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Analysis of components and find mechanism models to promote digital transformational leadership of school administrators

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CITATION

Roopsuwankun P, Prasertsin U, Kawmongkon S, Rodthong T. (2025). Analysis of components and find mechanism models to promote digital transformational leadership of school administrators. *Journal of Infrastructure, Policy and Development*. 9(1): 10788. <https://doi.org/10.24294/jipd10788>

ARTICLE INFO

Received: 7 December 2024

Accepted: 8 January 2025

Available online: 15 January 2025

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Abstract: The research aimed to: 1) analyze components and indicators of digital transformation leadership among school administrators, 2) assess their leadership needs, and 3) develop mechanism models to promote this leadership. A mixed-method approach was applied, involving three sample groups: 8 experts, 406 administrators, and 7 experts. Data collection tools included semi-structured interviews, leadership scales, needs assessments, and focus group discussions, with analysis performed through construct validity testing, needs assessment, and content analysis. The findings revealed: 1) The components and indicators of digital transformation leadership showed structural validity, as confirmed by the model's alignment with empirical data (Chi-Square = 82.3, $df = 65$, $p = 0.072$, CFI = 0.998, TLI = 0.997, RMR = 0.00965, RMSEA = 0.0256). 2) Among the leadership components, "innovative knowledge" ranked highest in need (PNImodified = 0.075), followed by "ideological influence" (0.066), "consideration of individuality" (0.055), "intellectual stimulation" (0.052), and "inspiration" (0.053). 3) Mechanism models for promoting leadership emphasized enhancing these five components to strengthen administrators' skills in applying technology, managing teaching and development plans, and fostering innovation. Administrators were encouraged to tailor strategies to individual needs, inspire personnel, and create a commitment to organizational change and development. These mechanisms aim to equip administrators to effectively lead transformations, motivate staff, and drive educational institutions to adapt and thrive in evolving environments.

Keywords: components; needs; mechanism models; digital transformation leadership; school administrators

1. Introduction

Education is regarded as the foundation and an important tool for promoting and developing the national economy, society, and culture, which can be seen from the vision and direction of national development to make Thailand stable, prosperous, and sustainable with the Thailand 4.0 strategy, an era in which the country must be driven by the potential citizen capable of innovative development resulting from the context of their careers and living lives. To achieve the same equality as the potential of people in developed countries, this will support economic growth in the form of developing and creating various innovations leading to national development and competition on a global stage. Therefore, education is an important mechanism to create the personal characteristics of Thai people to have leadership potential and the abilities that the government has expected because Thai people have been nurtured and developed their potential through the education system since the age of 3 until they graduate from university with a bachelor's degree, lasting up to 19 years, one third of the working age. To develop national education, the set goals must be truly clarified in order to

determine and set the development directions to meet the target and be achieved in a short period of time. On the other hand, without deeply clarification and explicit development directions, the goals cannot be achieved in the specified time (Rojanasarnrom, 2018).

From the current situation of the global digital transformation, leadership is an important factor in managing and driving the organization to success. The current situations of rapid digital transformation have become more important, causing leaders to be essential to adjusting and changing the management process in various dimensions and digital age management. The digital transformation leadership of school administrators must emphasize adjusting to the changes, technological literacy, technological application in work and various technological or innovative developments. For digital management of school administrators, the leaders or the school administrators must realize that they cannot apply the traditional way to manage the organization. As the digital age is continuously changing, they must broaden their visions, give importance to planning, set and adjust strategies and plans in accordance with the changes, including the importance of personnel, another important mechanism in driving the organization to success. Therefore, the leaders or the school administrators must support personnel in various aspects, both in providing good welfares, training and developing their skills, knowledge and abilities to be knowledgeable and up-to-date with constant transformation technology, including allowing the organization to survive and compete effectively with others (Pholchai, 2020). However, when talking about the word “leader”, people often have a picture of a person who can lead others or groups. The leader’s behaviors influence others, make others follow or accept, and motivate or guide individuals or members to join and complete various missions and achieve the set goals (Tokeaw, 2017). Explicitly, transformational leadership is a process influencing the change of attitudes and assumptions of organizational members to create a commitment and to change the organization’s important objectives and strategies. It is also related to the influence of the leaders on the followers. However, that influence can entitle the followers to become leaders and change the process of transformational organizations. Thus, transformational leadership is viewed as a holistic process that involves the leaders’ actions at various levels in sub-units of the organizations (Muchinsky, 1997).

Transformational leadership represents a dynamic approach that emphasizes inspiring and enabling change at both the individual and organizational levels. Leaders who embrace this style go beyond merely pursuing business objectives; they focus on cultivating personal development and fostering meaningful relationships within their teams (Bass and Riggio, 2021). These leaders excel in articulating a clear and compelling vision that energizes team members to strive for ambitious goals. Through effective communication, they instill enthusiasm and commitment, fostering a robust organizational culture that drives exceptional performance (Zhu et al., 2021). A core principle of transformational leadership is the personalized attention given to the unique needs and aspirations of each team member. By offering tailored opportunities, such as career development programs, and equipping individuals with the necessary resources, these leaders nurture growth and ensure their followers’ success (Shin et al., 2020). Furthermore, transformational leaders encourage their teams to think creatively and approach complex challenges from fresh perspectives. This intellectual

stimulation fosters innovation and adaptability, qualities that are essential for thriving in dynamic and competitive environments (Lee et al., 2022). Integrity and trustworthiness are fundamental traits of transformational leaders, who serve as role models for their teams. By embodying fairness and self-sacrifice, they build trust and inspire collective action, setting the standard for excellence within their organizations (Wang et al., 2021). The adoption of transformational leadership strategies has been shown to drive sustainable change and enable organizations to accomplish intricate objectives. Research highlights a strong positive correlation between transformational leadership and long-term organizational performance, underscoring its value in achieving enduring success (Nguyen et al., 2023).

Therefore, the digital leadership is a significant transformation for the future success of schools. The abilities to plan and manage digital leadership projects are important and help improve students' learning outcomes (Hamzah et al., 2021). With digital leadership behaviors in stimulating transformation in their schools resulting in better effectiveness of the schools, the school administrators should emphasize the teaching and learning management and advanced academic achievement according to the schools' goals and objectives (Chaonkasem et al., 2020). The school's mission must be clearly defined. The school administrators can organize practical training workshops on the use of various platforms of educational technology for teachers. In learning and teaching managing education, the school administrators should use available platforms to manage education and share them with the teachers (Munsing, 2021). Digital technology advancement is an important factor that increases the digital challenges of school management. In order to manage education in the digital age, learners can access information and knowledge conveniently, quickly and at any time, in accordance with the goals of the National Strategic Plan 2018–2037, aiming to create good, capable and qualified Thai citizens ready to support the way of life in the 21st century (Sipai and Sinlarat, 2018). A leadership model can devote and dedicate one's life with full potential to the development of society regardless of social status, wealthiness, or rights. The leaders in this era are givers bringing goodwill to others, creating beauty of global views, elevating broadened visions and appropriate possibilities for humanity, strengthening life experiences, protecting rights and freedoms, maintaining peace, and bringing about prosperity as much as possible (Woodward and DeMille, 2015). In response to the educational reform plan that aims to change the quality of education with human resource development technology to prepare educational personnel to cope with the social context that is changing to the digital age, the researchers are; therefore, interested in studying and analyzing the components of needs assessment and searching for mechanism models to promote digital transformational leadership of school administrators.

2. Materials and methods

This study is mixed-method research using quantitative and qualitative research methods as follows:

Phase 1: Analysis of components and indicators of digital transformational leadership of school administrators.

1.1 Study of experts' opinions to draft the components of digital transformational leadership of school administrators. The sample consisted of 8 experts in leadership and educational innovation who were educational administrators with achievements and experiences in educational innovation at the supervisor level and above, namely (1) 2 school directors, (2) 2 deputy school directors, and (3) 4 heads of the class level. The instrument used in this step was a form of interview with experts to draft the components of digital transformational leadership of school administrators. All information and contents obtained from 1.1 and 1.2 were used to synthesize to create a draft of the components of digital transformational leadership of school administrators.

1.2 To examine the construct validity of digital transformational leadership of school administrators, the sample group used in this study was 406 school administrators at the supervisor level and above under the Bangkok Metropolitan Administration. The instrument was a measurement model of digital transformational leadership of school administrators, a 5-level rating scale, consisting of 5 components, 3 indicators per component, and 3 questions per indicator, totaling 45 questions. The data analysis and statistics were used to examine the construct validity of the components of digital transformational leadership of school administrators by analyzing the confirmatory components to study the consistency of the model for measuring the digital transformational leadership of school administrators with the empirical data collected by the researchers.

Phase 2: Assessment of the needs for digital transformational leadership of school administrators.

The population in this phase was directors, deputy directors, heads of departments/divisions/grades/subject groups of schools under the Bangkok Metropolitan Administration. The total sample size was 406 people. The sampling method in this phase was a 2-step random sampling using proportional stratified sampling. The simple random sampling was used in each step. The instrument was the needs assessment for digital transformational leadership of school administrators, which was a dual-response format with a 5-level rating scale, consisting of 8 components, 5 items per component, totaling 40 items. Prioritizing the needs using the Modified Priority Needs Index (PNIModified) was used for data analysis. The needs assessment was conducted by finding different results between the expected state (I) and the current actual state (D), using the principle of determining the needs from the actual state level to obtain a standard score (Suwimol Wongwanich, 2019). The calculation formula was as follows:

$$\text{PNIModified} = (I - D)/D$$

PNI means the Priority needs index;

I means the average of the expected state (Importance);

D means the average of the actual state (Degree of success).

Phase 3: Finding mechanism models to promote digital transformational leadership of school administrators.

The key informants were 7 experts in leadership and educational innovation, school administrators with achievements and experiences in educational innovation at the supervisor level or above: (1) 2 school administrators, (2) 2 deputy school

administrators, and (3) 3 educational supervisors. Purposive sampling was used for selecting the informants. The instrument used was a focus group discussion to find 6 items of mechanism models to promote digital transformational leadership of school administrators.

Content analysis, opinions and suggestions, finding common conclusions and synthesizing contents about the mechanism models to promote leadership in the digital transformational leadership of school administrators were used for data analysis.

3. Results and discussion

Objective 1: Analysis of components and indicators of transformational leadership in the digital transformational leadership of school administrators. According to **Table 1** as follows:

Table 1. Results of confirmatory factor analysis of observed variables in the model for measuring digital transformational leadership of school administrators.

Components	Components weight matrix			β
	<i>b</i>	S.E.	C.R.	
Component 1 Individualized Consideration: IC				
(1.1) Considering individual differences	1.000			0.854
(1.2) Two-way communication	1.028	0.036	28.6	0.899
(1.3) Caring for co-workers	1.096	0.046	24.0	0.893
Component 2 Idealized Influence: II				
(2.1) Ideological goals based on reality	1.000			0.862
(2.2) Morality and ethics	1.018	0.040	25.8	0.897
(2.3) Sacrifice and dedication	1.045	0.040	26.2	0.903
Component 3 Intellectual Stimulation: IS				
(3.1) Awareness of problems	1.000			0.921
(3.2) Thinking skills	0.962	0.034	28.5	0.876
(3.3) Systematic problem-solving skills	1.030	0.032	32.1	0.913
Component 4 Inspiration Motivation: IM				
(4.1) Motivation	1.000			0.924
(4.2) Enthusiasm	0.967	0.028	34.7	0.933
(4.3) Positive attitudes	0.971	0.029	33.2	0.922
Component 5 Innovative Literacy: IL				
5.1) Experimentation and practice	1.000			0.915
(5.2) Deep situation analysis	1.032	0.027	38.3	0.927
(5.3) Understanding data connections	0.985	0.031	31.9	0.927
Chi-Square = 82.3, df = 65, $p = 0.072$, CFI = 0.998, TLI = 0.997, RMR = 0.00965, RMSEA = 0.0256				

Objective 2: Needs assessment of digital transformational leadership of school administrators.

The needs assessment of digital transformational leadership of school administrators by ranking the current and expected needs using the modified Priority

Needs Index (PNImodified) calculated from the average of the expected state (I) and the average of the actual state (D) as follows:

Rank 1: Compared each component, Component 5, innovative literacy, had the highest need (PNImodified = 0.075), followed by Component 2, idealized influence (PNImodified = 0.066), Component 1, individualized consideration (PNImodified = 0.055), Component 3, intellectual stimulation (PNImodified = 0.052), and Component 4, inspiration motivation (PNImodified = 0.053).

Rank 2: Compared each indicator in each component, Component 1, individualized consideration, indicator 1.3, caring for colleagues, had the highest need (PNImodified = 0.064), followed by indicator 1.1, considering individual differences (PNImodified = 0.052), and indicator 1.2, two-way communication.

Component 2, idealized influence, revealed that indicator 2.1, ideological goals based on reality, had the highest need (PNImodified = 0.078), followed by indicator 2.3, sacrifice and dedication (PNImodified = 0.071) and indicator 2.2, morality and ethics (PNImodified = 0.051).

Component 3, intellectual stimulation, revealed that indicator 3.3, systemic problem-solving skills, had the highest need (PNImodified = 0.059), followed by indicator 3.1, awareness of problems (PNImodified = 0.055) and indicator 3.2, thinking skills (PNImodified = 0.048).

Component 4, inspiration motivation, revealed that indicator 4.1, motivation, had the highest need (PNImodified = 0.055), followed by indicator 4.2, enthusiasm (PNImodified = 0.055) and indicator 4.3, positive attitudes (PNImodified = 0.045).

Component 5, innovative literacy, revealed that indicator 5.2, deep situation analysis, had the highest need (PNImodified = 0.080), followed by indicator 5.1, experimentation and practice (PNImodified = 0.055), and indicator 5.3, understanding data connections (PNImodified = 0.071).

Objective 3: Finding mechanism models to promote digital transformational leadership of school administrators from synthesized document data combined with interviews with experts in studying the characteristics of digital transformational leadership of school administrators.

The appropriate mechanism models to promote digital transformation leadership of school administrators were to promote the five leadership components enhancing the skills and competencies of administrators in leading the transformational organization. They can apply technology appropriately in teaching, management, and development of educational plans, taking into account individuality, and also develop and encourage the potential of personnel and students to participate in inventing new approaches. Additionally, they help develop knowledge in schools continuously, inspire personnel to work, and create a commitment to changes and development so that everyone is determined to work and drive the schools through various changes effectively. The mechanism models to promote digital transformational leadership of school administrators can be applied and used by using the Bearing cycle technique, consisting of several steps because the process includes both operational planning and social development. The technique starts from specifying objectives and numbers of eligible persons and participants to the basic data analysis process. Then, the management models are implemented; after that, the results are developed into development plans for empirical application or inviting participants to acknowledge

the development plans. And finally, it is reused and a knowledge check or training format through various techniques in accordance with the teacher's expertise, such as promoting learning, work management, a mentor to help teachers, seminars or observation, and external organization participation in management for the school board, the parents' network board, the parents' association and foundation to promote school administration and development.

3.1. Results

1) Digital transformational leadership of school administrators consists of 5 components, the "5 I's" as follows: (1) Individualized Consideration: IC, (2) Idealized Influence: II (3) Intellectual Stimulation: IS, (4) Inspiration Motivation: IM, (5) Innovative Literacy: IL, and when to consider the confirmatory factor analysis, models for measuring transformational leadership for school administrators are in accordance with the empirical data, with the chi-square value not significantly different from zero (Chi-Square = 82.3, $df = 65$, $p = 0.072$, CFI = 0.998, TLI = 0.997, RMR = 0.00965, RMSEA = 0.0256). All values passed the criteria for harmonious consistency checking.

2) Component 5, innovative knowledge, had the highest need (PNI_{modified} = 0.075), followed by Component 2, ideological influence (PNI_{modified} = 0.066), Component 1, individualized consideration (PNI_{modified} = 0.055), Component 3, intellectual stimulation (PNI_{modified} = 0.052), and Component 4, inspiration (PNI_{modified} = 0.053).

3) Appropriate mechanism models to promote digital transformation leadership of school administrators were to promote the five leadership components that enhance the skills and competencies of administrators in leading the organization through the changes. They can apply technology appropriately in teaching, management, and development of educational plans, taking into account individuality, and also develop and encourage the potential of personnel and students to participate in inventing new approaches. Additionally, they help develop knowledge in schools continuously, inspire personnel to work, and help create a commitment to change and development, so that everyone is determined to work and drive educational institutions through various changes effectively.

3.2. Discussion

1) The analysis of the components and indicators of digital transformational leadership among school administrators revealed that the overall characteristics of digital transformational leadership were deemed appropriate and comprehensive by most experts. This aligns with the demands of a rapidly evolving era. School administrators must adapt their institutions to navigate these changes effectively, including the development of teachers and staff in formats suited to the institutional context. In certain scenarios, younger generations may assume leadership roles, highlighting the need for administrators to act as role models by applying innovative and technological solutions. This is consistent with the findings of Dionne et al. (2004), who identified that digital leadership fosters ideology, inspiration, and critical thinking, which are expressed through envisioning, collaborative decision-making, teamwork, and problem-solving.

Similarly, Ozaralli (2003) examined the impact of transformational leadership on empowerment and team performance, finding that transformational leadership enhances subordinates' performance expectations and overall team output. The development of components and indicators demonstrated structural validity through confirmatory component analysis. Models for fostering digital transformational leadership in school administrators were consistent with empirical data. Administrators demonstrated effective communication, task delegation based on individual competencies, and teamwork. They also emphasized supervision, goal-setting aligned with current contexts, and the integration of digital technologies to enhance performance. These findings resonate with the International Society for Technology in Education (ISTE) Standards (2009), which emphasize the critical role of technology in modern educational administration. Consequently, school administrators must possess technological competencies to transform educational landscapes, aligning with the National Association of Educational Technology standards, which evaluate the skills and knowledge required to support digital-age learning.

2) The needs assessment for digital transformational leadership among school administrators highlighted components with higher average scores than the overall mean, ranked as follows: innovative literacy, ideological influence, individualized consideration, intellectual stimulation, and inspirational motivation. Notably, "Innovative Literacy" emerged as the most pressing need, reflecting current global trends. Administrators must apply their expertise to experiment, establish innovative procedures, and implement solutions for complex problems, thus improving operational efficiency. These attributes align with the findings of Duickert (2016), who emphasized that digital school administrators should be innovative, trustworthy, and open to experimentation, thereby increasing agility and flexibility in digital environments.

Regarding "Ideological Influence," school administrators demonstrated the ability to plan and achieve goals within specified timeframes, turning crises into opportunities while adhering to ethical principles and serving as role models. These qualities align with Bass and Avolio's (1994) assertion that transformational leaders build meaningful relationships with their teams, acting as mentors and promoting individual growth to unlock their teams' full potential.

For "Individualized Consideration," administrators supported personal development tailored to individual differences, granting freedom for staff to explore challenges aligned with their interests and skills. Bass and Avolio (1993) also noted that leaders who serve as role models inspire pride and respect among their followers, fostering collaboration and mutual growth.

In terms of "Intellectual Stimulation," administrators managed their schools systematically, encouraged collaborative decision-making, and supported coworkers in realizing their potential. By synthesizing internal and external factors, they instilled confidence that all challenges have solutions, even when facing significant obstacles.

Lastly, "Inspirational Motivation" involved fostering a positive work environment, recognizing staff contributions, and motivating them to exceed expectations. Leaders encouraged collective efforts to achieve shared visions, as noted

by Oke et al. (2009), who highlighted the importance of inspiring enthusiasm and fostering a sense of purpose within the organization.

3) The exploration of mechanism models to promote digital transformational leadership identified “Innovative Literacy” as the most critical and needed component. Administrators must effectively utilize digital tools and adapt to changes in online education, as emphasized by Thawikan and Pinyo (2016). Developing leadership styles that align with technological advancements ensures adaptability in a rapidly changing world. Administrators must also foster equitable collaboration, leverage digital technology for management improvements, and enhance educational quality. This aligns with Thongsaiporn et al. (2023), who highlighted the transformative role of technology in reducing educational inequality and driving growth.

Conversely, “Inspirational Motivation” was identified as the least prioritized component. Nevertheless, proactive measures, such as cultivating an energized organizational atmosphere and instilling confidence in team problem-solving, remain essential. Malisuwan and Kaewphanukrangsi (2018) emphasized that administrators must excel in personnel management, particularly by supporting teams in digital literacy and facilitating digital transformation. By empowering teams through effective leadership, administrators can ensure smooth decision-making, problem-solving, and continuous adaptation to digital advancements.

4. Recommendations

4.1. Recommendations from the study

Agencies or institutions involving the development of school administrators should consider the values obtained from the analysis of components and indicators to plan for supporting and promoting modern digital skills and innovations so that they can effectively apply digital technology and tools to the management of educational institutions, create opportunities to exchange knowledge and experiences among the school administrators, and facilitate the school administrators to have the opportunity to fully develop their digital transformational leadership on best practices in the effective digital technology application of the education sectors.

- Policy recommendations: Agencies or institutions involving the development of the school administrators should establish policies to develop digital transformational leadership of school administrators by applying components and guidelines for developing digital transformational leadership of school administrators applied in the development of school administrators or for school administrators to use as guidelines for self-development to enhance abilities to lead organizational changes effectively and sustainably.
- Academic recommendations: Agencies or institutions involving the development of school administrators can apply knowledge about data, components, and indicators of the digital transformational leadership of school administrators to design and develop training courses for school administrators at both basic and advanced levels by including contents of digital transformational leadership of school administrators in the curriculum to enhance knowledge, understanding, and skills in applying technology and innovation into the management of educational institutions effectively, such as training programs with training

formats such as lectures, workshops, brainstorming, projects, and the use of digital tools used in the program, such as Google Workspace (Google Drive, Google Meet, Google Forms), Microsoft Teams, Microsoft Power BI, Kahoot, and LMS platforms such as Moodle, Canvas, etc.

- Academic recommendations: Knowledge about components and indicators of the digital transformational leadership of school administrators should emphasize systematic utilization both at school and related agency levels by using related concepts and theories to explain and assess the level of digital transformational leadership of school administrators, which will help identify strengths and areas that need developing in school management in the digital technology to drive changes in educational organizations effectively, leading to the development of teachers, students and organizations.

4.2. Suggestions for future research

1) The indicators in each component should be studied in detail, especially the component with the most appropriate and needed issues, innovative literacy, followed by idealized influence. The least appropriate and necessary component is inspiration motivation to apply the information into analyze and plan further qualitative research to develop digital transformational leadership of school administrators.

2) The study should be conducted in depth by using qualitative methods to clarify understanding of components and indicators that should be promoted, developed and implemented for developing program formation or training courses in various learning management approaches to develop those components and indicators.

Author contributions: Conceptualization, PR and UP; methodology, UP; software, PR; validation, PR, UP and SK; formal analysis, UP; investigation, PR; resources, PR; data curation, SK; writing—original draft preparation, TR; writing—review and editing, UP; visualization, UP; supervision, PR; project administration, PR; funding acquisition, PR. All authors have read and agreed to the published version of the manuscript.

Funding: This research received funding from North Bangkok University, Thailand, funding number 100/2024.

Acknowledgments: The authors would like to express gratitude to the co-researchers and participants for their cooperation throughout the recruitment and data collection processes.

Conflict of interest: The authors declare no conflict of interest.

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