving transcription, coding, categorization of core themes, and summarization of systematic problems and improvement suggestions.

RESULTS

Demographic Characteristics of Respondents

Among the 127 questionnaire respondents, female teachers accounted for 62.99% and male teachers accounted for 37.01%. In terms of age structure, teachers aged 30-39 accounted for the largest proportion at 51.97%, followed by those aged 25-29 at 24.41%, indicating that young and middle-aged teachers are the main body of the teaching staff. In terms of educational background, teachers with bachelor's degrees accounted for 71.65%, those with master's degrees accounted for 26.77%, and those with doctoral degrees accounted for 0.79%. In terms of work experience, teachers with less than 5 years of experience accounted for 58.27%, those with 6-10 years of experience accounted for 22.05%. Regarding double-qualified teacher certification, 35.43% reported having obtained such certification, while 64.57% had not, indicating significant room for improvement.

OVERALL STATUS OF TEACHER TRAINING MANAGEMENT

Table 1. Summary of the Overall Findings

Guidelines for the Development of Teacher Training Management of Guangxi Talent International College	n = 127		Interpretation
	M	S.D.	
1. Training Policy	3.03	0.90	Moderate
2. Training Quality	3.05	0.89	Moderate
3. Digital Training Management	2.83	0.91	Moderate
4. Training Support Conditions	2.86	0.90	Moderate
5. Training Effectiveness Evaluation	2.72	0.91	Moderate
Total	2.90	0.90	Moderate

Table 1 shows the overall mean score and standard deviation of teacher training management. The overall level is at a moderate level ($M = 2.90$, $S.D. = 0.90$). The scores of each dimension from high to low are: Training Quality ($M = 3.05$, $S.D. = 0.89$), Training Policy ($M = 3.03$, $S.D. = 0.90$), Training Support Conditions ($M = 2.86$, $S.D. = 0.90$), Digital Training Management ($M = 2.83$, $S.D. = 0.91$), and Training Effectiveness Evaluation ($M = 2.72$, $S.D. = 0.91$). The results show unbalanced development across the five dimensions: dimensions related to training content and policy formulation perform relatively better, while dimensions related to digital management and evaluation mechanisms are relatively weak.

STATUS OF EACH DIMENSION

1. Training Policy

The overall score of this dimension is $M=3.03$, at a moderate level. The items with relatively higher scores are the training policy emphasizes the cultivation of double-qualified teachers and has clear support measures ($M=3.35$) and the training policy is clear and in line with the college's development orientation ($M=3.28$). The items with the lowest scores are the training policy establishes effective incentive and restraint mechanisms ($M=2.79$) and the training policy is effectively implemented and not just a formality ($M=2.82$). It indicates that while the college has formulated training policies aligned with national requirements, the policies lack detailed implementation rules, effective incentive mechanisms, and adequate implementation, leading to a gap between policy formulation and actual practice.

2. Training Quality

This dimension has the highest score among the five, with $M=3.05$. The highest-scoring item is the trainers have rich professional experience and strong teaching guidance capabilities ($M=3.38$), followed by the training content is closely linked to professional teaching and industry development needs ($M=3.31$). The lowest-scoring item is the training content includes ASEAN-related professional knowledge and cross-border teaching capabilities ($M=2.78$), reflecting the insufficient integration of ASEAN-oriented internationalization characteristics. The findings suggest that the college has a reasonably qualified trainer team but the training content lacks regional characteristics, timely updates, and advanced digital teaching skills coverage.

3.Digital Training Management

The mean score of this dimension is $M=2.83$, the second lowest among the five dimensions. The highest-scoring item is the digital training platform has complete basic functions ($M=3.15$). The items with the lowest scores are the digital training platform is connected with the college's teaching management/teacher evaluation system ($M=2.58$) and the digital training platform has intelligent functions ($M=2.65$). The findings confirm that the college's digital training management is still at a preliminary stage of having platforms but lacking management and having resources but lacking application, with insufficient intelligent functions, system integration, and high-quality digital training resources.

4.Training Support Conditions

The mean score of this dimension is $M=2.86$, at a moderate level. The highest-scoring item is the college creates a positive training atmosphere ($M=3.12$). The lowest-scoring items are the training resource allocation is balanced ($M=2.62$) and the training funding is sufficient to meet the needs of high-quality training ($M=2.68$). The findings suggest that while the college has a generally supportive atmosphere and has established enterprise cooperation, concrete support conditions including funding, time allocation, and resource balance need substantial improvement.

5.Training Effectiveness Evaluation

The mean score of this dimension is $M=2.72$, the lowest among all five dimensions. The highest-scoring item is the evaluation process is fair and transparent ($M=3.02$). The lowest-scoring item is the college establishes a long-term tracking mechanism for training effects ($M=2.48$), the lowest of all 40 items, indicating a near-total absence of long-term tracking. This was followed by the training evaluation forms a closed-loop management of evaluation-improvement ($M=2.52$). The findings strongly support the conclusion that the training evaluation mechanism is the weakest dimension, focusing primarily on process and reaction evaluation while lacking in-depth assessment of learning effects, behavior changes, and organizational impacts.

MAIN PROBLEMS SUMMARIZED FROM INTERVIEWS

1. Policy level: Training policies remain relatively macro-level and lack detailed implementation rules. The connection between training participation and teacher evaluation, promotion, and incentives is weak. The ASEAN-oriented international training policy lacks clear selection criteria, funding quotas, and management systems. Some departments have not strictly implemented training requirements due to the pressure of teaching tasks, resulting in a gap between policy and practice.

2. Content level: Training content is somewhat homogenized and has not fully incorporated the college's characteristics of serving the Beibu Gulf Economic Zone and ASEAN cooperation. Teaching skills training mostly uses general vocational education cases, lacking cases related to cross-border logistics, port economy, and other regional industries. The training content on digital teaching skills is relatively basic, and ASEAN-related content is almost nonexistent in practice.

3. Digital management level: The digital training platform lacks intelligent functions such as personalized course recommendation and learning data analysis. The platform is not connected with the college's teaching management system and teacher evaluation system. Digital training resources are insufficient in both quantity and quality, and the application of advanced digital training methods such as virtual simulation is almost nonexistent.

4. Support condition level: Funding constraints restrict the quality of teacher training, with insufficient funds for high-end international training and digital resource development. Time guarantees for teacher training are insufficient due to heavy teaching loads. Training resource allocation is unbalanced, with more opportunities going to backbone teachers in key majors. Post-training follow-up support is almost nonexistent.

5. Evaluation level: The training evaluation is limited to process and reaction evaluation. The evaluation of learning effects, behavior changes, and organizational impacts is basically nonexistent. The evaluation results are mostly used for archival purposes and are not effectively linked to training plan adjustment, incentive mechanisms, or professional development, resulting in the failure of the evaluation function of promoting improvement through evaluation.

DISCUSSION

Analysis of the Overall Status

The overall moderate level of teacher training management indicates that the college has established a basic training management system and achieved certain results, but faces significant challenges across all dimensions. The variation across dimensions suggests that these components are not yet fully integrated into a coherent management system. The college has developed the components of teacher training management, but has not yet achieved full system integration. This is consistent with Phetdalaphone Bouttavong (2023), who emphasized that modernization of educational governance requires alignment among policy, content, digital management, support conditions, and evaluation mechanisms. The unbalanced development pattern of strong culture, weak system is a common problem in the governance transformation of Chinese private vocational colleges, which also means that the college is currently in a stage with the highest marginal benefit of improvement.

Analysis of Dimension Differences and Causes

1. Relatively stronger performance in Training Quality and Training Policy. The relatively higher scores in these dimensions benefit from the national policy emphasis on improving vocational education teacher teams and the college's genuine efforts to assemble a qualified trainer team. However, the low scores for incentive-restraint mechanisms and effective implementation indicate that policies lack detailed implementation rules, leading to a gap between policy formulation and actual implementation (Peng Geng, 2023; Zhao Yansong, 2025).

2. Weak performance in Digital Training Management. The lack of system integration and intelligent platform functions reflects the broader challenge of digital transformation in vocational education. Many colleges are at the stage of having platforms but lacking management (Xu Duo, 2024). Digital training often focuses on basic tool operation rather than advanced applications (Zhao Yansong, 2025). This aligns with Tyagi and Misra (2021), who emphasized that digital transformation requires not only technology infrastructure but also systematic management, professional personnel, and high-quality resources.

3. Weakest performance in Training Effectiveness Evaluation. The near-absence of long-term tracking and closed-loop management indicates that the evaluation system fails to fulfill the function of promoting improvement through evaluation. This aligns with Kirkpatrick (2006), who observed that many organizations struggle with evaluating beyond reaction and learning levels. The evaluation results in many Chinese vocational colleges are mostly used for archival purposes rather than driving improvement (Li Shanghua & Zhang Yiqian, 2022).

Theoretical and Practical Implications

Theoretically, this study verifies the applicability of Human Resource Development Theory and Organizational Support Theory in the context of Chinese private vocational colleges. It confirms that perceived organizational support, including funding, time allocation, and training channels, is a key factor restricting teacher training engagement. The five-dimensional analytical framework enriches the localized measurement system of teacher training management in vocational education. The application of Kirkpatrick's Four-Level Model and the PDCA cycle provides a systematic approach to evaluation and continuous improvement.

Practically, this study clarifies the priority of system optimization: in the short term, improving the evaluation mechanism and strengthening policy implementation can exert a significant leverage effect. In the medium term, upgrading digital training management and enhancing training content pertinence can consolidate the construction achievements. In the long term, relying on the existing supportive cultural foundation to build a comprehensive training management system can realize sustainable development. This implementation path provides a clear and operable reference for similar private vocational colleges.

DEVELOPMENT GUIDELINES

Improving the Training Policy System and Strengthening Implementation Mechanisms

The college should formulate detailed implementation rules for each training policy, transforming macro directives into specific, actionable guidelines with clear timelines, responsible departments, evaluation standards, and accountability mechanisms. Effective incentive and restraint mechanisms should be established to link training participation and outcomes to teacher evaluation, professional title promotion, and performance bonuses. Classified training policies should be developed for different teacher categories (new teachers, backbone teachers, and leading teachers). The college should strengthen the supervision and assessment of policy implementation at the departmental level, incorporating training implementation into departmental performance evaluation.

Optimizing Training Content Design and Enhancing Pertinence and Practicality

The college should integrate regional industrial needs and ASEAN-oriented characteristics into training content, developing training modules for Beibu Gulf regional industries such as cross-border e-commerce, port logistics, and marine engineering technology. Modular training programs for double-qualified teachers should combine professional skill certification, industry practice, and pedagogical training. Digital teaching competence training should be upgraded from basic tool operation to advanced applications, including digital curriculum design, intelligent teaching platforms, and virtual simulation teaching. A trainer certification and evaluation system should be established, and training scheduling should be improved through flexible formats and teaching substitution mechanisms.

Strengthening Digital Training Management and Promoting Platform Upgrading

The college should upgrade the digital training platform with intelligent features such as personalized course recommendation, learning data analysis, and adaptive learning paths. The platform should be integrated with the teaching management system and teacher evaluation system for real-time tracking and data-driven evaluation. High-quality digital training resources, including video courses, electronic materials, case libraries, and virtual simulation training scenarios, should be developed. Professional digital training management personnel should be cultivated through specialized training. The college should leverage artificial intelligence and big data for data-driven training management, enabling personalized learning paths and evidence-based decision support.

Enhancing Training Support Conditions and Optimizing Resource Allocation

The college should increase the proportion of education funds allocated to teacher training, with dedicated budgets for high-end international training and digital resource development. Funding sources should be diversified through government special funds, enterprise sponsorship, and social donations. Equitable resource allocation mechanisms should be established based on training needs assessment results, ensuring that teachers in non-key majors and part-time teachers have sufficient training opportunities. Time guarantees should be strengthened through teaching substitution mechanisms, dedicated training weeks, and vacation-period intensive programs. Post-training follow-up support mechanisms, including mentor guidance, peer exchange groups, and teaching consultation services, should be established.

Improving the Training Evaluation Mechanism and Achieving Closed-Loop Management

The college should construct a comprehensive four-level evaluation system based on Kirkpatrick's Model, expanding from the current reaction and process levels to include learning evaluation (tests, skill assessments), behavior evaluation (classroom observations, peer feedback), and result evaluation (teaching quality, student outcomes, organizational impact). Diverse evaluation methods should be adopted, including self-assessment, peer evaluation, and 360-degree feedback. A long-term tracking mechanism should be implemented to monitor teachers' application of learned knowledge and skills over a 6-12 month period. The PDCA cycle should be implemented in training management, using evaluation results to drive continuous improvement in training plans, content, methods, and resource allocation, ensuring that the evaluation function of promoting improvement through evaluation is fully realized.

CONCLUSION

This study systematically investigates the current status of teacher training management in Guangxi Talent International College by using a mixed research method of questionnaire survey and in-depth interview. The research results show that the overall level of teacher training management is at a moderate level ($M=2.90$), with unbalanced development across five dimensions. Training Quality and Training Policy have formed a basic foundation, while Digital Training Management and Training Effectiveness Evaluation are core weak links. Main problems include incomplete policy implementation, homogenized training content lacking regional characteristics, weak digital training capacity, insufficient support conditions with unbalanced resource allocation, and an imperfect evaluation mechanism lacking closed-loop management.

Based on Human Resource Development Theory, Adult Learning Theory, Kirkpatrick's Four-Level Model, and Organizational Support Theory, this study puts forward five targeted development guidelines from the aspects of policy system, content design, digital management, support conditions, and evaluation mechanism. These guidelines are closely combined with the characteristics of private vocational education and the actual situation of Guangxi Talent International College, with strong operability and practicality. They can provide an important reference for the college and similar private vocational colleges to optimize teacher training management and improve institutional governance effectiveness in the context of educational digital transformation and regional economic development.

REFERENCES

- Aswatun Hasanah, N. (2020). The role of madrasah principal policies in improving the professional quality of teachers. *Journal of Education and Learning*, 9(3), 215-228.
- Cronbach, L. J. (1984). *Essentials of psychological testing* (4th ed.). Harper & Row.
- Eisenberger, R., Huntington, R., Hutchison, S., & Sowa, D. (1986). Perceived organizational support. *Journal of Applied Psychology*, 71(3), 500-507.

- Feng, J., & Wang, Y. (2025). Policy evolution, characteristics, and prospects of in-service teacher training in China under the background of building a strong education country. *Journal of Teacher Education Research*, 39(1), 25-42.
- Kirkpatrick, D. L., & Kirkpatrick, J. D. (2006). *Evaluating training programs: The four levels* (3rd ed.). Berrett-Koehler Publishers.
- Knowles, M. S., Holton, E. F., & Swanson, R. A. (2005). *The adult learner: The definitive classic in adult education and human resource development* (6th ed.). Elsevier.
- Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, 30(3), 607-610.
- Li, J. (2025). Application of PDCA cycle theory and credit-based management in teacher training management. *Vocational Education Forum*, 44(2), 56-63.
- Li, S., & Zhang, Y. (2022). Training management as the core path to improve teachers' quality in vocational colleges. *Journal of Higher Vocational Education*, 12(3), 34-41.
- McLagan, P. A. (1989). Models for HRD practice. *Training and Development Journal*, 43(9), 49-60.
- Ministry of Education of the People's Republic of China. (2021). *Opinions on promoting the high-quality development of modern vocational education*. General Office of the Communist Party of China Central Committee and General Office of the State Council.
- Nguyen, H. C. (2019). Professional development of educational policymakers, institutional leaders, and teachers: An investigation into the disconnect. *International Journal of Educational Management*, 33(6), 1312-1326.
- Peng, G. (2023). Problems and countermeasures of teacher training management in private higher vocational colleges. *Journal of Private Education Research*, 18(5), 92-99.
- Phetdalaphone Bouttavong, S. (2023). Modernization of educational governance and transformation of university teacher training management: Technological empowerment and policy adaptation. *Journal of Southeast Asian Education*, 24(2), 156-174.
- Popova, A., Evans, D. K., Breeding, M. E., & Arancibia, V. (2022). Teacher professional development around the world: The gap between evidence and practice. *The World Bank Research Observer*, 37(1), 107-136.
- Sims, S., & Fletcher-Wood, H. (2021). Identifying the characteristics of effective teacher professional development: A critical review. *School Effectiveness and School Improvement*, 32(1), 1-24.
- Smitha, S. (2020). Pre-service teacher training: Foundations, practices, and perspectives. *International Journal of Teacher Education*, 8(2), 45-58.
- Stufflebeam, D. L. (2003). The CIPP model for evaluation. In D. L. Stufflebeam & T. Kellaghan (Eds.), *International handbook of educational evaluation* (pp. 31-62). Kluwer Academic Publishers.
- Tang, X. (2023). Non-teaching burdens and teacher training in private vocational colleges: Challenges and solutions. *Vocational and Technical Education*, 44(14), 56-62.
- Tyagi, R., & Misra, S. (2021). Continuous professional development and supply-demand collaboration models in teacher training: Effectiveness and implications. *International Journal of Educational Development*, 82, 102375.
- Xu, D. (2024). Digital transformation and quality improvement of educational management in China: Trends and challenges. *Journal of Higher Education Management*, 16(3), 77-89.
- Zha, Y. (2025). Teacher training management in private higher vocational colleges: Policy alignment and practical dilemmas. *Journal of Higher Education*, 46(2), 88-97.
- Zhang, J. (2023). Logical, connotative characteristics, and practical paths of building a strong teacher education country. *Educational Research*, 44(9), 76-84.
- Zou, R., & Liu, H. (2023). Optimization of teacher training management in higher vocational colleges: Based on PDCA cycle theory. *Journal of Vocational Education*, 40(5), 73-80.

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