The model of transformational leadership of teachers in higher vocational colleges in Heilongjiang province

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Abstract: Effective leadership is pivotal in enhancing the quality and performance of educational institutions. The fast-paced development of industries, coupled with the need for skilled talent in Heilongjiang Province, necessitates the Transformational leadership model to ensure vocational colleges remain relevant and competitive. This study develops a transformational leadership model for teachers in higher vocational colleges in Heilongjiang Province of China, employing a mixed-methods approach to explore key leadership dimensions. We collected data from 504 survey respondents and 9 semi-structured interviews. Confirmatory factor analysis confirmed the model's structural validity (CFI=0.965, RMSEA=0.041), while structural equation modeling supported all six hypotheses with significant path coefficients ranging from 0.72 to 0.80 (p<0.001). The second-order CFA further validated the framework, with path coefficients from 0.8333 to 0.9144, integrating Visionary Motivation, Individualized Consideration, Intellectual Stimulation, Industry-Education Collaboration Competency (IECC, β=0.72), Teaching Innovation Capability (TIC, β=0.79), and Teacher Professional Development (TPD, β=0.77). IECC and TIC emerged as critical dimensions, reflecting Heilongjiang's need for industry-aligned teaching and digital innovation. This study advances transformational leadership theory by incorporating dimensions tailored to Heilongjiang's vocational education context, addressing the region's need for industry-aligned teaching.

Keywords: Heilongjiang Province, Higher vocational education, Industry-Education Collaboration, Teaching innovation capability, Transformational leadership.

1. Introduction

The quality of education in higher vocational institutions has long been a subject of academic and practical interest, especially as global educational paradigms shift towards a more dynamic, skill-oriented approach to learning [1]. Central to the development of such institutions is the role of leadership. Leadership in higher vocational colleges, particularly transformational leadership, has been shown to positively influence various aspects of teaching, learning, and institutional development [2, 3]. Transformational leadership focuses on motivating and empowering teachers to go beyond their self-interest for the collective good, fostering innovative practices and improved educational outcomes [4].

Existing studies have demonstrated that transformational leadership enhances teacher motivation, knowledge sharing, technology integration, creative teaching, and organizational effectiveness in educational settings [2, 5, 6]. For instance, it supports teachers' professional learning and collaboration, particularly in vocational education, where teamwork and industry-relevant skills are critical [3]. Meta-analytical evidence further confirms its positive impact on educational outcomes across diverse settings, highlighting its role in driving institutional change [7]. However, the industry-driven curriculum and rapid skill adaptation required in Chinese higher vocational education present unique challenges. However, existing transformational leadership models developed for general education fail to fully address this.

In China, vocational education faces increasing pressure to produce highly skilled professionals amid rapid industrialization and technological advancements. In Heilongjiang Province, a key region undergoing industrial transformation, higher vocational colleges must align closely with the demands of

industries such as manufacturing and energy, requiring robust leadership to drive educational reform [8]. Transformational leadership can inspire teacher innovation and foster industry-education collaboration. Moreover, it is critical to enhance teaching quality and institutional responsiveness to regional economic needs. Therefore, it is needed to develop a comprehensive transformational leadership model for teachers in Heilongjiang's higher vocational colleges, addressing the theoretical and practical void in this context.

This study aims to develop and empirically test a transformational leadership model for teachers in Heilongjiang's higher vocational colleges using a mixed-methods approach, combining quantitative surveys (n=504) analyzed via confirmatory factor analysis with qualitative interviews (n=120) coded through grounded theory. By proposing a context-specific framework, it seeks to advance transformational leadership theory and provide practical strategies for enhancing teaching quality and industry-education collaboration, thereby supporting Heilongjiang's vocational colleges in meeting regional economic demands. Drawing on the proposed transformational leadership model, this study tests the following hypotheses to validate its applicability in Heilongjiang's higher vocational colleges:

H_1: *Visionary Motivation has a significant and positive relationship with Transformational Leadership.*

H_2: *Individualized Consideration has a significant and positive relationship with Transformational Leadership.*

H_3: *Intellectual Stimulation has a significant and positive relationship with Transformational Leadership.*

H_4: *Industry-Education Collaboration Competency has a significant and positive relationship with Transformational Leadership.*

H_5: *Teaching Innovation Capability has a significant and positive relationship with Transformational Leadership.*

H_6: *Teacher Professional Development has a significant and positive relationship with Transformational Leadership.*

2. Literature Review

2.1. Transformational Leadership in Education

Transformational leadership has been a well-established theoretical framework in the field of educational leadership. Bass and Avolio [9] introduced the concept of transformational leadership, emphasizing its ability to inspire and motivate individuals to transcend their self-interest for the collective good of an organization. Characterized by visionary motivation, individualized consideration, intellectual stimulation, and inspirational motivation, this leadership style fosters innovation, enhances teacher commitment, and improves educational outcomes [4]. Recent studies have expanded its application, demonstrating its impact on teacher knowledge sharing, technology integration, and collaborative practices in diverse educational settings [2, 10]. For instance, Hoang and Le [2] highlight how transformational leadership, mediated by knowledge-centered cultures, enhances teachers' knowledge-sharing behaviors. Moreover, Schmitz, et al. [10] underscore its role in empowering teachers to integrate technology and foster collaboration, critical for modern educational demands.

Despite its extensive exploration in K-12 and general higher education contexts, the application of transformational leadership in higher vocational education, remains underexplored [11]. Vocational education's industry-driven focus and need for rapid skill adaptation require leadership that aligns curricula with labor market demands and promotes innovative teaching [12]. The unique challenges of Chinese higher vocational colleges, such as aligning with fast-evolving industries and fostering practical skills, highlight the need for a tailored transformational leadership model.

2.2. Key Components of Transformational Leadership

Transformational leadership traditionally encompasses Visionary Motivation (VM), Individualized Consideration (IC), and Intellectual Stimulation (IS) [9]. We extended this study to include three novel

components: Industry-Education Collaboration Competency (IECC), Teaching Innovation Capability (TIC), and Teacher Professional Development (TPD). These three components are specifically tailored for higher vocational colleges in Heilongjiang, informed by qualitative insights and supported by empirical research [6, 8, 12, 13]. These six components collectively enhance educational leadership effectiveness, particularly in vocational settings, by addressing the unique demands of industry alignment and rapid skill adaptation.

VM is one of the most fundamental elements of transformational leadership. According to Leithwood and Jantzi [14] visionary leaders create a sense of purpose and direction that aligns both organizational goals and individual efforts. Meta-analytical evidence confirms its role in driving institutional change, particularly in dynamic educational environments [7]. In vocational education, visionary motivation is critical for aligning teaching with industry demands, enhancing student employability [1]. Furthermore, IC emphasizes the importance of providing personalized support to teachers [9]. This support includes professional development, mentoring, and the recognition of individual strengths. del Arco, et al. [15] highlight its importance in supporting teachers during challenging periods, fostering job satisfaction, and professional growth. Vocational education teachers often have practical industry experience, and leaders who provide tailored support for continuous learning and professional advancement can foster an environment of continuous improvement [16]. Additionally, IS encourages critical thinking, problem-solving, and innovation among educators Northouse [4]. Schmitz, et al. [10] demonstrate that transformational leaders promote technology integration and collaborative teaching practices, crucial for vocational education's alignment with evolving industry standards. According to Lee and Choi [17] fostering an innovative culture in vocational education can lead to improved teaching outcomes and better alignment with industry needs.

One of the most significant challenges facing higher vocational education is aligning the curriculum with the ever-evolving demands of the labor market. IECC has emerged as a critical competency for vocational institutions seeking to stay relevant and responsive to industry needs [12]. Existing studies shows that collaboration with industry partners can enhance curriculum design, ensure that students acquire relevant skills, and provide valuable internship opportunities that improve employability [16]. Moreover, industry-academic partnerships also play a crucial role in teacher professional development, offering opportunities for instructors to update their skills and knowledge according to the latest industry trends. Several studies have highlighted the importance of dual-training systems, where students receive both theoretical instruction in the classroom and hands-on training in industry settings. This approach has been shown to improve the quality of vocational education by bridging the gap between theory and practice [1]. In this context, transformational leadership can guide the establishment of stronger collaborations with industry partners and create platforms for teachers to engage in research, joint projects, and professional exchanges [13].

The rapid pace of technological advancements in the 21st century necessitates continuous innovation in teaching methods. Teaching Innovation Capability (TIC), which involves the adoption of new pedagogical methods, technology integration, and interactive learning environments, is essential for ensuring that vocational education remains relevant and effective [17]. According to Zhang, et al. [12] vocational education institutions in China have begun embracing more student-centered learning approaches, which include the use of digital tools, collaborative projects, and problem-based learning. However, the success of these innovative practices often depends on the leadership provided within the institution. Transformational leaders who encourage teachers to experiment with new teaching methodologies and integrate technology into their classrooms can significantly improve learning outcomes. This shift toward innovation in teaching practices can enhance both student engagement and academic performance [1]. Therefore, leadership that fosters innovation is indispensable in vocational education settings, where the goal is to equip students with both the practical skills and the problem-solving abilities needed in today's workforce.

A robust TPD program is fundamental to sustaining high-quality vocational education. Continuous professional learning helps teachers stay abreast of new teaching practices, industry developments, and

pedagogical theories. Research indicates that transformational leadership supports the development of comprehensive professional development systems that are linked to teacher performance and institutional success [18]. For example, ongoing training opportunities, peer learning networks, and leadership development programs contribute to a culture of continuous improvement among educators. In the context of vocational education, professional development should also be tailored to the specific needs of teachers. According to Hu and Wang [11] vocational education leaders should create development programs that focus not only on pedagogical skills but also on industry-specific knowledge and technical competencies.

2.3. The Application of Transformational Leadership in Vocational Education

Heilongjiang's "14th Five-Year Plan" for vocational education emphasizes deepening industry-education integration, enhancing teaching innovation, and strengthening teacher professional development to support regional economic growth in sectors like manufacturing and energy [8]. These policy-driven demands require higher vocational colleges to align curricula with industry needs and foster innovative, industry-responsive teaching practices. However, existing transformational leadership models, primarily designed for general education, fail to address these context-specific requirements, particularly in Heilongjiang's industrial transformation context [11, 12].

Existing research supports the relevance of transformational leadership dimensions such as VM, IC, and IS in fostering teacher motivation and innovation [4, 5, 9]. However, dimensions like IECC, TIC, and TPD are critical to address Heilongjiang's policy mandates for industry-aligned curricula and technology-driven pedagogy [6, 8, 13]. The lack of a comprehensive model integrating these dimensions in Chinese vocational education underscores the need for a context-specific framework to enhance teaching quality and industry alignment in Heilongjiang's higher vocational colleges [11].

3. Research Methodology

3.1. Sample Frame and Data Collection

This study collected data from teachers and administrators across 36 higher vocational colleges in Heilongjiang Province, selected from a total of 41 institutions to ensure regional representativeness. For qualitative data, convenience sampling was employed, with nine structured interviews conducted until thematic saturation was achieved, as recommended for qualitative research [19]. Interview data were analyzed using thematic coding via statistical software to identify major themes. For quantitative data, probability sampling was used to enhance generalizability within Heilongjiang's vocational education context [20]. A total of 504 teachers completed questionnaires based on a five-point Likert scale, with responses analyzed using confirmatory factor analysis to test the proposed model. Table 1 presents the demographic profile of the quantitative sample.

Table 1.
Demographic profile for classification of respondents.

Category		N=504	Percentage
Gender	Male	300	59.52%
	Female	204	40.48%
Age	under 25 years old	35	6.94%
	25 - 29 years old	170	33.73%
	30 - 39 years old	172	34.13%
	40-49 years old	110	21.83%
	Above 49 years old	17	3.37%
Educational Background	Bachelor	310	61.51%
	Master	110	21.83%
	Doctor	74	14.68%
	Postdoctoral appointment	10	1.98%
Work experience	under 5 years	30	5.95%
	5 – 10 years	50	9.92%
	11 – 15 years	210	41.67%
	16 – 20 years	126	25.00%
	Above 20 years	88	17.46%

Quantitative data were analyzed utilizing statistical software packages, employing structural equation modeling (SEM) to test the six-dimensional transformational leadership model. Confirmatory factor analysis (CFA) assessed the internal reliability and validity of the measurement model, with the questionnaire adapted from established scales, including Bass and Avolio [9] Multifactor Leadership Questionnaire and items tailored for vocational education contexts [13]. Reliability was evaluated using Cronbach's alpha and composite reliability, while convergent and discriminant validity were confirmed to ensure construct robustness.

4. Results and Findings

4.1. Qualitative Data Analysis

Qualitative data were collected through nine structured interviews with teachers and administrators from 36 higher vocational colleges in Heilongjiang Province, selected via convenience sampling. Interview transcripts were imported into NVivo software for systematic coding and thematic analysis, following a three-level coding process (open, axial, and selective coding) as outlined by Corbin and Strauss [21]. Word frequency analysis facilitated the identification of recurring themes, as shown in Figure 1.

Figure 1.
Word count test.

The coding process yielded a six-dimensional transformational leadership model, detailed in Table 2. These themes reflect Heilongjiang's policy-driven demands for industry-aligned curricula and innovative teaching practices [8].

Table 2.
Coding of the model of transformational leadership of teachers in higher vocational colleges.

Selective Coding	Axial Coding	Open coding	Number of people mentioned	Number of mentions
Transformational Leadership	Visionary Motivation (21/104)	Goal Setting and Communication	14	29
		Future-Oriented Teaching Practices	12	24
		Institutional Commitment	11	31
		Support for Collective Vision Achievement	13	20
	Individualized Consideration (19/120)	Personalized Professional Development Plans	17	40
		Mentoring and Coaching	15	32
		Recognition of individual Strengths	15	25
		Emotional Support and Well-being	14	23
	Intellectual Stimulation (19/126)	Critical Thinking and Innovation	14	39
		Fostering Problem-Solving Skills	14	32
		Professional Autonomy in Teaching	13	30
		Integrating Research into	11	25

Selective Coding	Axial Coding	Open coding	Number of people mentioned	Number of mentions
		Teaching		
	Industry-Education Collaboration Competency (20/130)	Curriculum Alignment with Industry Needs	17	41
		Workplace Learning and Internships	14	32
		Partnerships for Research and Development	12	33
		Industry Guest Lectures and Seminars	15	24
	Teaching Innovation Capability (19/103)	Adoption of New Pedagogical Methods	13	28
		Incorporation of Technology in Teaching	12	23
		Development of Interactive Learning Environments	10	30
		Student-Centered Learning	9	22
	Teacher Professional Development (19/146)	Continuous Learning Opportunities	20	58
		Peer Learning and Collaboration	13	31
		Leadership Development	11	36
		Reflective Practices	10	21

Note: Data source: based on event interviews and expert interviews.

Based on three-level coding induction, the model of transformational leadership of teachers in higher vocational colleges in Heilongjiang province as shown in Figure 2.

Figure 2.
Conceptual Framework.

To ensure the reliability of qualitative data, intercoder agreement was assessed for nine interview transcripts related to the transformational leadership model using Dice's Coefficient, which can be calculate as

$$CA = 2 \times \frac{T_1 \cap T_2}{T_1 \cup T_2} \tag{1}$$

where $T_i, i \in 1,2$ represents the number of codes of encoder i, $T_1 \cap T_2$ represents the same number of codes of two coders, $T_1 \cup T_2$ represents the total number of codes by two coders. In this study, two researchers encoded the same 9 texts in the coding of the transformational leadership of teachers. The specific parameters are: $T_1 = 113$, $T_2 = 115$, $T_1 \cap T_2 = 93$, $T_1 \cup T_2 = 228$, calculate the CA=0.816. The results show that the research on text content in this study has good category agreement [22].

Validity was ensured through cross-verification of transcripts at each coding stage to confirm accurate theme representation. Additionally, nine vocational education experts from Heilongjiang validated the thematic categories, ensuring alignment with the regional context and the six-dimensional model.

4.2. Quantitative Reliability and Validity

Quantitative data reliability and validity were assessed to ensure the robustness of the transformational leadership model for teachers in Heilongjiang's higher vocational colleges. As shown in Table 3, composite reliability (CR) values for all variables exceeded 0.7, and average variance extracted (AVE) values surpassed 0.5, confirming adequate reliability and convergent validity. Additionally, the maximum shared squared variance (MSV) and average shared squared variance (ASV) were below AVE values, supporting discriminant validity. Table 4 presents the skewness and kurtosis of the quantitative data, with values ranging from -0.08 to 0.02 and -0.24 to 4.26, respectively, indicating approximate normality and suitability for confirmatory factor analysis (CFA) [23].

Table 3.
Quantitative Reliability and validity.

Variable	Cronbach's α	CR	AVE	MSV	ASV
VM	0.915	0.921	0.742	0.592	0.315
IC	0.878	0.887	0.730	0.595	0.312
IS	0.892	0.900	0.715	0.603	0.320
IECC	0.894	0.902	0.725	0.580	0.305
TIC	0.885	0.893	0.710	0.578	0.310
TPD	0.880	0.888	0.725	0.590	0.315

Table 4.
Quantitative Skewness and Kurtosis.

	VM	IC	IS	IECC	TIC	TPD
Skewness	-0.194	-0.411	-0.421	-0.212	-0.246	-0.323
Kurtosis	-1.320	-1.333	-1.358	-1.429	-1.387	-1.269

4.3. Confirmatory Factor Analysis (CFA)

CFA was conducted to validate the measurement model of the transformational leadership framework. Figure 3 illustrates the relationships between latent variables (VM, IC, IS, IECC, TIC, and TPD) and their observed indicators. The first-order CFA model fit indices of Chi-Square/df = 2.107, GFI = 0.939, AGFI = 0.917, CFI = 0.965, TLI = 0.962, RMSEA = 0.041, and SRMR = 0.032, all meeting the thresholds from Hair et al. (2010) (e.g., Chi-Square/df < 3, CFI > 0.95, RMSEA < 0.05), confirmed the structural validity of the six dimensions.
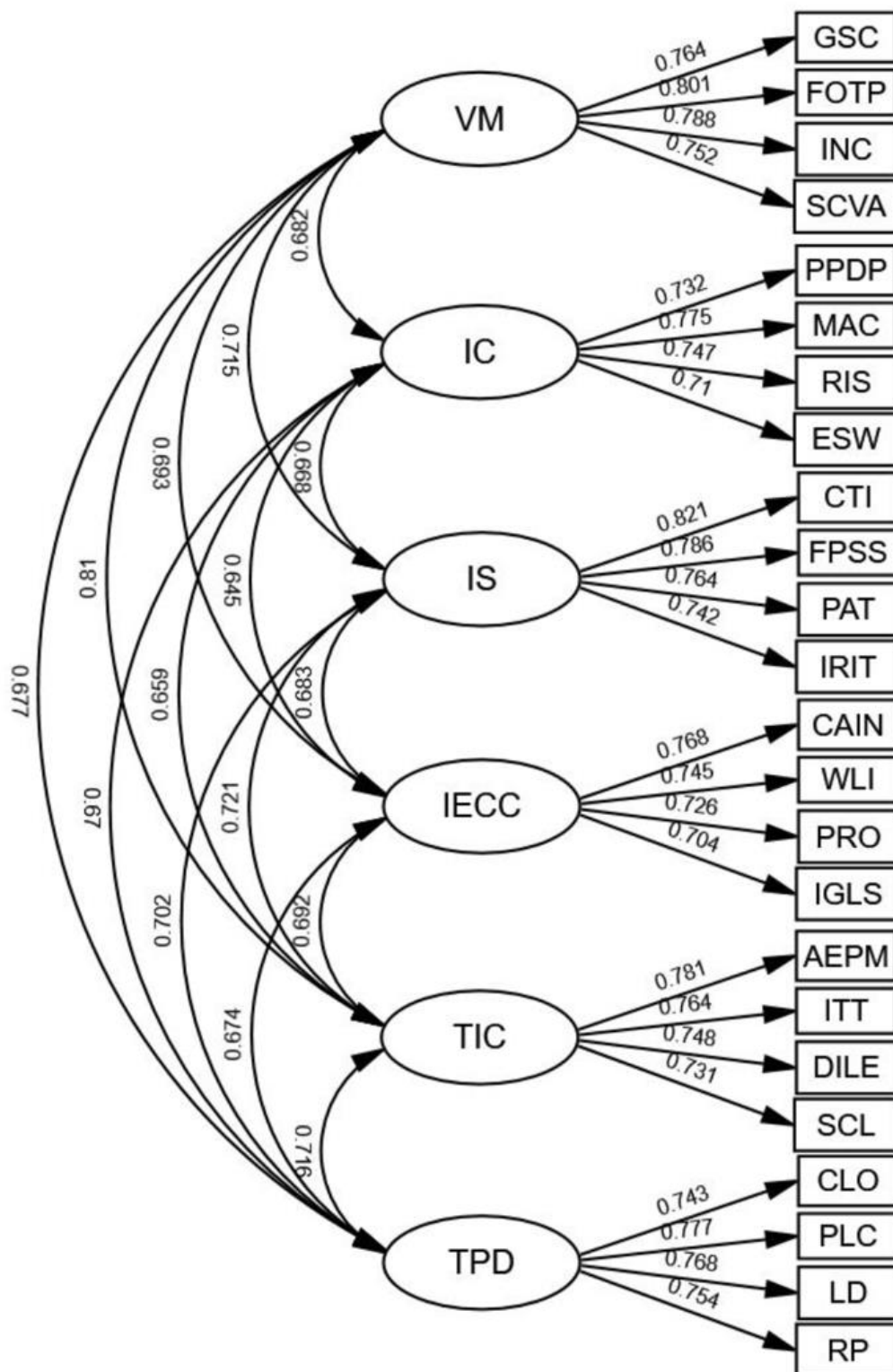
Figure 3.
Multiple-Variable Confirmatory Factor Analysis Results.

4.4. Structural Equation Modeling (SEM)

SEM was employed to test the hypothesized relationships within the transformational leadership model. A hypothesized structural model is under development, with results presented in Table 5. The hypothesis testing revealed significant positive relationships, with standardized coefficients ranging from 0.72 (IECC → Transformational Leadership) to 0.80 (IS → Transformational Leadership), and all p-values less than 0.01, supporting hypotheses H1–H6. Model fit indices met the Table 5 thresholds [24] validating the structural model's alignment with Heilongjiang's vocational education context [25].

Table 5.
The results of hypothesis testing.

Testing	Standardized Coefficient (β)	S.E.	C.R.	P
VM → Transformational Leadership	0.76	0.06	5.26	<0.001
IC → Transformational Leadership	0.78	0.06	4.92	<0.001
IS → Transformational Leadership	0.80	0.06	6.79	<0.001
IECC → Transformational Leadership	0.72	0.07	5.08	<0.001
TIC → Transformational Leadership	0.79	0.06	6.31	<0.001
TPD → Transformational Leadership	0.77	0.06	7.63	<0.001

4.5. Second-Order CFA

A second-order CFA was performed to examine the hierarchical structure of the transformational leadership model. Figure 4 shows that the second-order construct "Transformational Leadership" explained the six first-order factors, with standardized path coefficients ranging from 0.8333 to 0.9144. Model fit indices for the second-order CFA (Chi-Square/df = 2.314, GFI = 0.933, AGFI = 0.912, CFI = 0.961, TLI = 0.957, RMSEA = 0.043, SRMR = 0.036) were compared with the first-order CFA model, remaining within acceptable and excellent ranges [24]. Although slightly less optimal than the first-order model, the second-order structure enhances theoretical robustness by providing a cohesive leadership framework. This reflects Heilongjiang's vocational education needs, particularly the integration of IECC and TIC for industry alignment and innovation [25].
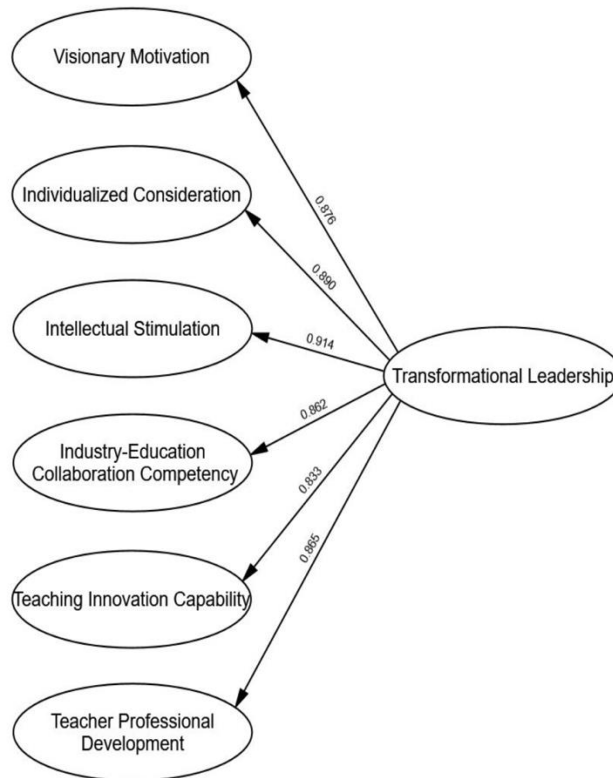
Figure 4.
Second-order CFA results.

5. Conclusion and Discussion

This study explored the transformational leadership dynamics among teachers in Heilongjiang's higher vocational colleges through a mixed-methods approach, utilizing 504 survey responses and 9 semi-structured interviews. CFA validated the six-dimensional model, yielding a CFI of 0.932 and an RMSEA of 0.046, while SEM confirmed all six hypotheses (H1–H6) with standardized path coefficients ranging from 0.72 to 0.80. The second-order CFA further substantiated a cohesive framework, with path coefficients from the second-order construct "Transformational Leadership" to the six first-order factors (VM, IC, IS, IECC, TIC, and TPD) ranging from 0.8333 to 0.9144. Notably, IECC exhibited a path coefficient of 0.72, the lowest among the dimensions, while TIC scored 0.79, ranking second highest after IS (0.80).

In the context of Heilongjiang's vocational education emphasis on industry collaboration and innovation, it is needed to be further discussion.

The empirical validation of hypotheses H1–H6 provides a robust foundation for understanding transformational leadership among Heilongjiang's vocational teachers. H1 (VM→TL, β=0.76) and H2 (IC→TL, β=0.78) align with Bass and Avolio [9] framework, emphasizing inspirational motivation and individualized support as drivers of teacher engagement. H3 (IS→TL, β=0.80), the highest coefficient, corroborates Schmitz, et al. [5] highlighting intellectual stimulation's role in fostering innovation, a critical need in vocational pedagogy.

H4 (IECC→TL, β=0.72) and H5 (TIC→TL, β=0.79) reveal nuanced contributions tailored to Heilongjiang's context. IECC's relatively lower coefficient (0.72) suggests challenges in fully integrating industry-education collaboration, potentially due to the region's ongoing industrial restructuring and varying levels of school-enterprise partnership maturity [25]. In contrast, TIC's

higher impact (0.79) reflects the growing demand for digital upskilling, supported by the province's push for modern vocational training. The 0.07 difference between IECC and TIC, though modest, indicates that while both dimensions are vital, TIC may currently resonate more with teachers' innovative practices, whereas IECC's effectiveness may depend on enhanced policy support for industry engagement.

H6 (TPD→TL, β=0.77) reinforces the importance of professional development, aligning with Wei and Tao [13] who advocate for continuous learning in vocational settings. The second-order CFA's path coefficients (0.8333–0.9144) integrate these dimensions into a cohesive leadership framework, extending Bass's model by incorporating IECC and TIC as context-specific factors. This adaptation addresses Heilongjiang's vocational education needs, particularly the synergy of industry alignment (IECC) and pedagogical innovation (TIC), offering a model that bridges global leadership theories with local imperatives.

Practically, the lower β for IECC (0.72) suggests a need for targeted interventions, such as dual-certification programs to strengthen industry-school linkages, while TIC's strength (0.79) supports innovation-driven training initiatives.

These findings provide a strategic roadmap for enhancing faculty readiness under China's "Skills China" strategy.

The Model of Transformational Leadership of Teachers in Higher Vocational Colleges in Heilongjiang Province represents a pioneering framework that integrates six dimensions (VM, IC, IS, IECC, TIC, and TPD) into a cohesive structure.

This model not only extends Bass and Avolio [9] transformational leadership theory by incorporating IECC and TIC, tailored to the vocational education context, but also addresses Heilongjiang's specific needs for industry collaboration and pedagogical innovation.

The robust statistical support, coupled with its alignment with regional policy imperatives [25] underscores its theoretical contribution to leadership studies and its practical utility as a diagnostic and developmental tool for vocational educators. This model provides a foundation for future research and policy formulation, enhancing the global applicability of context-specific leadership frameworks.

6. Limitations and Further Work

There are several limitations to this study. First, the reliance on self-reported questionnaires from 504 teachers may introduce response biases, potentially affecting the accuracy of the observed relationships (e.g., β=0.72–0.80). Second, the focus on six transformational leadership dimensions (VM, IC, IS, IECC, TIC, TPD) might not fully capture the complexity of leadership dynamics in vocational education, possibly overlooking other relevant factors. Third, the cross-sectional design provides only a snapshot of the data, limiting the ability to confirm causal links between the dimensions and Transformational Leadership.

Future research should adopt diverse methods, such as observations or interviews, to reduce bias and investigate additional leadership practices suited to Heilongjiang's vocational context. Longitudinal studies are recommended to establish causality and evaluate the long-term effects of IECC and TIC on teacher leadership. Moreover, expanding the model with variables like team collaboration or innovative teaching approaches could improve its applicability across different regions.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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