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Digital Leadership Development Model for Science School Administrators in Thailand

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Abstract

The objectives of this research were to (1) examine the current and desirable conditions of digital leadership development of science school administrators in Thailand, and (2) propose a digital leadership development model for science school administrators in Thailand. The population in this research was personnel of 18 science schools in Thailand, in two groups--the administrators and the teachers. The first group--18 executive directors and 18 deputy directors--was purposively selected, and the second group--246 teachers as school human resources—was selected by a multi-stage random sampling. The two instruments used in the study were a self-rating questionnaire and a semi-structured interview guide, covering the current and desirable conditions of digital leadership in science school operations, and suitability and feasibility assessment of the proposed model. The obtained data were analyzed by mean, standard deviation, Priority Need Index (PNI Modified Index), followed by content analysis. The results showed that the whole current condition of digital leadership development was perceived by the respondents at a high level ($\bar{x}$=3.61, SD=0.60), and the overall desirable condition was rated at a very high level ($\bar{x}$ 4.66, SD=0.52). The digital leadership development model carried four components, namely, (1) *The main components* consisted of five dimensions: (i) visionary leadership, (ii) communication strategy, (iii) management system integration, (iv) educational innovation organization, and (v) culture of digital learning. (2) *The development methods* held five dimensions: (i) digital self-learning, (ii) online self-learning, (iii) online training, (iv) online study and certificate, (v) AI-learning via human resource management system. (3) *The development goals* contained five dimensions: (i) motivation, (ii) building confidence, (iii) allocation of access time, (iv) leading to change, and (v) virtualization. (4) *The characteristics* comprised seven dimensions: (i) diversity

awareness, (ii) influencing ability, (iii) good governance, (iv) information management, (v) clear targeting, (vi) aim for achievement, and (vii) learning agility respectively.

Keywords: *Leadership development model, digital leadership, science school administrators, science school management, Thai science school teachers*

1. Introduction

The Ministry of Education stipulated educational reforms in the second decade of 2009-2018 with the vision that "Thai people access to quality lifelong learning." Four areas of reforms were systematically delineated, namely, (1) improving quality of education and learning, (2) increasing opportunities and options for education, (3) providing opportunities for Thai people to access quality learning, and (4) encouraging participation from all sectors of society in educational management. To comply with the National Education Act B.E. 2562/ 2019, the Office of Basic Education Commission has emphasized quality improvement as a prime driver of curriculum implementation, teaching and learning management, including learners' measurement and evaluation (Ministry of Education, 2019). Thailand has recognized the importance of education and aimed to bring in the ICT system to support education management and maximize students' learning inputs/outputs. It has been conceived that ICT can exert great impacts on the education system, which mainly involves gathering data information, and knowledge, organizing and processing data, transmitting and communicating data and information at a high speed and in large volume (Phakamach et al., 2021a). ICT also facilitates presentation and display of data and information, with various media systems, such as, images, audio, animation and video, which can create an interactive system that will make learning in the new era successful (Sinlarat, 2020). With the ever-increasing volume of a vast body of world-class knowledge, learning in the new era includes both volume and speed, with which learners need to be able to distinguish, search and seek out for those relevant to their needs (Håkansson Lindqvist & Pettersson, 2019; Caredda, 2021).

In addition, to comply with the government's policy according to the Twenty Years National Strategy (2017-2036), the 3rd ICT Master Plan, and the National Education Act B.E. 2562/2019--all envisioning more application of computers and the Internet in education provision, the Ministry of Education has therefore endorsed its policies and standards to encourage educational institutions and educational agencies to utilize ICT in education, by enabling teachers, educational personnel, and learners with capabilities to access educational platforms in teaching and learning via management systems. Consequently, basic education institutions need to explore and adopt ICT management systems to develop educational innovations and further improve the quality of education (Wachirawongpaisan et al., 2021a).

"Science School" in Thailand is a boarding secondary school that provides education for students with exceptional abilities in mathematics and sciences at both lower and upper secondary levels. The fundamental missions are to study, research, develop and cooperate with various government and private agencies, both at the domestic and international levels, in order to offer a unique curriculum with excellence in mathematics and sciences for students competitively screened at both levels. The science school category is expected to educate and nurture the young talents over six years in the curriculum with not only basic knowledge of

secondary education, but also incubate the spirits of researchers and innovators in science and technology, sound minds and bodies, proper morality and ethics, strive for learning, patriotism, public-mindedness, and global awareness. It is well conceived that conventional management systems currently organized for general secondary schools in Thailand could not fully support the new science school management (Phakamach et al., 2021c). Based on the special and innovative missions assigned to all science schools, the teaching and learning management system has to accommodate innovation, technological inclusion, suitable buildings, and school leadership for change relevant to the global trend of the 21st century (Phakamach et al., 2021c).

Under the disruptive digital transformation process, an organization needs to build its own digital resilience particularly with effective human resource development so as to adapt its operations toward the intended goals (Vial, 2019; Kashive et al., 2022). For educational organizations, the IT-function building is practically shouldered by the leaders or administrators to handle such complex and challenging tasks (Håkansson Lindqvist & Pettersson, 2019). Digital leadership competency is, therefore, essential for administrators in the era of disruptive transformation (Phakamach et al., 2021b). To fulfill the demanding mission of "Science School" in Thailand, human resource empowerment at both executive and teaching force levels serve as the key strategy. It is also envisioned that in order to support and maintain smooth operations, a so-called continuous human resource development has to be effectively practiced (Wachirawongpaisan et al., 2021b).

Considering such a rationale, the research team was interested in examining and proposing a digital leadership development model for science school administrators in Thailand in providing support for leadership development of science school administrators and enhancing the effectiveness of science school operations in Thailand as a whole.

2. Research Objectives

The study had two research objectives:

(1) To examine the current and desirable conditions of digital leadership development of science school administrators in Thailand, and

(2) To propose a digital leadership development model for science school administrators in Thailand.

3. Research Methodology

This research carried three aspects as follows:

3.1 Population and Samples

The population was personnel of science schools and regular secondary schools offering the science and mathematics-oriented curriculum in Thailand. The participants were from: (1) A total of 16 schools under the Office of the Basic Education Commission, namely, 12 Chulabhorn Ratchawitthayalai Schools and four general secondary schools, Bodindecha School, Yupparaj Wittayalai School, Samsen Wittayalai School, and Hat Yai Wittayalai School; (2) 2 special schools under the supervision of the Ministry of Education, Mahidol Wittayanusorn School and Kamnoet Wittaya School respectively. A total of 282 samples were drawn from personnel of these 18 schools. The first group of 36 persons were purposively selected from the directors and deputy directors, while the second group were 246 teachers selected by a multi-stage random sampling.

3.2 Research Instruments

There were two main instruments in this study:

(1) The instrument used in the quantitative research part was an integrated self-rating and open-ended questionnaire containing items designed to solicit perception and suggestions concerning the development of digital leadership model for science school administrators in Thailand. The questionnaire contained three parts: (i) general information of the respondents, (ii) perception of the conditions and development patterns of digital leadership of science school administrators in Thailand, and (iii) suggestions.

(2) A Semi-structured interview guide was developed to collect qualitative data related to meaning and interpretation, components of model, development methods, and related problems and obstacles.

The verification of instrument quality was carried out for both validity and reliability. The validity of questionnaire was calculated from the IOC index as assessed by five experts and only items with IOC values of at least 0.60 were included in the final version of the questionnaire. As for the instrument's reliability, the adjusted questionnaire was distributed to a compatible group of 30 respondents, and the data returned were used to calculate Cronbach's Alpha coefficient. The reliability of the whole questionnaire was 0.938.

3.3 Procedures in Conducting Research

The research procedures were in four steps as follows:

Step 1 : Study and review of concepts, theories, documents and previous research related to digital leadership development, in order to formulate a conceptual framework for digital leadership development of school administrators in science schools in Thailand.

Step 2 : Assessment of the current and desirable conditions of digital leadership development of science school administrators in Thailand.

Step 3 : Development of a proposed digital leadership development model for science school administrators in Thailand.

Step 4 : Evaluation of the suitability and feasibility of the proposed model.

4. Data Collection

The researchers collected data through the constructed questionnaire and the semi-structured interview guide, both offline and online in January-March 2022.

5. Data Analysis

There were two stages in analyzing the obtained data:

(1) The quantitative data analysis consisted of two parts: The respondents' personal data analyzed by descriptive statistics--frequency and percentage, while the data on digital leadership development of science school administrators analyzed by means, standard deviation, and the Priority Needs Index (PNI Modified). The interpretation criteria of the Likert-type five-point scale regarding the levels of the current or desirable conditions were as follows:

The mean score between 4.50 - 5.00 = Very High
The mean score between 3.50 - 4.49 = High
The mean score between 2.50 - 3.49 = Moderate
The mean score between 1.50 - 2.49 = Low
The mean score between 1.00 - 1.49 = Very low

(2) The qualitative data analysis was by content analysis with specifically classified responses. The researchers also used the information from relevant government documents, literature and related research reviews, as well as comments from five experts to conclude the triangulated data for the digital leadership development model for science school administrators in Thailand.

6. Research Results

The analyzed results revealed three major aspects of the digital leadership development model for science school administrators in Thailand: (1) overall development model, (2) development methods, and (3) key characteristics, as presented in Tables 1-3.

Digital Leadership Components

Table 1: Overall Development Model: Digital Leadership Components

Digital Leadership Components	**Current Condition**				**Desirable Condition**				**Priority Needs**		
	$\bar{x}$	S.D.	Level	Rank	$\bar{x}$	S.D.	Level	Rank	PNI Modified	Group	Rank
1. Modern Vision	3.53	0.64	High	5	4.78	0.56	Very high	2	0.268	Weakness	1
2. Digital Professional Skills	3.63	0.58	High	2	4.82	0.49	Very high	1	0.221	Strength	4
3. Data-Driven Competence	3.56	0.57	High	4	4.56	0.54	Very high	4	0.259	Weakness	3
4. Knowledge Management	3.61	0.63	High	3	4.63	0.55	Very high	3	0.263	Weakness	2
5. Digital Learning Culture	3.74	0.58	High	1	4.52	0.48	Very high	5	0.219	Strength	5
Total	**3.61**	**0.60**	**High**		**4.66**	**0.52**	**Very high**		**0.246**	**Weakness**	

Table 1 shows the current condition of digital leadership development of science school administrators in Thailand as a whole at a high level (mean=3.61, S.D.=0.60), and the desirable condition at a very high level (mean=4.66, S.D.=0.52). All five components of digital leadership were rated at a high level for the current condition, and a very high level for the desirable condition. The value of the total priority needs index (PNI Modified) was at 0.246, which was classified as a weakness of the organization. Except for digital professional skills and digital learning culture, the remaining three components--modern vision, data-driven competence, and organizational knowledge management were in the weakness category.

Table 2: Development Methods: Current Condition, Desirable Condition and Priority Needs of Digital Leadership Development of Science School Administrators in Thailand

Development Methods	**Current Condition**				**Desirable Condition**				**Priority Needs**		
	$\bar{x}$	S.D.	Level	Rank	$\bar{x}$	S.D.	Level	Rank	PNI Modified	Group	Rank
1. Digital Self-Learning	3.65	0.73	High	1	4.64	0.58	Very high	1	0.198	Strength	5
2. Online Self-Learning	3.45	0.68	Moderate	3	4.60	0.57	Very high	2	0.223	Strength	4
3. Online Training	3.62	0.75	High	2	4.58	0.49	Very high	3	0.259	Weakness	3
4. Online Study and Certification	3.41	0.71	Moderate	4	4.51	0.47	Very high	5	0.302	Weakness	1
5. AI- learning via Human Resource Management System	2.98	0.66	Low	5	4.53	0.52	Very high	4	0.296	Weakness	2
Total	**3.44**	**0.70**	**Moderate**		**4.57**	**0.52**	**Very high**		**0.255**	**Weakness**	

Table 2 reports five development methods specified for the assessment: the current conditions were diverse from low to high levels, making the total assessment at a moderate level (mean=3.44, S.D.=0.70). Digital self-learning and online training methods were highly favored, followed by online self-learning and online study and certification at a moderate level, and AI-learning through the human resource management system at a low level. The desirable condition total mean score was at a very high level (mean=4.57, S.D.=0.52). All five development methods were well rated at a very high level, with digital self-learning and online self-learning coming first and second in ranking, while online study and certification came last among the five. The value of total priority needs index (PNI Modified) was 0.255, indicating as a weakness of the organization. When considering the development methods, the researchers found only two development methods--digital self-learning and online self-learning categorized in the strength group. The remaining three methods--online training, online study and certification, and AI-learning through the human resource management system, were in the weakness group.

Table 3: Key Characteristics: Current Condition, Desirable Condition and Priority Needs of Digital Leadership Development of Science School Administrators in Thailand

Key Characteristics	**Current Condition**				**Desirable Condition**				**Priority Needs**		
	$\bar{x}$	S.D.	Level	Rank	$\bar{x}$	S.D.	Level	Rank	PNI Modified	Group	Rank
1. Diversity Awareness	3.51	0.72	High	7	4.63	0.56	Very high	6	0.298	Weakness	1
2. Influencing Ability	3.58	0.67	Moderate	6	4.59	0.49	Very high	7	0.261	Weakness	4
3. Good Governance	3.72	0.68	High	4	4.68	0.55	Very high	5	0.228	Strength	5
4. Information Management	3.86	0.67	High	1	4.75	0.48	Very high	3	0.267	Weakness	3
5. Clear Targeting	3.69	0.65	High	5	4.79	0.52	Very high	2	0.220	Strength	6

Key Characteristics	Current Condition				Desirable Condition				Priority Needs		
	$\bar{x}$	S.D.	Level	Rank	$\bar{x}$	S.D.	Level	Rank	PNI Modified	Group	Rank
6. Aim for Achievement	3.82	0.58	High	2	4.72	0.45	Very high	4	0.196	Strength	7
7. Learning Agility	3.78	0.63	High	3	4.81	0.50	Very high	1	0.276	Weakness	2
Total	**3.69**	**0.65**	**High**		**4.71**	**0.50**	**Very high**		**0.249**	**Weakness**	

As shown in Table 3, the current condition of digital leadership development relating to key characteristics of science school administrators in Thailand in seven dimensions posed for assessment revealed that except for the moderately rated influencing ability, other remaining six dimensions of key characteristics were highly rated by the respondents, resulting in a high level (mean=3.69, S.D.=0.65). Among the high-ranking characteristics, information management skills came first (mean=3.86, S.D.=0.67), followed by the aim for achievement (mean=3.82, S.D.=0.58), learning agility (mean=3.78, S.D.=0.63), good governance (mean=3.72, S.D.=0.68), clear targeting (mean=3.69, S.D.=0.65), and diversity awareness (mean=3.51, S.D.=0.72), respectively. For desirable conditions, all seven characteristics were rated at a very high level (mean=4.71, S.D.=0.50), falling under the very high level. In terms of ranking, the first three very high ranked were learning agility (mean=4.81, S.D.=0.50), clear targeting (mean=4.79, S.D.=0.52), and information management skills (mean=4.75, S.D.=0.48). The consecutive order of the remaining four characteristics was from achievement (mean=4.72, S.D.=0.45), good governance (mean=4.68, S.D.=0.55), diversity awareness (mean=4.63, S.D.=0.56), to influencing ability (mean=4.59, S.D.=0.49).

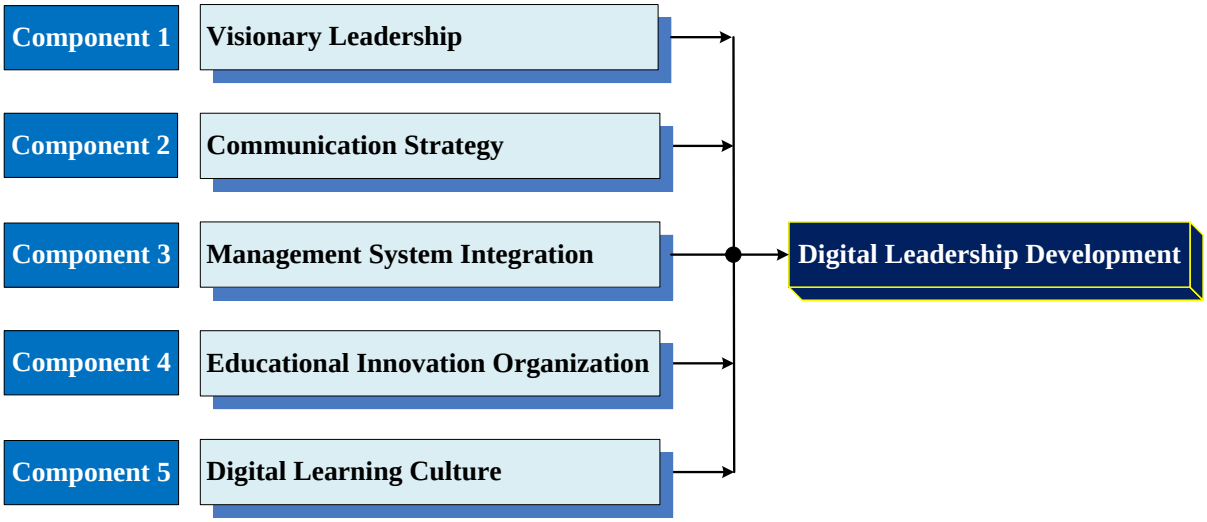
The total priority needs index was 0.249, considered as weakness of an organization, with four characteristics--diversity awareness, learning agility, information management, and influencing ability as weaknesses, and three characteristics--good governance, clear targeting and aim for achievement as strengths.

The Proposed Digital Leadership Development Model for Science School Administrators in Thailand

The proposed digital leadership development model for science school administrators in Thailand was based on the related literature review, content analysis, expert groups on government strategies and policy guidelines to utilization of advanced technology in educational management, especially in providing quality teaching and learning for young talents in organizations, particularly science schools. The researchers used the obtained quantitative data from the current study to help construct the target model as follows:

(1) The components of the digital leadership development model for science school administrators in Thailand consisted of (i) Visionary Leadership, (ii) Communication Strategy, (iii) Management System Integration, (iv) Educational Innovation Organization, and (v) Digital Learning Culture, as shown in Figure 1.

Figure 1: Components of Digital Leadership Development



How to develop the digital leadership model with key components and sub-components was by:

(1) Visionary Leadership: (i) determine the organization's goals, and (ii) determine the organization's digital information infrastructure;

(2) Communication Strategy: (i) defining a culture based on continuous and rapid feedback on the network, (ii) defining engagement through engagement, and (iii) leveraging digital communication tools to lead teams to take part in virtual;

(3) Management System Integration: (i) database preparation and coding (data collection and coding) and (ii) content management system or CMS;

(4) Educational Innovation Organization: (i) innovative leadership, (ii) innovative climate, and innovative behavior for teachers and educators; and

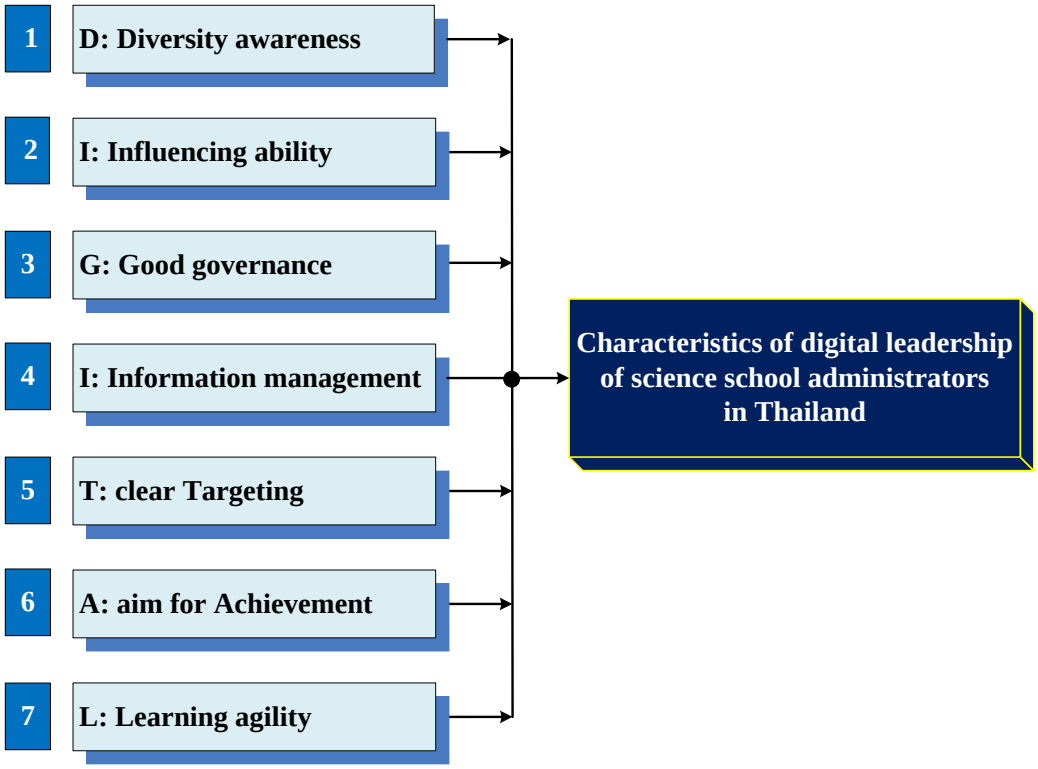
(5) Digital Learning Culture: (i) management collaboration, (ii) knowledge management, and (iii) motivating and controlling.

The *strategic goals* of the digital leadership development model aimed at empowering the science school administrators with (i) Inspiration, referring to executive ability to lead participative development and shared vision by integrating comprehensive educational technology to promote excellence in science for learners; (ii) Confidence, referring to commitment to continuously develop a digital-based science learning model for learners with confidence; (iii) Time management, referring to managing time of use and access to digital systems to create optimum educational technology integration and professional growth; (iv) Transformation, referring to aim of change to increase the efficiency and achievement of learning goals with appropriate technology and educational resources; and (v) Virtual Reality, referring to creating awareness and understanding of the digital world with virtual reality and its impacts on social issues, ethics, regulations, and responsibilities bonded to digital culture.

As seen in Figure 2, the *characteristics* of digital leadership model for science school administrators in Thailand consisted of seven dimensions with the abbreviation of "DIGITAL," where the first "D" stands for Diversity awareness, "I" for Influencing ability,

"G" for Good governance, "I" for Information management, "T" for clear Targeting, "A" for aim for Achievement, and "L" for sequential Learning agility.

Figure 2: Characteristics of Digital Leadership of Science School Administrators in Thailand



The data triangulation technique and connoisseurship by five experts suggested that the main activities of digital leadership development can be done in five ways: self-development, exemplary practice, case studies, experiential teaching and training. The secondary development activities are exchanging knowledge-using media, technology and modern educational innovations studied by models and learning through experience. In policy terms, it may be defined as a leadership development process using the PIER process: (i) Planning (P), (ii) Implement (I), (iii) Evaluation (E), and (iv) Reflection (R), which can serve as a clear annual policy and work plan for science schools in further development of executives at all levels.

It should be noted that school administrators and personnel should have functional digital skills to work effectively in their organization. The research results clearly showed that the demand index was the most essential attribute for an active digital user. In order to activate the use of digital technology, data management, data link and operations through digital communication must be appropriate and effective for the organization. Additionally, science school administrators and related agencies should train digital skills in their personnel as active digital users. Furthermore, school administrators, academics, researchers, or experts concerned can apply the digital leadership development model as a training platform to enhance digital skills of personnel and maximize their potential so that they can serve well in the management system under the leadership development model.

7. Discussion

According to the research objectives, the obtained results were discussed as follows:

(1) As shown in the study, the digital leadership development model for science school administrators in Thailand was highly rated, and its desirable conditions for developing digital leadership in science school administrators were rated at a very high level, indicating the need for empowerment of school administrators to manage science schools toward excellence by international standards. This point was in line with the findings in Phakamach et al. (2021c) and Carvalho et al. (2022), which emphasized that administrators of science schools in the reform era had to possess a vision and innovative leadership to manage science education suitable to change in providing for learners with quality education and competitive learning outcomes. The result as such was consistent with research by Gil et al. (2018), Sriboonnark (2020), Chandra et al. (2021), and Petchroj (2022)--all reporting that educational institutions should focus on transforming educational organizations into innovative organizations in the rapidly changing digital age. In particular, Gil et al. (2018) and Chandra et al. (2021) proposed 12 essential factors for consideration, some directly related to digital technology, such as determining the proper hardware, software, and digital platforms. Hakansson Lindqvist & Pettersson (2019), Busse & Weidner (2020), Suksaen & Trairat (2021), and Tulowitzki et al., 2022) also revealed similar research findings that "digital competences" were required of modern education administrators, especially digital mobility or integration, digital competence, and understanding how technology affects education. Therefore, the development of ICT for education and digital skills of executives and personnel has to be emphasized and practiced in educational organizations, particularly in science schools.

(2) The confirmation of experts' opinions and empirical data analysis in this study reflected priority in human resource development in science school implementation. To empower school administrators with digital knowledge and competencies and time management skills would lead to their courage and initiative in coping with change in science schools. In addition, the digital learning culture can help school administrators to keep pace with the disruption of education and learning technology to professionally and practically lead the organization to transform its culture to fit in new technology. This point was consistent with the Thai education management guidelines toward Thailand 4.0 in putting digital technology into education (Sinlarat, 2020; Phakamach et al., 2021a). The proposed model for developing digital leadership in science school administrators, when properly implemented, would add to the strengths of science school operations in Thailand to a certain extent.

8. Suggestions

On the basis of the obtained findings, the researchers would like to suggest two points:

(1) The research results revealed the gap between total current and desirable conditions, indicating the perception of the respondents that science school administrators need digital leadership skills development. In this regard, further investigation is needed to ensure priority and details of the development. Besides, the implementation of the proposed digital leadership development model requires consideration of the contextual circumstances of educational institutions--professionally, physically, and environmentally.

(2) The proposed digital leadership development model's validity and applicability could be further assessed with larger relevant sample groups in comprehensive secondary schools to understand the real needs for digital literacy by concerned parties working at the time of digital disruption. To the researchers of this study, an in-depth case study could shed more light on the implementing method of the proposed model for digital competency development of science school administrators, and support personnel and learners as significant and critical stakeholders in the long run.

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