
A Confirmatory Factor Analysis of Leadership Attributes Among Administrators in Vocational Educational Institutions in the Digital Era: A Study of the Northern College Network

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Abstract:

The main objective of this positive factor analysis is to assess the efficacy of the digital-era leadership model employed by educational administrators at Northern College's vocational institutes in relation to empirical data. The sample cohort for the 2024 academic year comprises 161 administrators and educators from Northern College's vocational institutions. The utilized research instrument was a questionnaire having a reliability coefficient of 0.92. The data were analyzed utilizing descriptive statistics and confirmatory factor analysis. The research findings indicate that the digital-era leadership of administrators in vocational institutions affiliated with Northern College consists of three components and nine indicators. The initial component involves the implementation of digital technology, characterized by four indicators: fostering a learning culture centered on digital technology, advocating for ethical practices in its use, integrating digital technology into management, and establishing a network for digital technology learning. The second component entails formulating a vision for digital technology, defined by three criteria: strategic planning, dissemination of the strategic plan, and assessment and evaluation of results. The third component encompasses lifelong learning in digital technology, defined by two indicators: the advocacy for digital technology in education and the facilitation of its ongoing utilization. The utilization of digital technology demonstrated the highest predictive coefficient for the digital era leadership of administrators in vocational institutions under Northern College, at 96%. This was followed by lifelong learning in digital technology at 94%, and possessing a vision for digital technology at 91%.

Keywords: A Confirmatory Factor Analysis, Leadership, Educational Institution Administrators, Digital Era

Introduction

The global landscape is rapidly evolving across all domains, including economics, politics, society, and technology. Technological advancements are progressively propelling these transformations, and Thailand is rapidly assimilating new technologies within the nation. The 13th National Economic and Social Development Plan (2023-2027) was designed to provide Thai individuals with the requisite skills and attributes for success in contemporary society. The goal is to strengthen the nation's ability to respond to fluctuations and threats in the changing global landscape by prioritizing the creation of institutional frameworks and infrastructure to facilitate the transition to the digital era. The strategy emphasizes workforce and technology development through focused projects, including enhancements to high-speed internet infrastructure and the establishment of statewide 5G coverage. The emphasis is on the advancement of technical sectors including artificial intelligence (AI), blockchain, cloud computing, and the Internet of Things (IoT), which are expected to significantly enhance workforce growth. The plan emphasizes

the development of digital capabilities to enable individuals to adapt to the technological transformations resulting from these advancements.

Educational administrators in the digital era must be leaders who keep up with technological changes. They should have strategies and practices that utilize social media communication to receive information and promote various aspects of the educational institution, enhancing its value (Sheninger, 2014). Educational management requires administrators who can lead the institution to achieve the quality and standards set, staying up-to-date and managing all aspects of the institution effectively, in line with the characteristics of the digital age (Dowruwan Thawinkan, 2019). Digital leadership is the behavior of educational administrators that demonstrates knowledge and understanding of using digital technology to enhance learning management in the institution. It entails possessing a vision and leadership in encouraging workers to incorporate technology into their pedagogical practices, in accordance with the learners' situation (Sukanya Chamchoi, 2017). Consequently, digital leadership is a pivotal element influencing the performance of an educational institution. Administrators possessing robust leadership capabilities can attain sustainable objectives and efficiently oversee the institution, harmonizing with the aims and trajectory of transformation. (Chantana Saensuk, 2016). Learning in the digital era is focused on applying knowledge and promoting the skills and ability for lifelong learning. Therefore, educational administrators must have a vision for managing educational institutions, being able to apply digital technology to develop the organization into a digital one. This ensures that the institution stays modern and can be effectively managed in all aspects (Punnitha Machek, 2022). Digital technology utilization in educational management enhances management efficiency, personnel administration, curriculum oversight, quality assurance in education, monitoring and evaluation of educational management, and document management systems inside the institution. These processes can be expedited, hence minimizing operational stages. Administrators may swiftly access extensive data sets (Big Data) in real time, facilitating precise and effective planning and decision-making. It also facilitates the monitoring and assessment of diverse activities or programs (Ministry of Education, 2021).

Northern College has a network of eleven affiliated vocational institutes that provide training at the Certificate of Vocational Instruction (Cert. Voc.) and Higher Certificate of Vocational Education (Adv. Cert. Voc.) levels. Management's objective is to improve the leadership of administrators in affiliated institutions by prioritizing planning and operations that facilitate collaboration and the realization of common goals. The incorporation of technology into management practices is a critical strategy that improves the effectiveness of a wide range of domains, including curriculum development, resource management, teaching and learning, monitoring and evaluation, staff and student learning, and skill development. Technology facilitates prompt adaptation to changes in the digital era by promoting efficient collaboration across interconnected enterprises.

Given the importance and obstacles identified, it is clear that institutional growth depends on digital-era leadership among educational administrators, as it enables the efficient execution of technology. Leaders possessing exceptional digital competencies can proficiently advance educational development and progress in the digital age. The researcher seeks to examine the essential elements of digital leadership within vocational institutions in the digital era. The research findings will be employed to formulate a plan for promoting digital leadership at vocational institutions throughout the Northern College network. This will enhance both administrative and instructional operations for optimal efficiency while responding to the demands of a dynamic world.

Research Objectives

1. To examine the elements of digital leadership among executives in vocational education schools within the Northern College network.

2. To examine the confirmatory elements of digital leadership among executives at vocational education institutions within the Northern College network.

Research Hypothesis

The digital leadership model of executives in vocational education institutions within the Northern College network aligns with empirical evidence.

Research Framework

The researcher established this study paradigm after a thorough evaluation of empirical evidence and relevant studies on digital leadership among educational leaders in vocational institutions, both domestically and globally. This synthesis is based on the contributions of several researchers, including Sapphirun Jantarak (2019), Karat Thongsai Porn and associates (2023), and Pornwipha Chao-klien (2023). Educational leaders might find it helpful to organize their work by using these six basic digital leadership concepts: The way someone thinks about digital tools. getting modern technology and using it 3) Creating a society where people are good with technology 4) Using modern technology in an ethical way 5) overseeing and helping to put digital technology-based teaching into place Sixth) Always looking into and using digital tools more.

Research Methodology

The quantitative research methodology and confirmatory factor analysis (CFA) employed in this study are employed to assess the validity of the measuring model for digital-age leadership among educational administrators in vocational education institutions within the Northern College network. The assessment is founded on empirical data. The scholar conducted the investigation in the following order:

Population

The study sample comprises administrators and educators from 10 vocational education institutions within the Northern College network, totaling 161 personnel for the academic year 2024.

Research Instruments

A questionnaire comprising three components was implemented in this investigation: 1. General Information: This section comprises the respondent's gender, age, greatest educational level, current position, work experience in the current position, and the vocational institution to which they belong. 2. Opinions on the Characteristics of Digital-Age Leadership: This section contains 39 items covering six aspects of digital-age leadership of educational institution administrators within the Northern College network: 1) Vision for digital technology, 2) Learning and using digital technology, 3) Creating a learning culture for digital technology, 4) Ethics in using digital technology, 5) Management and organization of learning with digital technology, and 6) Continuous learning and use of digital technology. 6) Responses were recorded on a five-point Likert scale, with the options ranging from "Strongly agree" (5 points), "Agree" (4 points), "Neutral" (3 points), "Disagree" (2 points), and "Strongly disagree" (1 point). 3. Additional Recommendations: This section compiles supplementary recommendations regarding the digital-age leadership of educational institution administrators.

Instrument Quality Assurance

1. Questionnaire Validity Check:

The researcher developed the questionnaire following a comprehensive analysis of relevant concepts, theories, and research. Subsequently, it was submitted to three specialists for content validity evaluation, based on the established standard that each query must be consistent

with the content and/or objectives intended for measurement. An Index of Item Objective Congruence (IOC) greater than 0.5 was the criterion for acceptance (Rovinelli and Hambleton, 1977). The findings indicated that the IOC values for each item were within the range of 0.67 to 1.00.

2. Reliability Check of the Questionnaire

The researcher refined the questions to ensure clarity and precision before collecting data from 30 administrators and staff members at Tak Technical College. The data were then analyzed to determine the reliability of the questionnaire. The Cronbach's alpha coefficient for the entire questionnaire was found to be 0.92.

Data Analysis

The data analysis was conducted using computer software. The statistics used for analysis included:

1. **Descriptive Statistics:** These included frequency, percentage, mean, standard deviation, maximum, and minimum values, used to describe personal information and the digital-age leadership characteristics of vocational institution administrators within the Northern College network.
2. **Confirmatory Factor Analysis (CFA):** This was used to analyze the digital-age leadership components of the vocational institution administrators within the Northern College network, using the LISREL software. The fit indices for examining the consistency between the research model and empirical data included: $p\text{-value} > 0.05$, $X^2/df < 2$, $GFI \geq 0.90$, $AGFI \geq 0.90$, $SRMR \leq 0.05$, $RMSEA \leq 0.05$, and $Critical\ N \geq 200$ (Hair, Back, Babin, & Anderson, 2010).

Research Ethics

The researcher obtained permission to conduct human research through the Human Research Ethics Committee of Northern College, approval number 888-0040, dated February 29, 2024.

To protect the rights of the participants, the researcher coordinated with the population group, explaining the research objectives, procedures, and benefits they would receive. Participants had the right to withdraw from the study at any time. The data collected would be presented in aggregate form, ensuring that individual participants could not be identified.

Research Results

The female demographic constituted 54.0% of the population, while 42.2% were aged 20 to 29 years. 85.8% possessed a bachelor's degree, and 70.2% were presently employed as educators. 56.5% of individuals have fewer than 5 years of experience in their present role. The results of the confirmatory factor analysis of digital-age leadership of vocational institution administrators within the Northern College network can be explained as follows:

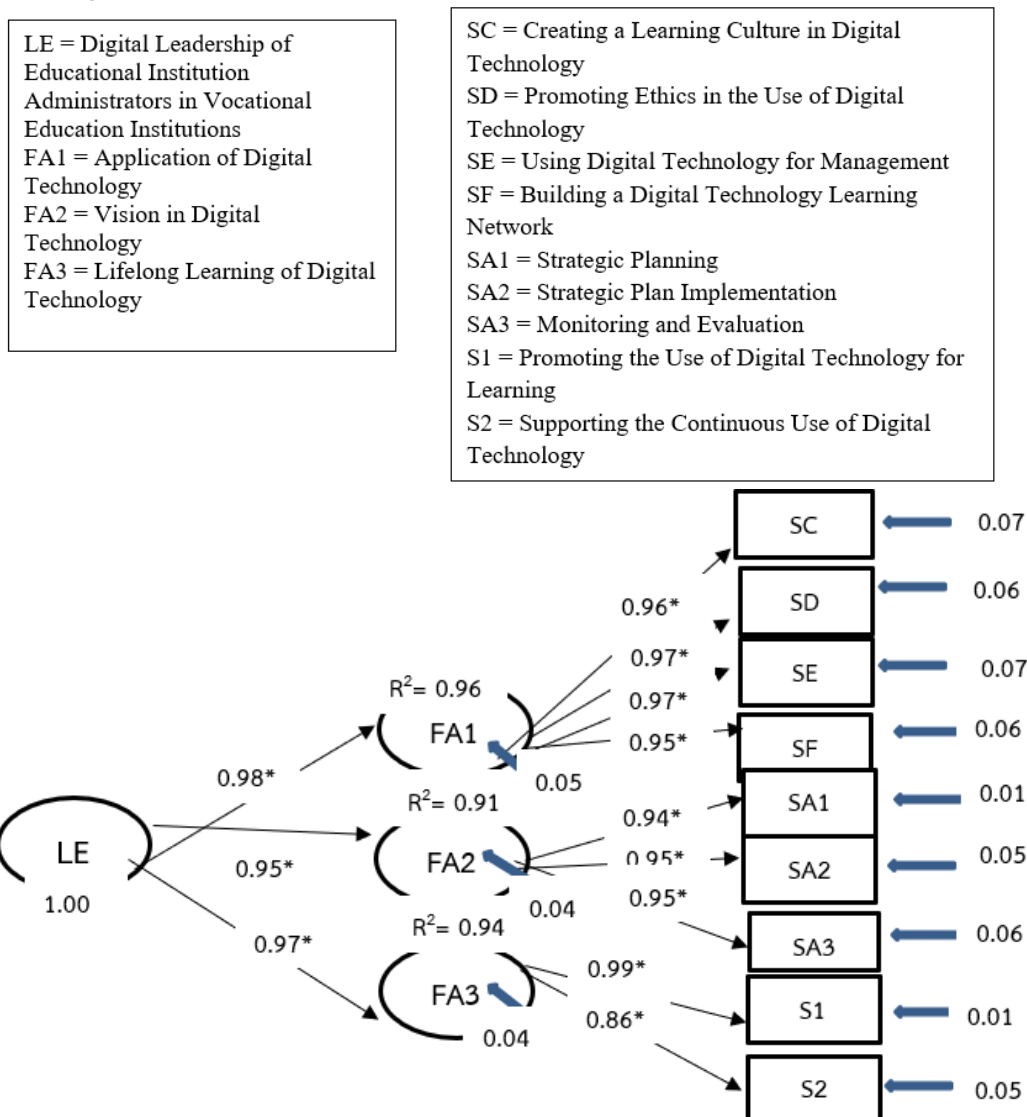
Before performing the confirmatory factor analysis, the researcher categorized the 39 questions to group the questions that were related to one another using factor analysis. It was found that there were three components with eigenvalues greater than 1 ($KMO = 0.965$). The Bartlett's test of Sphericity showed an Approx. Chi-Square value of 10236.116 ($p < 0.001$), indicating that the variables were correlated and suitable for use in developing and validating the model with empirical data. The three components could explain 82.99% of the variance in digital-age leadership of vocational institution administrators within the Northern College network. The analysis results summarized the three components and nine indicators as follows:

Component 1: Application of Digital Technology – There are four indicators: creating a learning culture for digital technology, promoting ethics in digital technology use, applying digital technology in management, and building a network for digital technology learning.

Component 2: Vision for Digital Technology – There are three indicators: strategic planning, communicating strategic plans, and monitoring and evaluating.

Component 3: Lifelong Learning of Digital Technology – There are two indicators: promoting the use of digital technology for learning and supporting continuous use of digital technology.

The researcher subsequently conducted a confirmatory factor analysis of the digital technology leadership components among vocational institution administrators within the Northern College network. Initially, the model was discovered to be misaligned with the empirical data. According to the confirmatory factor analysis statistics, certain values failed to satisfy the fit indices criteria established by Hair, Black, Babin, and Anderson (2010): $\chi^2 = 129.34$, $df = 24$ ($\chi^2/df > 2$), $p\text{-value} = 0.000$ ($p\text{-value} > 0.05$), $RMSEA = 0.166$ ($RMSEA \leq 0.05$), $SRMR = 0.016$ ($SRMR \leq 0.05$), $GFI = 1.00$ ($GFI \geq 0.90$), and $AGFI = 1.00$ ($AGFI \geq 0.90$). The researcher then adjusted the model until it achieved a statistically significant fit with the empirical data, as determined by the confirmatory factor analysis fit indices based on the criteria of Hair, Back, Babin & Anderson (2010). The final results were: $\chi^2 = 20.49$, $df = 15$ ($\chi^2/df < 2$), $p\text{-value} = 0.153$ ($p\text{-value} > 0.05$), $RMSEA = 0.048$ ($RMSEA \leq 0.05$), $SRMR = 0.005$ ($SRMR \leq 0.05$), $GFI = 1.00$ ($GFI \geq 0.90$), and $AGFI = 1.00$ ($AGFI \geq 0.90$). Details are shown in Figure 1 and Table 1.



Chi-square = 20.49, $df = 15$, $p\text{-value} = 0.15384$, $RMSEA = 0.048$, $*t\text{-value} > 1.96$

Image 1: A model for assessing the digital leadership of administrators in vocational institutions within the Northern College network, after the model adjustment

Table 1: Results of the confirmatory factor analysis of the digital leadership of administrators in vocational institutions within the Northern College network, categorized by factors and indicators.

Factor / Latent Variable	Indicator / Observed Variable	Factor Loading	Error of the Indicator (SE)	Regression Coefficient (R ²)
1. Application of Digital Technology		0.98*	0.05	0.96
	Creating a learning culture in digital technology	0.96*	0.07	0.93
	Promoting ethics in the use of digital technology	0.97*	0.06	0.93
	Using digital technology for management	0.97*	0.07	0.95
	Building a digital technology learning network	0.95*	0.06	0.91
2. Vision in Digital Technology		0.95*	0.04	0.91
	Strategic planning	0.94*	0.11	0.89
	Implementing the strategic plan	0.95*	0.05	0.90
	Monitoring and evaluation	0.95*	0.06	0.90
3. Lifelong Learning in Digital Technology		0.97*	0.04	0.94
	Promoting the use of digital technology for learning	0.99*	0.01	0.99
	Supporting the continuous use of digital technology	0.86*	0.05	0.73

* p-value <0.05

Upon examining the details of the model based on Table 1 and Image 1, the components can be explained as follows:

Component 1: Application of Digital Technology — All four indicators have a strong correlation with the component, with factor loadings between 0.95 and 0.97.

Component 2: Vision in Digital Technology — All three indicators have a strong correlation with the component, with factor loadings between 0.94 and 0.95.

Component 3: Lifelong Learning in Digital Technology — Both indicators have a strong correlation with the component, with factor loadings between 0.86 and 0.99.

All three components exhibit a robust positive link with the digital leadership of administrators in vocational institutions within the Northern College network. The application of digital technology has the strongest predictive coefficient for the digital leadership of administrators in vocational institutions within the Northern College network, at 96%. Lifelong Learning in Digital Technology stands at 94%, followed by Vision in Digital Technology at 91%.

Discussion of Results

From the research findings, the following key points were discussed:

The empirical evidence is consistent with the digital leadership paradigm of vocational institution administrators within the Northern College network. It is composed of three elements: 1) Continuous Education in Digital Technology, 2) Perspective on Digital Technology, and 3) Implementation of Digital Technology, each accompanied by nine metrics: 1) Promoting a learning culture in digital technology, 2) Promoting ethical practices in digital technology usage,

3) Utilizing digital technology for management purposes, 4) Establishing a digital technology learning network, 5) Participating in strategic planning, 6) Executing the strategic plan, 7) Conducting monitoring and evaluation, 8) Encouraging the application of digital technology for educational purposes, and 9) Facilitating the ongoing utilization of digital technology. The digital leadership of vocational institution administrators within the Northern College network exhibits a robust positive correlation with all three components. This aligns with the study done by Wanchai Rajawong (2019), which investigated the digital leadership of leaders in educational institutions. Rajawong concluded that school administrators must demonstrate leadership traits, including expertise in the integration and application of technology to facilitate transitions, along with vision and knowledge. Digital leadership in education encompasses the ability to utilize technology for instruction, administration, evaluation, and ethical considerations in its implementation. Furthermore, leaders must formulate a definitive strategy for information and communication technology (ICT), proficiently oversee infrastructure, and cultivate a culture and atmosphere that promotes the extensive utilization of technology. This aligns with the research conducted by Waraporn Puangsampao and Chanomane Salanukit (2023) on the digital leadership of school administrators within the Eastern Bangkok group under the Bangkok Metropolitan Administration. Research indicates that digital leadership among educational administrators encompasses 1) digital communication, 2) digital citizenship, 3) digital vision, 4) fostering a learning culture in the digital realm, and 5) professional excellence in practice. Additionally, it corresponds with the research conducted by Sawai Veeraphan and Theerapat Thinsandi (2023), which investigated the digital leadership of school administrators and their management of organizational transformation in the contemporary day. It was concluded that "school administrators" have a crucial role in directing educational administration and must demonstrate "digital leadership." This leadership trait enables administrators to leverage technology to improve learner management and school administration. Digital leadership comprises six components: a digital vision, the ability to foresee the organization's future, and the skill to manage the business in response to developments in the digital age. This is consistent with the research conducted by Wancharoen Boonkasem and associates (2024), which examined the elements of digital leadership among school administrators within the Udon Thani Secondary Education Service Area Office. The elements of digital leadership for school administrators comprise 1) communication, 2) vision, 3) digital competencies, and 4) fostering a digital culture. Furthermore, the model aligns with empirical data, as demonstrated by the following fit indices: $\chi^2 = 81.305$, $df = 64$, $P\text{-Value} = .0711$, $RMSEA = .025$, $CFI = .997$, $TLI = .996$, and $SRMR = .017$. This aligns with the assertions of Anderson, M., & Dexter, S. (2005), who posited that technological leadership is essential for the effective application of technology in vocational schools. Administrators possessing expertise and foresight in technology use can proficiently facilitate educational transformation. Their work underscores the significance of leaders who advocate for technology across all domains, including education and administration.

Research Recommendations

Educational institutions can leverage study findings as a framework for cultivating leadership potential among school administrators to keep pace with technological changes in the digital era. This will enable administrators to fulfill their objectives and efficiently oversee schools in alignment with the Digital Economy Promotion Master Plan 2018-2021, which envisions "a dynamic digital economy founded on an informed, perceptive society and a workforce adept at adapting to and generating opportunities from digital technologies and innovations.

Suggestions for Future Research

1. To study the model for developing digital leadership among administrators of vocational institutions within the Northern College network.

2. To study the effectiveness of the digital leadership development model for administrators of vocational institutions within the Northern College network.

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