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Model for Development of Informatization Leadership of Deans in Second-Level Colleges of Higher Vocational Institutions in Guangxi Zhuang Autonomous Region, China

Xia Wei[1], Pimporn Charuchit[2*], and Suchada Bubpha[3]
Udon Thani Rajabhat University, Thailand
[1]Email: 382483962@qq.com, ORCID ID: https://orcid.org/0009-0000-9131-7940
[2]*pimporn.ch@udru.ac.th, ORCID ID: https://orcid.org/0009-0005-3387-5211
[3]Email: suchada.bu@udru.ac.th, ORCID ID: https://orcid.org/0000-0002-0280-4112

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Abstract

Background and Aims: The rapid growth of technologies, such as AI and big data, has reshaped teaching, research, and student services in second-level colleges. More critically, it has transformed the leadership roles and thinking of vocational deans. To drive quality education and talent development, deans must now adopt and effectively practice informatization leadership. The purposes of this research were: 1) to investigate and identify the components of informatization leadership of deans of second-level colleges of higher vocational institutions in Guangxi Zhuang Autonomous Region. 2) to examine the current state, desirable state, and needs regarding informatization leadership of deans of second-level colleges of higher vocational institutions in Guangxi Zhuang Autonomous Region. 3) to develop a model of informatization leadership for deans of second-level colleges of higher vocational institutions in Guangxi, in the context of high-quality development.

Methodology: This study used methods including literature review, in-depth interviews with deans, questionnaires, data analysis, and connoisseurship. A questionnaire was developed with a sample of 155 deans from 51 second-level colleges of higher vocational institutions in Guangxi Zhuang Autonomous Region, China, and the sampling survey method was used to assess both the current and desired states of deans in second-level colleges of higher vocational institutions.

Results: The findings of this study are summarized as follows: The informatization leadership of deans in second-level colleges within higher vocational institutions comprises four key components and fifteen associated indicators. Both the current and expected states of these components and indicators were evaluated at a high level. The perceived needs, ranked from highest to lowest, were: (1) teaching, research, and innovation; (2) management and evaluation; (3) coordination and cooperation; and (4) decision-making and planning. The standard deviations reflecting the differences between the actual and expected states for each component were 2.73, 2.53, 2.11, and 2.05, respectively. A model of informatization leadership for deans of second-level colleges in higher vocational institutions was developed. This model encompasses four core competencies: decision-making and planning, coordination and cooperation, teaching and research innovation, and management and evaluation.

Conclusion: This research aimed to study the informatization leadership of deans in second-level colleges of higher vocational institutions in the Guangxi Zhuang Autonomous Region by analyzing its components, current state, desirable state, and needs, as well as developing a leadership model. The findings revealed that informatization leadership consists of four components and fifteen indicators, all of which were found at a high level. The highest need was in the area of teaching, research, and innovation. A comprehensive leadership model covering all four main components was developed.

Keywords: Informatization Leadership; Second-level College; Higher Vocational Institutions; Guangxi Zhuang Autonomous Region

Introduction

By 2022, China's higher vocational education had enrolled 16.79 million students, with a gross enrollment rate of 59.6%, indicating its transition from massification to popularization according to Trow's theory of higher education development stages. However, scholars and policymakers emphasize that expanding enrollment alone does not ensure improved quality or efficiency. The 19th Party Congress advocated for connotative development, which focuses on improving educational quality rather than merely increasing scale. Scholars like Pan Maoyuan highlight that true progress lies in enhancing teaching and learning quality within higher vocational institutions (Ministry of Education of the People's Republic of China, 2022).

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The COVID-19 pandemic in 2020 accelerated online teaching in higher education, giving deans a chance to exercise informatization leadership. However, this shift also exposed challenges: only 16.9% of teachers were satisfied with the current management, while most called for reforms through big data and new technologies. Experts worry that institutions might revert to outdated practices unless deans effectively lead informatization efforts. Universities, being complex and often anarchic systems, require flexible leadership. Others argue the goal post-pandemic is not a return to the old normal, but the creation of a new educational paradigm. Ulrich Beck's theory of the "risk society" underscores the need for forward-looking leadership in unpredictable environments. For sustainable change, deans must develop strong informatization leadership, coordinate internal and external resources, and guide higher vocational institutions into a new digital era (Beck, 1992)

The informatization leadership of deans in higher vocational education is a crucial but often overlooked component of China's broader digital education transformation. With support from national policies, such as President Xi Jinping's call for building a digital, personalized, and lifelong learning system, and the Ministry of Education's Ten-Year Development Plan for Education Informatization, the role of deans is becoming increasingly vital (Ministry of Education, 2011). As second-level colleges gain more autonomy, the dean becomes central to planning, coordinating, and executing informatization strategies, bridging top-down institutional goals with grassroots teaching reform. Deans are responsible not only for coordinating internal resources but also for cultivating a culture of technological adoption, motivating teachers, and aligning their efforts with national reform agendas. Their leadership becomes especially critical given that university presidents cannot manage every detail of digital transformation. In this system, the informatization level of a college reflects the university's overall digital maturity. Furthermore, teaching reform models such as TPACK require strong leadership at the college level to help teachers navigate and improve their use of educational technologies. As scholars have noted, viewing deans as peripheral to IT reform has hindered progress; instead, their leadership must be recognized as both strategic and indispensable.

Research Objectives

This study has the following three objectives:

1. To investigate and indicate the components of informatization leadership of deans of second-level colleges of higher vocational institutions in Guangxi Zhuang Autonomous Region.
2. To study the current state, desirable state, and needs analysis of informatization leadership of deans of second-level colleges of higher vocational institutions in Guangxi Zhuang Autonomous Region.
3. To create a model of informatization leadership of deans of second-level colleges of higher vocational institutions in Guangxi in the process of high-quality development.

Literature review

Leading theory

David Day and John Antonakis reviewed the historical development of leadership research by analyzing various leadership theories according to their periods of influence. They define leadership in two ways: first, as the interactive process between leaders and followers and the outcomes of that process; second, as the interpretation of this influence based on leader traits and behaviors, follower perceptions, and contextual factors. Leadership theory and leadership research differ but are related—leadership theory developed earlier, with typical theoretical schools emerging from industrial production needs, initially based on perceptual understanding and later validated through quantitative methods. Leadership research, in contrast, combines both qualitative and quantitative methods to form stable theoretical schools such as trait, behavioral, power-change, and situational theories. Leadership manifests in diverse forms shaped by situational, social, and technological factors, resulting in a rich and evolving landscape of leadership theories (Day & Antonakis, 2012).

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Leadership theory research began systematically in the early 20th century in the U.S. and Western countries, typically categorized into four main theories. First, Trait Leadership Theory emphasizes innate and learned traits of leaders but overlooks environmental influences; this suggests that deans' informatization leadership should consider personal backgrounds and behavioral differences. Second, the Leadership Styles and Behaviors Theory focuses on leadership effectiveness but cannot definitively identify the most effective style, implying that a dean's leadership style impacts their informatization effectiveness. Third, Contingent Leadership Theory argues that leadership effectiveness depends on context, highlighting that informatization leadership must align with leader traits, organizational culture, and social environment. Finally, New Leadership Theory, shaped by modern societal changes, stresses humanistic and ethical leadership, recommending that deans adopt democratic and consultative approaches in informatization leadership (Northouse, 2021).

Informatization leadership theory of college deans

In Western research, university presidents are generally viewed as the core drivers of informatization efforts in higher education, while teachers are seen as the frontline implementers of information technology in teaching. Consequently, there is limited research focusing specifically on the informatization leadership of college deans abroad, with existing studies often scattered across theories related to the influence, tools, and environment of information technology on leadership. Influence theory suggests that as society becomes networked and IT advances, traditional hierarchical structures are replaced by more cross-boundary management roles for leaders. Scholars like Shamir (1995) highlight how IT/IS access changes leaders' knowledge and leadership nature, while Glick (1985) and Avolio and Kahai (2003) note the significant growth and dynamic impacts of informatization leadership on organizations over the past decades.

Conceptual connotations

Leadership is one of the most extensively studied phenomena in social sciences and is essential for effective organizational and societal functioning. However, it remains a complex and multifaceted concept that is difficult to define precisely. Warren G. Bennis highlights this complexity by comparing leadership to love, which is widely recognized but hard to define. He notes that despite extensive writings on leadership, understanding remains limited. Similarly, Fred Fiedler points out the vast number of leadership definitions, which correspond to the many leadership theories and researchers in the field. This complexity extends to informatization leadership among college deans, where clear definitions and research are scarce. Nevertheless, insights from related fields like enterprises and education suggest several representative perspectives on informatization leadership, including competence, process, purpose, and relationship theories (Bennis, 1989; Fiedler, 1967; Northouse, 2019).

Value the utility of the informatization leadership of college deans.

The National Educational Technology Standards for Administrators (NETS-A) by the International Society for Technology in Education (ISTE) emphasize that school administrators should effectively use technology for planning, evaluation, and understanding legal and ethical issues related to technology. The National Collaborative on Technology Standards for School Administrators (NCREL) supports these ideas, urging administrators to actively promote technology integration and ensure equitable access. Jameson, former president of the Society for Research into Higher Education (SRHE), advocated for more advanced research on informatization leadership, highlighting its importance across all educational leadership levels, from policymakers to teachers and students, in shaping learning processes and outcomes. John Maxwell warns mid-level leaders like college deans against two misconceptions: that leadership depends solely on positional authority, and that leadership skills can be learned only after reaching top positions. These misunderstandings often cause deans to neglect their role in informatization leadership, underscoring the need for clearer positioning and responsibility in middle leadership roles (ISTE, 2018; NCREL, 2000; Jameson, 2010; Maxwell, 2007).

Conducting Interdisciplinary Research on Informatization Leadership of the College Dean

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Recent research on the informatization leadership of college deans has increasingly embraced interdisciplinary approaches, integrating perspectives from sociology, education, economics, politics, psychology, and management. This trend reflects a growing recognition of the complex, multifaceted nature of leadership in the digital age. Sociological frameworks, in particular, have gained prominence, focusing on issues such as social justice, inclusivity, and collaboration. These frameworks examine how factors like race, gender, and cultural diversity influence leadership practices and outcomes. By incorporating diverse viewpoints, scholars aim to bridge gaps in economic, cultural, and social aspects, promoting fairness and sustainability in the development of informatization leadership among college deans. (Jameson, 2022; Maxwell, 2023)

Conceptual Framework

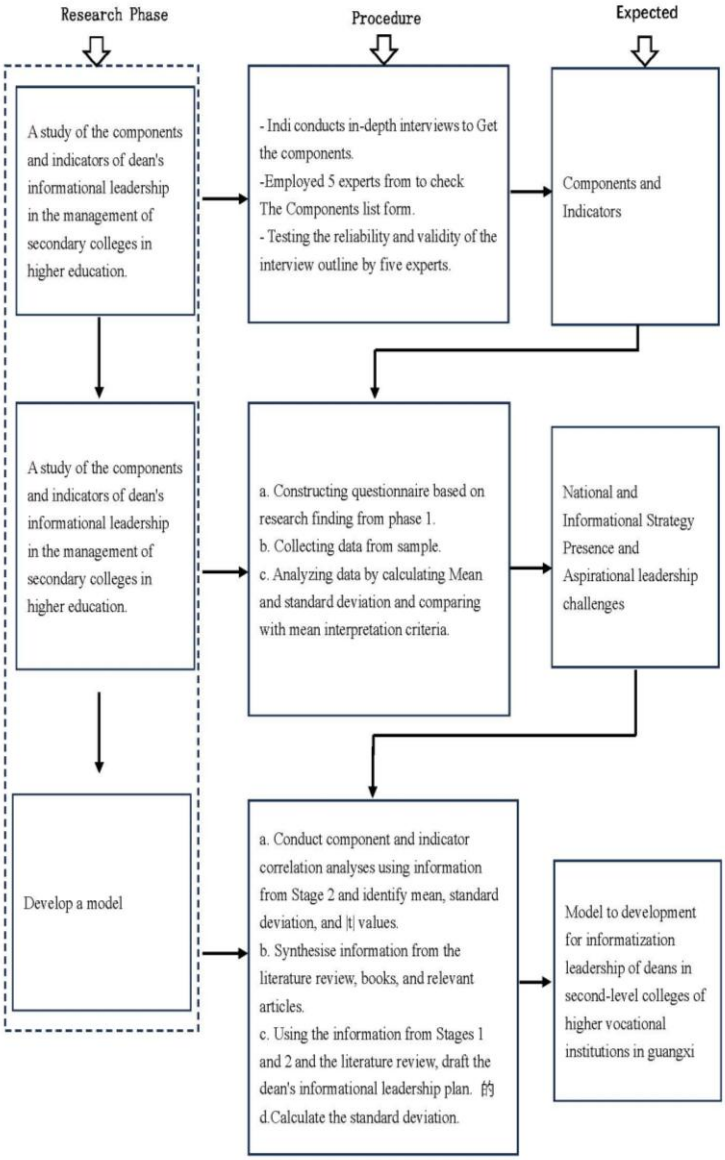

Figure 1 A research process to improve the dean's informational leadership in the management of second-level colleges of higher education

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Methodology

As shown in the figure, each phase details the procedural steps and expected outcomes. Details of each stage are given below:

Phase 1: To study the components and indicators of the dean's informatization leadership in the management of higher second-level colleges.

1. Data sources to examine how informatization leadership is implemented among deans of second-level colleges, the researcher followed a multi-step process. This included a literature review, in-depth interviews with seven deans from vocational institutions in Guangxi using grounded theory, and data analysis via NVivo 11 software to extract key leadership elements. These elements were then validated using an evaluation form assessed by five experts through the Item-Objective Coherence Index (IOC).

2. Five experts were selected to evaluate and inspect the elements of deans' informatization leadership in the management of second-level colleges. These experts possess expertise and experience in educational administration, educational research, educational psychology, or informatization leadership, holding at least a doctoral degree and having experience in teaching and supervising graduate students in the aforementioned fields.

3. Research Tools

3.1 Types of Research Tools

The assessment form includes elements and indicators of deans' informatization leadership in the management of higher second-level colleges. Content validity was verified by five experts through the Index of Item-Objective Coherence (IOC).

3.2 Instrument Construction

The specific construction of the research instrument is as follows: based on the literature review, NVivo 11 software was used to analyse and process the interview data and previous empirical studies related to the challenges of informatization leadership among deans in higher education. The contents of the elements and indicators concerning the challenges of informatization leadership were then summarised by the researcher.

4. Data collection

To collect data, the researcher obtained an official request letter from the Faculty of Education at the Royal University of Udon Thani to gain permission from experts to access the assessment form. This letter introduced the researcher to both the experts and institutions involved. The assessment form, including elements of informatization leadership challenges, was then sent to five experts via hard copy, email, and in-person meetings for content validation. After validation and necessary revisions, the final interview outline was constructed. All interviews were completed within two weeks.

5. Data processing and analysis

5.1 The researcher's job is as follows: to verify the reliability and validity of the data according to the variables studied. Interview outlines were assessed using the IOC (Index of Objective Coherence of the project), which was used to determine the content validity of the interview outlines.

5.2 The researcher used content analysis to summarize and organize interview data. The data was categorized into analysis tables and further processed using NVivo 11 software. NVivo enabled the generation of word frequency clouds, hierarchical charts, and 3D cluster diagrams by applying first, second, and third-level coding to the interview transcripts. This coding process helped break down and interpret the data into meaningful units. In the end, all five experts validated and agreed with the identified components and indicators of informatization leadership for higher education deans.

Phase 2: Explore the presence, influences, and strategies of dean's informatization leadership in the management of higher second-level colleges.

1. Procedures

In this phase, the researcher developed a questionnaire based on the components and indicators identified earlier to examine the presence, influencing factors, and strategies related to deans' informatization leadership. The questionnaire was validated by five experts who assessed its content and

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applicability. This expert review served as a crucial step before deploying the questionnaire. Following validation, the questionnaire was distributed over two weeks, and the responses were analysed to finalize the questionnaire.

2. Population and sample

To obtain the sample for this study, the researcher used a stratified random sampling technique, applying the criteria of high and low achievement in Guangxi's higher vocational informatization campus construction. The sample consisted of certified deans of second-level colleges in informatization leadership.

The population size was 255 deans from 51 higher vocational institutions in Guangxi. The sample size was determined using Yamane's (1973) formula.

3. Research tools

3.1 Instrument characteristics

The research instrument was a questionnaire. It was divided into the following sections.

Part 1: Background Survey. This paper investigates gender, college affiliation, and school attributes.

Part 2: Based on the basic elements and indicators of informatization leadership of higher education deans in the first stage, a five-level questionnaire and a prioritised ordinal questionnaire were used as research tools to explore the existence, influencing factors, and strategies of deans' informatization leadership in the management of higher education second-level colleges.

(1) The design of the questionnaire was based on the following factors. Study of the components and indicators of dean's informatization leadership in the management of higher second-level colleges. The first draft of the questionnaire was submitted to the consultant for revision, and then sent to five more experts to get an accurate questionnaire.

(2) The questionnaire's quality was validated using several statistical methods. The Index of Consistency (IOC) ranged from 0.80 to 1.00. The Item-Total Correlation (ITC) was assessed using Pearson's correlation to measure item discrimination. Reliability of the overall questionnaire was tested using Cronbach's alpha, with a high reliability score of 0.93. After these validations, the final version of the questionnaire was printed and used for data collection.

4. Data collection

4.1 A formal memorandum from the Faculty of Education, Royal University of Udon Thani, was issued to request support in distributing and collecting the questionnaire. The researcher distributed the questionnaire to 155 participants using the Questionnaire Star platform, achieving a 100% response rate. Exploratory Factor Analysis (EFA) was used to test the structural validity of the questionnaire, and the data were entered into statistical software for further analysis.

5. Data processing and analysis

5.1 Check the number and completeness of the returned questionnaires and analyse the data using appropriate procedures.

5.2 Provide general information about the status and size of the schools, analysed using frequencies and percentages.

5.3 Use the completed questionnaires to conduct the analysis related to the components and indicators of informatization leadership among higher education deans.

5.4 Analyse the Necessary Requirements Index (NRI) by priority.

6. Data analysis statistics

In this study, the researcher used statistical methods to analyse the data using a computer. By applying statistical software packages, the data were selected and analysed to suit the research purpose, and the following statistical methods were used:

- Average value
- Standard deviation
- |t| value

The formulas are:

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Mean value $=\frac{\sum_{i=1}^{n} Xi}{n}$, standard deviation = $\frac{\sum_{i=1}^{n}(Xi-\text{Average})^2}{n-1}$, where Xi is each data value and n is the number of data points.

|t| value = (X1 - X2) / sqrt ((s1^2 / n1) + (s2^2 / n2)), where X1 and X2 are the means of the two sets of data, s1 and s2 are the standard deviations of the two sets of data, and n1 and n2 are the number of samples in the two sets of data.

The mean, standard deviation, and |t| values of the questionnaire data were automatically calculated by SPSS, and the results were displayed in the output tables.

Phase 3: Developing an appropriate plan to address the challenges of informatization leadership for deans of higher vocational education in Guangxi.

1. Procedures

To assess the existing state and the desired state of informatization leadership challenges among higher education deans, the researcher will use the calculation method of the existing mean minus the desired mean. In addition, it is necessary to analyze the deans' informatization leadership in faculty assessment by modifying the Priority Needs Index (PNI).

2. Experts

Five experts with experience in informatics training or in organizing conferences, seminars, or training programs were invited as key informants to evaluate the feasibility and appropriateness of the proposed model and to offer suggestions for developing a suitable model to enhance informatization leadership skills among higher education deans. The selection criteria for these experts were as follows: (1) expertise in informatics training, educational administration, educational research, or educational psychology; (2) possession of at least a doctoral degree; (3) experience in instructional and educational technology leadership; and (4) involvement in supervising graduate students in one of the relevant fields.

3. Research tools

3.1 Types of research tools

In order to collect primary data, an evaluation form was designed and used to question five experts. The evaluation form was divided into two parts:

Part 1: (Closed questions with scales): The questionnaire focuses on the applicability and possibilities of the model in order to implement it and improve the technical leadership of teachers.

Part 2: (Open-ended questions): The questionnaire focused on five experts to obtain their views on the development of a comprehensive model to enhance teachers' technological leadership challenges.

3.2 Instrument construction

The specific construction of the research instrument is as follows:

(1) The evaluation form was presented to the five experts based on the findings of the existence and desired status of the Guangxi Higher Vocational Deans 'Informatization Leadership Development Challenge Model.

(2) After completing the study in Step 1, based on the suggestions of the instructors, we designed an evaluation form based on the content of the Informatization Leadership Challenge Enhancement Model for the deans of the second-level colleges in Wuzhou Vocational College.

(3) The draft assessment form has been submitted to the consultant for editing and revision to ensure accuracy.

(4) Finally, an evaluation form was presented to the five experts for data collection purposes.

3.3 Data collection

(1) Prepare a letter from the Faculty of Education requesting cooperation so that the experts can better work on the assessment scale.

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(2) Submit a letter of request for a collaborative paper outline and a structured interview form to the expert requesting assistance with the interview

(3) Coordinate with experts to request dates and times for interviews.

(4) Interviews are conducted on a specified date and time.

4. Data processing and analysis

Validation of the analyzed data and interpretation of the data were conducted. Interpretation criteria used mean values (Sri-saard, 2010).

At this stage of the study, the data collected were analyzed using a software program. A two-part evaluation form was used, and experts were asked to evaluate the system. The content analysis method was used to analyze the qualitative data, which came from some of the experts' recommendations on specific components of the program, as well as general recommendations for the overall development of the program. Descriptive statistics were used to cite some of the experts' comments to develop an appropriate plan to improve the dean's challenges in informatization leadership.

Results

1. Research Data Analysis Results: The Construction of a Model for Informatization Leadership among Deans of Second-level colleges in Higher Vocational Institutions.

The study, through first-level, second-level, and third-level coding using grounded theory, systematically distilled and synthesized four core competencies of informatization leadership among deans of higher vocational colleges: decision-making and planning ability, coordination and cooperation ability, teaching and research innovation ability, and management and evaluation ability. These competencies constitute the fundamental capability framework for deans in their practice of informatization leadership.

The study also found that individual characteristics of the deans (such as their attitudes toward informatization, basic skills, and leadership styles) are closely related to the application of information technology and its environment, jointly contributing to the formation and development of informatization leadership.

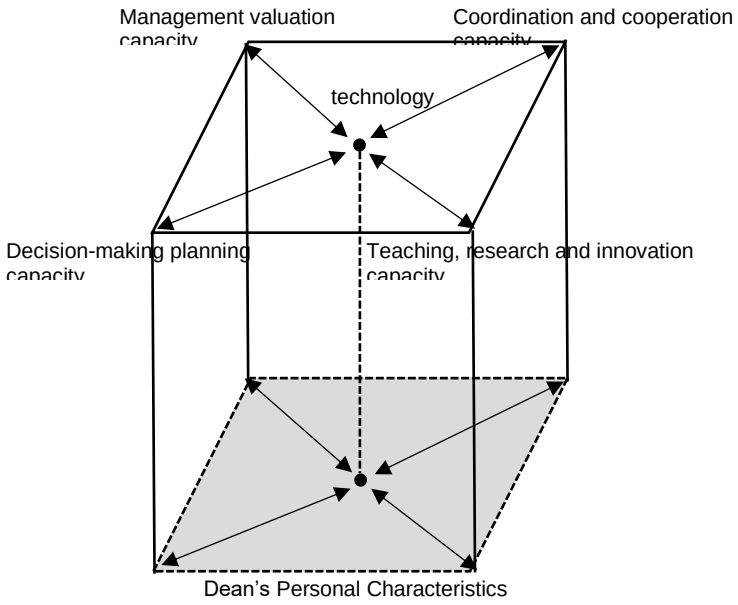

Figure 2 The Structural Model of Informatization Leadership for Deans of Higher Vocational Colleges in Guangxi.

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2. Model Validation Results: Holism and Unity of the Informatization Leadership Competency Structure

This study developed and validated a model of Informatization Leadership for deans of second-level colleges in higher vocational institutions. Using in-depth interviews with seven deans from three institutions in Guangxi Province, China, the data were analyzed with NVivo 11 software to identify the core components and indicators of effective informatization leadership. The proposed model comprises four main competencies: decision-making and planning ability, coordination and cooperation ability, teaching and research innovation ability, and management and evaluation ability. These four dimensions are interrelated and mutually supportive in the practice of informatization leadership within a technology-rich environment. Validation of the model demonstrated that this competency structure effectively addresses multi-dimensional leadership challenges and enhances the managerial effectiveness of deans in higher vocational education institutions.

2.1 First-Level Coding (Open Coding): The interview texts were imported into the analysis tool using NVivo 11 software. The study marked nodes based on the original, concise words or sentences of the interviewees, establishing 92 source nodes, such as "surveying the needs of faculty and students in the institution." Upon completing the first-level coding, core concepts were established. (See Figure 2 and Table 1)

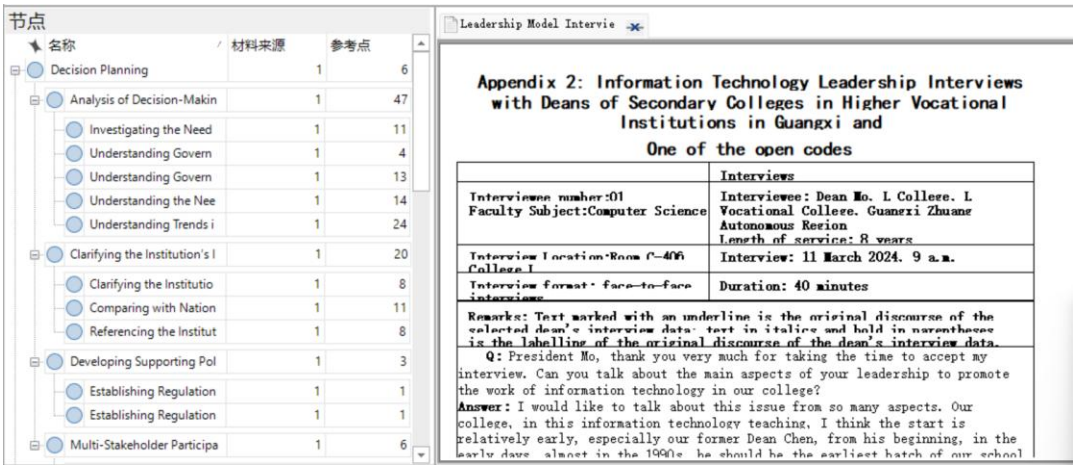

Figure 3 Level 1 Coding of the Informatization Leadership Model for Vocational College Deans.

Table 1 Level 1 Coding of the Informatization Leadership Model for Vocational College Deans (Partial)

Investigating the needs of the faculty and students
Understanding government informatization goals and policies
Understanding the Government's Demand for IT in Education
Understanding trends in information technology development and application
Understanding the needs of related industries
Clarify the College President's medium- and near-term information technology plans.
Comparison with the National Informatization Strategic Development Plan
Refer to the school's information technology master plan.

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Collective decision-making planning through joint party and government meetings, faculty councils, etc.
Hearing from experts
Teachers and students participate in decision-making and make recommendations.
Establishment of rules and regulations for different groups of students, teachers, and staff
Formulation of regulations on different aspects of teaching and research management
Ability to maintain contact and cooperation with alumni
Ability to cooperate with related industrial enterprises
Ability to work with all levels of government to meet national needs
Coordinate the partnership between the College and relevant industrial enterprises.
Able to coordinate cooperation between the College and local authorities
Ability to communicate regularly and smoothly with parents
Coordination with functional departments
Coordination with school leaders
Coordination with other colleges and similar programmes
Be able to use information technology to facilitate learning and problem-solving.
Basic knowledge and skills in information technology
Formation of a superior information technology research direction
Establishment of digital research resources
Cooperative research with other school units
Building an information-based research platform
Production of information technology research results and knowledge innovation
Enhancement of teachers' online teaching capacity
Developing Civic Politics in the Curriculum
Establishment of information-based teaching resources
Improvement of the information technology teaching mode
Regular teaching and research activities
Building an online teaching platform
Completion of the formation of the scientific research team
Adequate funding
Establishment of practice and innovation bases
With a systematic information management process
Have a clear information technology management organisation and personnel.
Be able to correctly understand the value and role of information technology.

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Handling various relationships within the College to create an atmosphere of democracy and equality
Safeguarding the academic authority of teachers and giving advice that can effectively manage different groups, such as teachers, students, and staff
The ability to use a variety of evaluation incentives, including financial honours, rationally.
Ensure information sharing and security.
Strengthening of infrastructure and hardware equipment
Focus on ethics in the use of information technology.

2.2 Following the initial coding phase, the first-level codes were refined through various techniques, including word frequency analysis, hierarchical diagrams, and matrix structure diagrams. Word clouds and word frequency summaries helped to identify key high-frequency terms, while the diagrams illustrated the relationships among categories, completing the second-level (axial) coding. At the first stage, the codes were numerous, basic, and often overlapping. Therefore, second-level coding was employed to reveal the relationships between conceptual categories. This phase, also referred to as "axial exploration," allows researchers to examine interrelations between themes in depth, clarifying and refining the analytical structure as the process evolves. After categorizing all source nodes, NVivo 11 software was used to analyze the interview data. The word frequency threshold was set at a minimum of two characters, and non-meaningful words were removed. The result was a word cloud (Figure 3) and a summarized frequency table (Table 2) of terms related to the informatization leadership model of deans at higher vocational institutions. Frequently occurring terms such as "teaching," "perception," "management," and "development" were prominently featured, highlighting their importance in shaping the leadership model and indicating their relevance to the understanding of informatization leadership in this context.

Figure 4 Word Cloud of the Informatization Leadership Model for Higher Vocational Education

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Table 2 Word Frequency Summary of the Model Structure of Informatization Leadership for Vocational College Presidents (Partial)

Word	Length	Frequency	Weighted Percentage (%)
Technology	10	259	3.60
Information	11	254	3.53
Also	4	106	1.47
Teaching	8	104	1.45
College	7	88	1.22
Dean	4	77	1.07
Students	8	73	1.02
Teachers	8	71	0.99
Research	8	70	0.97
School	6	68	0.95
Development	11	65	0.90
Leadership	10	64	0.89
Use	3	58	0.81
Think	5	54	0.75
Online	6	46	0.64
Now	3	40	0.56
Time	4	40	0.56
See	3	39	0.54
Course	6	38	0.53
Things	6	37	0.51
Data	4	33	0.46
Good	4	32	0.45
Needs	5	32	0.45
Year	4	32	0.45
Example	7	31	0.43
Fact	4	30	0.42
Thing	5	30	0.42

The hierarchical diagram tool provided by NVivo 11 software is primarily used to display the hierarchical structure of nodes. It typically shows hierarchical data as a set of nested rectangles of varying sizes using a matrix-style structure diagram. In this study, the hierarchical diagram tool was utilized to represent all nodes from the interview data as aggregated information. By using the size and color of the nested rectangles, 92 source nodes were aggregated into 15 second-level nodes, including "providing decision-making basis for analysis," "clarifying informatization goals of the institution," "multi-stakeholder participation in decision-making and planning," "conducting informatization research," "coordinating with

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internal departments and colleges," "improving informatization teaching," and "coordinating with external groups" (Figure 4).

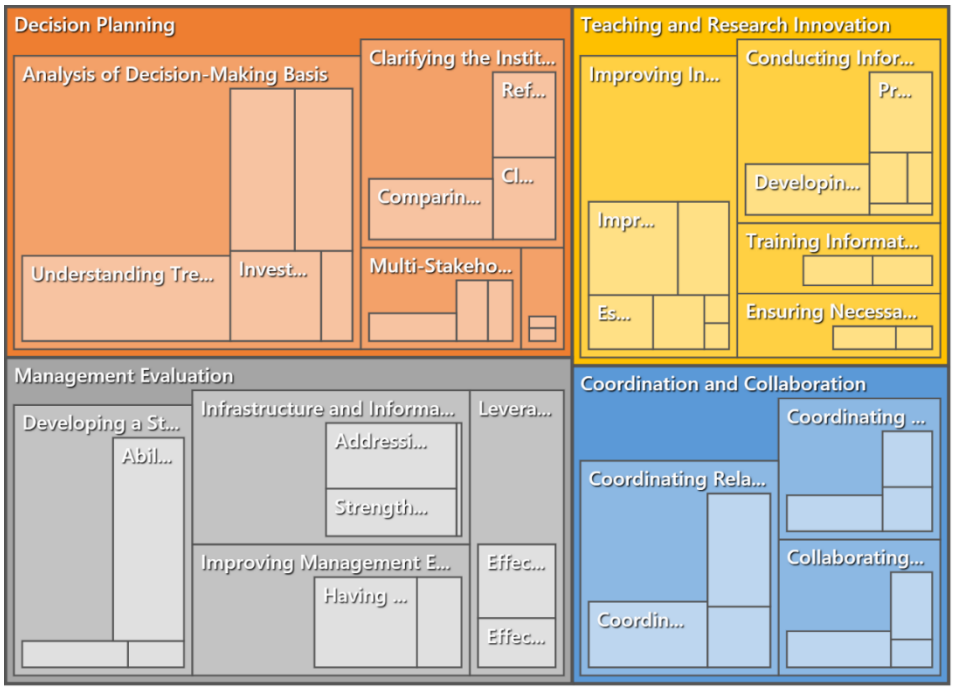

Figure 5 Hierarchical Diagram of the Informatization Leadership Model for Higher Vocational Deans

2.3 Development of the Informatization Leadership Model for Higher Vocational Deans

This study conducted in-depth interviews with seven deans from three higher vocational institutions in Guangxi. The interview transcripts were analyzed using NVivo 11 software. Initially, 92 source nodes were identified, such as “surveying the needs of faculty and students.” These were further categorized into 15 second-level nodes, including “conducting informatization research,” “coordinating with internal departments and colleges,” “surveying and analyzing to provide a decision-making basis,” and “improving informatization teaching.”

Through clustering analysis, these second-level nodes were grouped into four main categories: decision-making and planning, coordination and cooperation, teaching and research innovation, and management and evaluation. These categories correspond to the four sub-competencies of informatization leadership for deans. A node relationship diagram was constructed to illustrate the structural relationships among various informatization leadership competencies.

This approach aligns with NVivo's capabilities for organizing and analyzing qualitative data, facilitating the identification of themes and relationships within the data.

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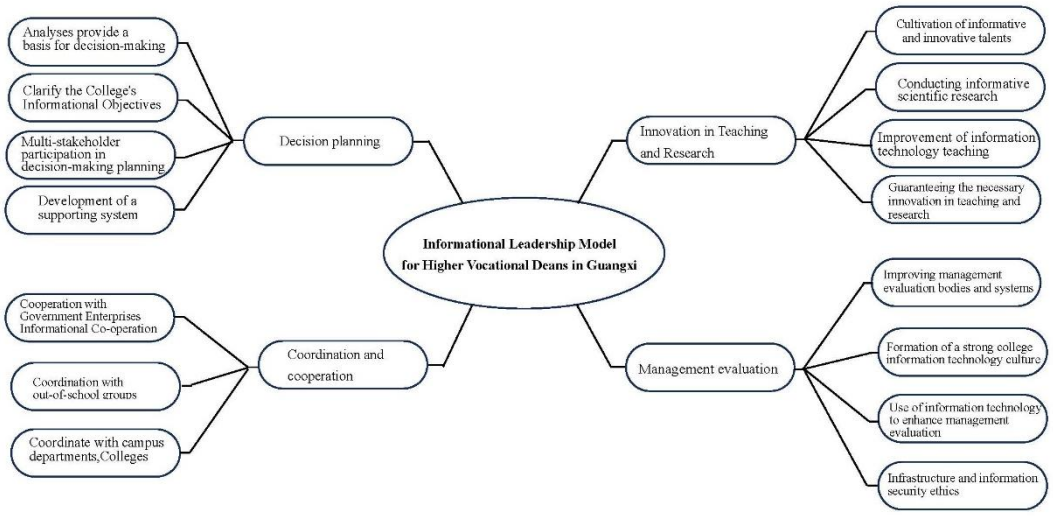

Figure 6 Nodal Relationship Diagram of Informatization Leadership Structural Model for Higher Education Deans

In addition to the four core competencies of informatization leadership—decision-making and planning, coordination and cooperation, teaching and research innovation, and management and evaluation, two key factors are essential.

First, informatization leadership among deans is closely linked to the support and influence of information technology. IT serves as a critical tool to advance informatization, such as using network technology to build educational websites and resource repositories. Even when IT is not directly used, the informatization environment in teaching and research remains crucial, and non-technical approaches must align with the institution's informatization goals. Thus, IT support plays a vital role in the dean's informatization leadership practice.

Second, the individual characteristics of deans—such as their attitude toward informatization, technical skills and knowledge, leadership style, and work approach—are fundamental to effective informatization leadership. A dean who resists informatization trends or lacks basic technical skills may struggle in an informatized environment. Deans also need insight and vision to recognize the benefits for student development and to promote reform actively.

In summary, individual characteristics form the foundation of the informatization leadership model for higher vocational deans, with IT application and environment providing essential support. The four core competencies form the leadership's core. Based on these factors, the study developed a structural model of informatization leadership for higher education deans.

3. Research Results and Theoretical Analysis of the Informatization Leadership Model for Deans of Second-level colleges in Higher Vocational Institutions.

This study analyzed the structure and influencing factors of informatization leadership among deans of higher vocational institutions through questionnaire surveys and in-depth interviews.

3.1 Preliminary Testing of the Informatization Leadership Model for Higher Vocational Deans

(1) Questionnaire Design

Based on the structure of the informatization leadership model for higher vocational deans, and incorporating open surveys and interviews, a set of questionnaire items was developed. These items

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were evaluated by relevant scholars to ensure appropriateness and to identify any issues with ambiguous wording. A preliminary questionnaire with 23 items was created, using a five-point Likert scale, where respondents rated each item from "strongly disagree" (1 point) to "strongly agree" (5 points).

(2) Survey Sample

A preliminary questionnaire survey was conducted with deans of higher vocational institutions in Guangxi Zhuang Autonomous Region. A total of 500 questionnaires were distributed, with 470 valid responses after excluding invalid ones, resulting in an effective response rate of 94%.

(3) Item Analysis

Discriminant analysis was used to assess the effectiveness of each questionnaire item. Respondents were divided into low and high score groups based on their total scores, with the top 27% classified as high score and the bottom 27% as low score. An independent sample T-test was conducted to examine the discriminative power of each item. Results showed significant differences for all items ($|t| > 13$; $p < 0.001$), indicating good discriminative power.

3.2 Formal Testing Questionnaire for Validating the Informatization Leadership Model for Higher Vocational Deans.

(1) Survey Sample

A formal questionnaire survey was conducted with 155 deans from 51 higher vocational institutions in Guangxi Zhuang Autonomous Region. Out of the 155 questionnaires distributed, 149 valid responses were received after excluding invalid ones, resulting in a response rate of 96.1%.

(2) Item Analysis

Discriminant analysis was used to assess the effectiveness of each questionnaire item. Respondents were divided into low and high score groups based on their total scores, with the top 27% classified as high score and the bottom 27% as low score. An independent sample T-test was conducted to examine the discriminative power of each item. Results showed significant differences for all items ($|H| > 15$; $p < 0.001$), indicating good discriminative power.

(3) Reliability Analysis

Cronbach's alpha coefficient (α) was used to test the consistency of responses across the overall questionnaire and each dimension (factor). The Cronbach's alpha coefficient for each dimension was above 0.7, and the overall Cronbach's alpha for the scale was 0.93. These results indicate excellent internal consistency reliability for the questionnaire, as shown in Table 3.

Table 3 Reliability Analysis of the Formal Questionnaire for Informatization Leadership.

Factor	Label	Cronbach αValue
Factor 1	Teaching and Research Innovation Ability	0.89
Factor 2	Decision-Making and Planning Ability	0.85
Factor 3	Coordination and Cooperation Ability	0.82
Factor 4	Management and Evaluation Ability	0.79
	Overall Questionnaire	0.93

(4) Structural Validity Analysis

This study employed exploratory factor analysis to test the structural validity of the questionnaire. Firstly, the KMO value was 0.95, and Bartlett's test of sphericity showed $p < 0.001$, indicating that the preliminary questionnaire was suitable for factor analysis. Secondly, based on theoretical analysis, four common factors were extracted using principal component analysis and varimax rotation. Items with factor loadings greater than 0.45 were retained. The results showed that the cumulative explained variance of the four factors was 69.41%, and all item factor loadings were greater than 0.49, indicating that the questionnaire has good structural validity.

(5) Analysis Results

Citation
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This study targeted 155 deans from 51 higher vocational colleges in the Guangxi Zhuang Autonomous Region. The survey questionnaires were distributed via the online platform "Wenjuanxing." After collecting the responses, invalid questionnaires were excluded, resulting in 149 valid responses, with an effective response rate of 96.1%.

Discussion

The overall results of this research were discussed based on the research question as follows.

1. This study examined the components of informatization leadership among deans of second-level colleges in higher vocational institutions in Guangxi Zhuang Autonomous Region. It began with a literature review on informatization leadership, followed by interviews with deans using grounded theory. The interview data were analyzed with NVivo 11 software to identify key leadership components. Five experts validated the research questions and findings. The study identified four essential competencies for effective informatization leadership: decision-making and planning, coordination and cooperation, teaching and research innovation, and management and evaluation (Sun & Zhang, 2020). Decision-making and planning involve analyzing the informatization status and challenges, setting development goals, and leading stakeholders in strategy formulation. Coordination and cooperation cover managing collaborations with government, enterprises, alumni, and internal departments. Teaching and research innovation focus on cultivating informatization talent, promoting research, enhancing teaching via technology, and supporting innovation. Management and evaluation relate to improving management systems, fostering an IT culture, leveraging technology for assessment, and addressing infrastructure and digital ethics. This framework aims to enhance informatization leadership effectiveness in higher vocational colleges (Sun & Zhang, 2020).

2. Explore the status and strategies of informatization leadership of deans of second-level colleges of higher vocational institutions in the Guangxi Zhuang Autonomous Region as follows.

This study analyzes the current status of informatization leadership among deans of higher vocational institutions in Guangxi from multiple perspectives, including strategy formulation, resource integration, educational innovation, and the challenges they face. Firstly, as informatization becomes increasingly important in higher vocational education, most deans in Guangxi are now aware of its key role in promoting educational modernization. Many have actively initiated the formulation and implementation of information technology strategies, focusing on areas such as digital campus construction, intelligent teaching, and information management. Some institutions have utilized information technology to enhance teaching quality, optimize management models, and promote the integration and sharing of campus resources (Zhang & Liu, 2019).

Secondly, the integration and application of informatization resources is another important aspect of informatization leadership. Under the leadership of deans, some institutions have encouraged cross-departmental collaboration, integrated IT resources, and improved operational efficiency through the development of unified platforms, cloud computing, and related technologies. For example, some schools have implemented digital teaching platforms and constructed smart campuses, leading to high levels of informatization in teaching, management, and services. However, some institutions are still in the early stages of informatization, with limited resource integration and a lack of systematic application, which hinders the overall improvement of education quality (Zhang & Liu, 2019).

In terms of educational innovation, many deans focus on reforming teaching models through the use of information technology. Some institutions actively promote teachers' competence in applying IT and explore new education models such as online learning and blended teaching. These initiatives provide students with more flexible learning options and support updates in teaching content and diversification of methods. However, there are significant disparities among institutions; some still struggle with low digital literacy among teachers and outdated technological infrastructure (Zhang & Liu, 2019).

Despite some achievements, deans still face many challenges in informatization leadership. First, the development of informatization requires substantial financial investment, and some institutions face slow progress due to limited funding. Second, some deans lack a deep understanding of informatization and do not have a long-term strategic vision, resulting in scattered projects and implementation difficulties. In addition, resistance from some faculty and staff toward technological changes can further hinder progress. Overall, the informatization leadership of Guangxi's higher vocational deans has improved, particularly in strategic planning and educational innovation. However, further efforts are needed to strengthen long-term

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strategic planning and investment, and to address challenges related to technology, funding, and human resources, to fully realize the goals of educational modernization (Zhang & Liu, 2019).

3. Develop a program to enhance the informatization leadership of deans of second-level colleges of higher vocational institutions in the management of second-level colleges of higher vocational institutions. The research findings indicate that the program to enhance informatization leadership consists of three key elements: (1) individual factors, (2) technical factors, and (3) non-technical factors. Each of these factors independently plays a leading role in fostering the informatization leadership of deans. Additionally, when two or all three factors coexist synergistically, they jointly contribute to the development of informatization leadership.

3.1 Individual factors. In the first case, the dean's knowledge and understanding of information technology, mastery and familiarity with IT skills, and foresight in predicting the effects and future potential of IT applications in higher education motivate them to promote the use of technology to improve classroom teaching and elevate scientific research. This, combined with the dean's determination to enact reform and an unwavering commitment to achieving their goals, forms a strong internal driving force for the emergence and development of informatization leadership.

3.2 Technological factors. The second scenario highlights the development of information technology itself as the driving force behind the rise of informatization leadership in higher education. Undeniably, modern society is deeply embedded in a technologically advanced, information-driven world. The influence of technology, through the Internet, data, digital platforms, and mobile devices, is pervasive and indispensable, making it nearly impossible for higher education to be disconnected from it. As such, deans must inevitably respond to and adapt to these technological developments. The overwhelming presence of IT compels them to enhance their informatization leadership to keep pace with societal and institutional demands.

3.3 Non-technical factors. In the third case, non-technical factors such as political, economic, and knowledge-related influences can also lead to the emergence and growth of informatization leadership among deans in higher vocational education. Political factors, for example, include the nationwide implementation of large-scale online teaching during the COVID-19 pandemic in 2020, which significantly advanced the use of online education and enhanced the informatization leadership of vocational education deans. Economic factors are also influential. For instance, in response to the growing demand from local governments and enterprises for the development of the artificial intelligence economy, a vocational college established an AI department and introduced intelligent logistics courses. These efforts, driven by external economic needs, pushed the dean to enhance informatization leadership by developing practical training programs and infrastructure. Knowledge factors, referring to the academic foundations upon which vocational education depends, also create strong incentives for informatization. In the digital era, deans are expected to utilize online platforms and virtual meetings to facilitate academic exchange among faculty and to promote deeper interaction and learning among students.

Suggestions and Recommendations

1. Suggestions for using research results

For the interest in informatization leadership of deans in second-level colleges of higher vocational institutions, the researcher recommends that:

1.1 To improve the informatization leadership of deans in second-level colleges of higher vocational institutions, suggestions and recommendations should be fostered.

1.2. To improve the informatization leadership of deans in second-level colleges of higher vocational institutions requires the development and upgrading of knowledge related to informatization leadership, such as knowledge of individual factors, technical factors, and non-technical factors.

1.3 Informatization leadership of deans in second-level colleges of higher vocational institutions should take note of the components of leadership.

1.4 Recently, the informatization leadership of deans has been growing rapidly, yet they still face many obstacles and constraints. Therefore, more attention is required in studying the informatization leadership of deans, so that they can improve their abilities and promote the overall development of second-level colleges.

1.5 To establish and improve the institutional mechanism to enhance the informatization leadership of deans in second-level colleges of higher vocational institutions from three aspects: individual factors, technical factors, and non-technical factors.

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2. Suggestions for future research

2.1 The empowerment of Informatization Leadership of Deans in Second-Level Colleges of Higher Vocational Institutions.

2.2 The developing program of Informatization Leadership of Deans in Second-Level Colleges of Higher Vocational Institutions.

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