A DEVELOPMENT OF DIGITAL LEADERSHIP MODEL FOR PRIMARY SCHOOL PRINCIPALS IN HENAN

Du Xueping

6419000028

A Dissertation Submitted in Partial Fulfillment of the

Requirements for the Degree of Doctor of Philosophy in

Educational Administration Innovation

Graduate School of Education

Siam University

Academic Year 2026

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Title	A Development of Digital Leadership Model for Primary School Principals in Henan
Researcher	Du Xueping
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Co-advisor	Dr. LeeHsing Lu

Graduate School of Education, Siam University approved to accept this Dissertation as part of Doctoral of Philosophy Program in Educational Administration Innovation.

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Abstract

Title	A Development of Digital Leadership Model for Primary School Principals in Henan
Research	Du Xueping
Degree	Doctor of Philosophy
Major	Educational Administration Innovation

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(Associate Professor Dr. Boonmee Nenyod) (Dr. LeeHsing Lu)

This research aimed to (1) examine current status of digital leadership of primary school principals and digital conditions in primary schools in Henan; (2) identify and analyze the core factors influencing the effectiveness of digital leadership of primary school principals in Henan;(3) develop a digital leadership model for primary school principals in Henan.

The study assessed the core factors that influence the effectiveness of digital leadership of primary school principals in Henan Province, with a focus on the mediating role of digital management. The development model was developed based on Educational Change Theory, Leadership Development Theory, Theory of Planned Behavior, and Self-Determination Theory. The model examines how digital vision planning, digital literacy of principals, and digital implementation assurance influenced digital management, which in turn affects the effectiveness of principal digital leadership, with teachers' digital behavioral intention serving as a moderator.

A mixed-methods approach was utilized. The quantitative data were collected via 462 structured questionnaires, and descriptive statistics were analyzed using SPSS 26.0. Confirmatory factor analysis and structural equation modeling were performed using AMOS 23.0, revealing that the relationships among variables were supported by hypothesis testing. In the qualitative phase, an exploration of research problems and questions was conducted through semi-structured interviews and Nvivo.14 software was used to conduct three-level coding analysis. Then, follow-up interviews found that the causal relationship was consistent with the actual situation. Further in-depth opinions were collected through focus group discussions to triangulate the quantitative analysis results, and 8 experts in education and management validated the model's propriety, feasibility, and utility.

The model proposes a theoretical framework to enhance effectiveness of principal digital leadership through digital management and teachers' digital behavioral intention, which effectively promote digital vision planning efficiency, digital management optimization, and digital implementation assurance development.

The theoretical model can be applied in practice for primary school principals with the help of six steps of "Guidelines", and it can help evaluate principal digital leadership and improve the effectiveness of the school's digital development.

Keywords: Digital Leadership, Primary School Principals, Digital Management, Leadership Development, Effectiveness of Principal Digital Leadership

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Writing the acknowledgements means that my doctoral study is about to come to an end. Looking back on this journey of learning, my heart is filled with gratitude.

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Du Xueping

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List of Abbreviations

Abbreviation	Full Name
ICT	Information and Communication Technologies
AI	Artificial Intelligence
CDDO	Chief Digital Development Officer
UNESCO	United Nations Educational Scientific and Cultural Organization
OECD	Organization for Economic Co-operation and Development
CNKI	China National Knowledge Infrastructure
GDP	Gross Domestic Product
ISTE	International Society for Technology in Education
EU	European Union
DL	Digital Leadership
IT	Information Technology
NETS	National Educational Technology Standards
WICS	Wisdom, Intelligence, Creativity, and their Mutual Synthesis
EFA	Exploratory Factor Analysis
CFA	Confirmatory Factor Analysis
SEM	Structural Equation Model
ECT	Educational Change Theory
LDT	Leadership Development Theory
TPB	Theory of Planned Behavior
SDT	Self-Determination Theory
IV	Independent Variable
DV	Dependent Variable
MV	Mediating Variable
MO	Moderating Variable
DVP	Digital Vision Planning

List of Abbreviations

Abbreviation	Full Name
DLP	Digital Literacy of Principals
DIA	Digital Implementation Assurance
EPDL	Effectiveness of Principal Digital Leadership
DM	Digital Management
TDBI	Teachers' Digital Behavioral Intention
IOC	Item Objective Congruence
WJX	Questionnaire Star, a Online Survey Platform
CITC	Corrected Item-Total Correlation
RMSEA	Root Mean Square Error of Approximation
AGFI	Adjusted Goodness-of-Fit Index
CR	Composite Reliability
AVE	Average Variance Extracted

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

The 2020s of the 21st century are often referred to as the era of the Industrial Revolution 4.0, or the Digital Age, characterized by significant changes in how people live, work, and interact, driven by technological advancements (Peng, 2023). Today, all facets of human life are primarily influenced by the new digital environment supported by information and communication technologies (ICT) (Limna et al., 2022). Expanding access to innovative technologies, including automated machinery, robotic devices, artificial intelligence (AI), the Internet of Things (IoT), digital networking, and augmented reality, continues to drive digital transformation in modern society. Various countries have elevated the development of digital transformation to a national strategic level. (Azrai et al., 2020; Oberer & Erkollar, 2018). In China, the construction of "Digital China" is a strategic choice in the digital era. With digital technology as the engine, artificial intelligence, integrating cloud computing, big data, and internet technologies, has become a major driver of economic development, scientific and technological innovation, and social progress, setting off a wave of artificial intelligence development worldwide (Yue & Cao, 2019).

In light of these rapid and ongoing changes, educational systems are also urged to innovate and align their teaching and learning environments to meet the changing needs of their student populations (Ilomäki & Lakkala, 2018; Zhong, 2017), who "learn in different ways and have different experiences with technology compared to many of their teachers and most of their administrators" (Levin & Schrum, 2014). New technologies must become integral to students' learning to enhance their academic success and equip them with the skills needed to thrive in a digital society (Battro & Fischer, 2012; Limna et al., 2022). In September 2023, UNESCO, released the "Guidelines for the Development of Digital Leadership for Principals", which clearly states that principals, as the "Chief Digital Development Officer" (CDDO) for the digital transformation of education, should regard digital leadership as a core qualification for principal positions, requiring them to possess three core abilities of "technological ethical decision-making", "teachers' digital empowerment", and "students' digital protection". The Organization for Economic Co-operation and Development (OECD)'s "Education Leadership 2024" report states that the digital strategic planning ability of principals is the primary factor affecting the effectiveness of digital transformation in schools (accounting for 37% of the weight). For every $1 increase in investment in principal digital leadership development, the effectiveness of the school's digital transformation can be improved by 23% (compared with a 7% improvement from hardware investment). The OECD's "Education Leadership 2025" report points out that the lagging development of digital leadership among principals is the biggest bottleneck in global digital transformation (with an impact weight of 42%). Digital leadership among principals is the primary factor influencing digital transformation.

The Education Ministry of China formally proposed the “Implementation of Digital Strategic Actions (2022-2025)” which clearly states that the “Principal Digital Leadership Development Project” is one of the top ten key tasks, requiring 100% of principals to complete special digital leadership training (supervised by the Ministry of Education) by 2025 and establish a provincial-level management platform for the “Principal Digital Leadership Development Archive”. “The Industry Standard for Teacher Digital Literacy” points out that “digital development leadership” has been identified as the core competency of principals for the first time, requiring principals to develop digital transformation plans for schools and organize teacher digital literacy training (with an average of ≥ 50 hours per year). The “Basic Education Plan for Teachers in the New Era” (newly added in 2024) lists “Digital Development Leadership” as a core indicator for principal promotion (accounting for 30%).

The essential definition of digital leadership in the UNESCO framework is a systematic leadership capability of educational institution leaders in the digital age, grounded in the fundamental goal of education. Through vision planning, resource integration, cultural shaping, ethical governance, and other practices, digital technology is deeply integrated into the processes of teaching, management, evaluation, and service, ultimately improving educational quality and fairness and inclusiveness (UNESCO, 2023).

The content and needs of digital leadership for principals at different stages of education also differ. Higher education is mainly based on independent innovation and development, and the principal is a “technology strategic investor”; Middle school and high school education focuses on the development of exam effectiveness, with the principal serving as a “data engineer” for further education (Wei, 2024); Primary education focuses on laying the foundation for governance and development, and principals are the designers who lay the foundation for digital literacy. It has been almost ten years since the proposal of “Digital China” in 2015. Although digital transformation practices across schools have made some progress, they still face numerous urgent challenges. For example, there is a clear tendency to prioritize hardware over software: significant investment in hardware, but a lack of high-quality, appropriate digital teaching content (software) that aligns with it.

1.2 Statement of the Problem

From the research background, it is clear that the digital leadership of principals at each stage has research significance and value. The main reasons for this study, which focuses on primary schools and the digital leadership of primary school principals, are as follows.

The shaping of digital citizens’ literacy originates from various sources. Compared with higher education and secondary education, the primary school is a critical period (6-12 years old) for the formation of children’s cognitive patterns, behavioral habits, and values. The digital transformation at this stage directly determines children’s basic digital survival abilities (information retrieval, tool operation, safety protection, etc.). In 2023, the Internet access rate in primary schools reached 100%, but the utilization rate of digital resources was only 37% (China Education Information Development Report 2023).

The controllability of primary school principal digital leadership is high. The main condition is that the mandatory implementation of relevant courses is significantly higher than in other grades (Chen, 2022). For example, the "Basic Education Information Technology Curriculum Standards" require that independent courses be offered from the first grade in primary schools, and that the principal coordinate the teaching staff, equipment, and class hours (most middle schools are elective).

There is an imbalance of academic stages in existing research. In the literature on education, higher education accounts for 52%, secondary education for 30%, and primary education for 18%. Moreover, most studies focus on introducing technological tools and classroom applications, yet there is little research on the digital leadership of primary school principals (Chen & Zhu, 2020).

The primary school principal is the first person to resolve the contradiction between teachers' "digital refugees" and students' "digital natives". The proportion of primary school teachers aged 45 and above is 42.3%, indicating a significant gap in digital skills. This stands in stark contrast to the fact that the average age at which primary school students born in the 2000s are first exposed to the internet is 6.4 years, and there is strong demand for digital classroom experiences (Chen, 2022).

The above issues profoundly reveal the importance, necessity, and complexity of principal digital leadership and digital effectiveness in primary schools. It is not simply a matter of introducing technology, but a systematic project involving updating educational concepts, adjusting organizational structures, reconstructing teaching models, optimizing resource allocation, enhancing teacher capabilities, reforming evaluation systems, and cultural construction. The digital effectiveness of primary schools is critical and represents a "silent revolution" that involves reshaping the nation's digital genes. In this process, the role and significance of the primary school principal as the school's core leader are crucial.

As early as 2013, the Ministry of Education in China introduced the "Professional Standards for Primary and Secondary School Principals (Trial)". It identifies that the principal of a full-time primary school is the only professional who performs school leadership and management responsibilities. It is a unified national framework for the professional competence, responsibilities, and requirements of principals, which clearly states the "six professional responsibilities" of principals (See Table1.1).

Table 1.1 Professional Standards for Primary and Secondary School Principals

Item	Main Content
Planning school development	Develop medium-and long-term development plans for the school to ensure compliance with national education policies and local practical needs.
Creating a culture of education	Construct a campus culture that embodies core socialist values, thereby strengthening moral education and fostering a positive academic atmosphere.
Leading Course Teaching	Supervise course implementation and teaching quality to promote teaching reform.

Item	Main Content
Leading Teachers' Growth	Organize teachers' training and evaluation to promote teachers' professional development.
Optimizing internal management	Improve the school's governance structure, standardize financial, personnel, and safety management systems.
Adjusting the external environment	Coordinate family-school social relations, integrating social resources to support school development.

(Source: Professional Standards for Primary and Secondary School Principals 2013)

In the management structure of primary schools, the principal's leadership intervention is more effective in resource allocation, teacher mobilization, and parental appeals than in high schools and universities. Given the high susceptibility of primary school students to digital behavioral risks, the Ministry of Education has explicitly designated the principal as the "first person responsible for campus network security". However, as shown in Table 1.1, primary school principals who perform only routine management of the school cannot cope with the profound changes of the digital transformation era. Therefore, principals must possess and exercised strong digital leadership during the digital transformation period.

The digital leadership of primary school principals refers to the principal's ability and traits to transform their own cognitive thinking and leadership concepts in the context of educational digital transformation, and to lead all teachers and students in the school to jointly achieve the school's digital development plan and personal digital growth goals. Studying the digital leadership of primary school principals plays a significant role in clarifying the relationship between principals and teachers in the digital era, promoting the development of schools in the digital domain, and reshaping the role of digital technologies in education and teaching (Yuan, 2023).

However, some scholars' research on principal digital leadership in the preliminary phase is not so optimistic. Wang (2023) noted that, in the digital era, digital leadership has become a core competency for principals, and that enhancing it is a requirement for the professional development of primary school principals. However, the investigation reveals that the level of digital leadership among principals in Chinese primary and secondary schools is entirely lacking. There are evident in the following three aspects:

Overall, the principal digital leadership in China is not optimistic. Li &Wang (2018), and their research team surveyed principals from 33 rural primary and secondary schools in seven counties of Linxia, Gansu Province, finding that although 78% of the principals acknowledged that information technology plays a crucial role in enhancing the quality of education, up to 98% had never personally participated in creating school information development plans. Cui & Li. (2019) investigated the status of informatization leadership among 104 primary and secondary school principals in Qinhuangdao City, finding that these principals lacked a deep understanding of educational informatization and even held biases.

Secondly, from the dimension perspective, principal digital leadership development is unbalanced. In analyzing the digital leadership levels of several principals in Anhui Province as research subjects, Xie (2017) found that, relative to other aspects, principals' practical experience in applying digital education is notably lacking. There is evident in the fact that a significant proportion of principals are unclear about how to integrate information technology with subject teaching. Lu (2019) conducted a follow-up investigation on 233 primary and secondary school principals in Chongqing and found that over 40% of principals in the region had low ability to convert data into information and translate information into school management decisions, which still fell far short of the fundamental qualities that principals should possess to support school administration and management effectively. Ren's research team (2019) performed a questionnaire survey on the digital leadership levels of primary and secondary school principals in Wuyuan County, Jiangxi Province, and discovered that 77.5% of the principals felt they lacked digital competencies, while 59.38% believed they had no time to enhance their digital leadership due to heavy daily workloads. Additionally, 40% of principals reported insufficient information about national education and digital development policies.

Thirdly, in the regional comparison, the principal level of digital leadership is not balanced. Wang et al. (2019) conducted an empirical study on the levels of informatization leadership among certain principals in Shanxi Province using questionnaires and interviews. The study revealed that the information quality of most county-level and below principals is below average, with nearly 50% of these principals able to use information technology only for simple, routine management tasks within the school management process. Lu (2021) focused on a district in Guangzhou, examining the informatization leadership structure and promotion strategy of primary and secondary school principals in the city through differentiation analysis. The findings indicated significant differences in principal digital leadership across school regions. Zhao (2021) surveyed and analyzed digital leadership among 1,654 primary and secondary school principals in Jiangsu Province, finding notable discrepancies between urban and rural areas.

The research above indicates that the level and quality of digital leadership among many primary school principals in China require improvement to adapt to the digital transformation trend.

In the context of technology integration in teaching and learning, the 2018 Education Informatization 2.0 Action Plan from the Ministry of Education indicated that principals across all school types and levels should serve as chief information officers, meticulously coordinating the planning and advancement of school informatization. This plan also emphasized the need for enhanced training in informational leadership for principals to strengthen their leadership roles among school administrators at all levels and types. Huai Jinpeng, China's Minister of Education, noted at the 2022 work conference that "in the future, artificial intelligence technology will be deep involved in the entire process of education, teaching, and management to study its effectiveness and adaptability, allowing the younger generation to learn more actively and teachers to teach more creatively." In response to new policies and changes in the country, the Ministry of Education of China issued a notice in August 2022 on the implementation of the New Era Primary and

Secondary School Teacher and Principal Training Plan (2023-2026), which aims to cultivate educational leaders with distinctive concepts and established models.

As a traditional populous province and located in central China, Henan Province's 2023 GDP ranking was relatively lower than other provinces in central China. Moreover, Henan Province has a very large number of primary schools; the digital transformation situation of these primary schools should be taken seriously, so Henan Education Department actively implements the Training Program for Teachers and Principals in the Digital Transformation Era (2023-2026), referred to as the "Digital Training Program" in further discussions.

The digital training program aims to build a high-quality, digitally proficient team of educators, including teachers and principals in primary and secondary schools, to enhance the effectiveness of digital transformation within each school in the digital era. This initiative is led by Henan University, Henan Normal University, Xinyang Normal University, and three other Normal Colleges. All teachers and principals from every primary and secondary school in Henan province must participate in a 10-day training program at various locations and times. The program is designed to cover all principals and teachers in the province within three years (vice principals and other administrative staff are also considered teachers, in addition to principals).

The training for principals incorporates various formats, including lectures by distinguished experts, classic readings, and case studies presented by outstanding, experienced principals from Beijing and Shanghai. This approach aims to enhance their educational management and leadership skills during this digital transformation. Simultaneously, the training develops specialized policies tailored to the unique contexts of different cities, provides platforms and practical opportunities for principals, and supports them in leading the digital transformation of school management and in cultivating teachers in basic education. At the end of the training, during the assessment phase, each principal must submit a training summary covering topics such as school digital management and the digital transformation of education. After completing the training, when the principal returns to school, they must develop an improvement plan based on the training requirements, emphasizing their role in localizing practices and demonstrating digital leadership.

According to the 2023 Government Statement of Henan Province, there are approximately 16,400 primary school principals. The general training schedule for primary school principals from 2023 to 2026 is detailed below (See Table 1.2).

Table 1.2 General Training Schedule for Principals of Primary Schools in the "Digital Training Program (2023-2026)"

Trainer		**Population**	**Time**	**Quantity**	**Tip**
Primary School	**Principals**	16.4 thousand	7 / 2023	2730	Six trainees are trained simultaneously each time. On average,
			2 / 2024	2740	
			7 / 2024	2730	
			2 / 2025	2730	
			7 / 2025	2740	

Trainer		Population	Time	Quantity	Tip
			2 / 2026	2740	about 450-500 people are in each training place.

(Data source: Department of Education of Henan Province)

Preliminary Research

To assess current state of digital leadership among primary school principals and the status of digital development in primary schools in Henan Province, the researcher conducted a small-scale, semi-structured interview with participants in the digital training program during the preliminary phase. The three groups of participants (each comprising 5 participants) were primary school principals, school administrative staff, and front-line teachers (See Table 1.3). The researcher encoded the interviewees with principal P1-P5, school administrative staff S1-S5, and front-line teacher T1-T5. They were interviewed to explore their varied experiences and perceptions regarding principal digital leadership and the digital condition of their schools. Each semi-structured interview included 5open-ended questions to elicit in-depth responses on related topics (see Appendix A). The interviews were conducted in depth, lasting approximately 30-40 minutes per interviewee, recorded on a voice recorder, and stored in a location accessible only to the researcher.

Table 1.3 Information of Semi-structured Interview Participants

Number	Identity	Gender	Age	Education Background
P1	Primary school principal	Male	45	Bachelor Degree
P2	Primary school principal	Male	42	Master Degree
P3	Primary school principal	Female	49	Bachelor Degree
P4	Primary school principal	Female	51	Bachelor Degree
P5	Primary school principal	Male	53	Bachelor Degree
S1	School administrative staff	Female	37	Master Degree
S2	School administrative staff	Female	39	Master Degree
S3	School administrative staff	Male	28	Master Degree
S4	School administrative staff	Female	31	Master Degree
S5	School administrative staff	Male	46	Bachelor Degree

Number	Identity	Gender	Age	Education Background
T1	Teacher	Female	51	Bachelor Degree
T2	Teacher	Male	42	Bachelor Degree
T3	Teacher	Female	34	Master Degree
T4	Teacher	Male	28	Master Degree
T5	Teacher	Female	32	Master Degree

After collecting semi-structured interview data from participants, the researcher transcribed the recordings verbatim with the assistance of two Ph.D classmates in educational management. Then, the recording was manually listened to, sentence by sentence, to ensure the authenticity and objectivity of the original data, resulting in written material of approximately 25,000 words (See Appendix B). Next, the text was input into Nvivo. 14 qualitative analysis software to conduct three-level coding analysis based on the Grounded Theory, with a focus on capturing textual data specific to the research needs during the interviews (See Table 1.4).

Table 1.4 Thematic Sentences of the Interview Text (Excerpt)

Participant	Thematic Sentence
Principal 1(P1)	Last year, the school was designated an 'Information Technology Standard School', which sounds positive, but in reality, it added only a few smart screens and a computer classroom.
Principal 2(P2)	Here, digitalization is primarily driven by projects, and once a project is completed, ongoing investment cannot keep pace.
Principal 3(P3)	The most pressing issues are funding and equipment. The number of tablets provided by the superior is insufficient; one tablet is required per day.
Principal 4(P4)	The school has a long history and many old teachers. They resist new technologies and believe that blackboard writing is the true skill.
Principal 5(P5)	Our school has a high hardware baseline, but the software and workforce cannot keep pace.
Staff member1(S1)	We need to use a digital platform to enter grades and analyze exams, but the system often lags and does not allow data export.
Staff member2(S2)	I am responsible for maintaining the school's network and equipment, but I am the only one.
Staff member3(S3)	The tools provided by the technical department are not user-friendly, and the homeroom teacher is also unwilling to make additional entries.
Staff member4(S4)	Digitization could have better connected parents, but the school platform has limited functionality and can only send notifications.
Staff member5(S5)	We purchased the equipment according to the list, but the teacher reported that it is not easy to use.
Teacher1(T1)	I hope to learn how to use data to analyze students' weaknesses or design blended learning activities, but no one is teaching me.
Teacher2(T2)	I am used to blackboard chalk, which is simple and direct. The

Participant	Thematic Sentence
	smart screens developed by the school are complex to operate and time-consuming to develop courseware for.
Teacher3(T3)	We attempted to use digital tools for collective lesson preparation and learning situation analysis, but the data platform was not unified.
Teacher4(T4)	The school's training content is repeated annually, and there are no advanced courses.
Teacher5(T5)	Lack of coordination among departments has increased our workload.

The entire three-level coding analysis process contains: Open coding, axial coding, and selective coding.

Step 1: Open Coding

The researcher first read the material repeatedly, identified relevant sentences that reflect the digital leadership of primary school principals and the digital condition of primary schools, and encoded them sentence by sentence, on this basis, further clarified its meaning, summarized, and merged similar concepts to form a more comprehensive category. Through open coding, the study identified the concepts (See Table 1.5).

Table 1.5 Concepts from the Open Coding (Excerpt)

No.	Concept from Open Coding
1	Lack of top-level design and data interoperability among departments.
2	Difficulties in cross-departmental collaboration and the principal's difficulty in integrating resources.
3	The principal realizes the need for a clear digital vision.
4	The principal's support for teacher development is insufficient, and the training content is disconnected from reality.
5	After the completion of the digital project, the principal did not establish a mechanism for continuous operation.
6	The principal pursues the procurement of advanced equipment, but the equipment is underutilized.
7	The principal failed to ensure timely maintenance and updates of the equipment.
8	Unreasonable training budget and content arrangement.
9	Network instability and insufficient bandwidth.
10	The procurement is disconnected from actual needs, and the functions are idle.
11	Old teachers reject new technologies and become accustomed to traditional teaching.
12	Young teachers lack systematic training and prioritize self-learning.
13	Weak data analysis ability, data not used for teaching improvement.

No.	Concept from Open Coding
14	The home-school collaboration platform is fragmented and has low usage.
15	Mismatch between software and hardware, insufficient workforce.
16	Unstable policies and unsustainable planning.

Step 2: Axial Coding

The researcher further read and analyzed the concepts obtained through open coding earlier, summarized and merged the categories, and finally got 9 main categories that can cover all the concepts (See Table 1.6).

Table 1.6 Categories of the Axial Coding

No.	Category of Axial Coding	Frequency
1	Loose management mechanism	9
2	Lack of personal literacy	8
3	Lack of implementation and promotion	9
4	Lack of an assurance system	8
5	Weak hardware and inefficient use	7
6	Polarization among teacher groups	8
7	Weak in a clear vision and strategic planning	6
8	Platform is landing and single functionality	7
9	Shortage of resources and insufficient sustainability	8

Step 3: Selective Coding

Selective coding means extracting core categories and forming a systematic understanding (Sun, 2010). Based on axial coding, further analysis of the logical relationships among the 9 main categories identified a core category: the digital leadership of principals is insufficient, and the digital development level of primary schools in Henan Province is generally lagging.

The detailed description is as follows:

The current situation of digital leadership among primary school principals in Henan is not very promising, primarily influenced by factors such as regional economy, policy support, technological infrastructure, training opportunities, and the teachers' digital behavioral intention of the school. Primary school principals' digital situations classified as:

Weak in a clear vision and strategic planning and a lack of personal literacy. High enthusiasm coupled with a lack of necessary technical skills and digital literacy, inadequate understanding of data analysis, and a lack of a clear vision and strategic planning for digital development and management.

Loose management mechanisms and a lack of assurance systems. There is greater emphasis on hardware investment than on integrating technology into education, resulting in insufficient awareness and capability.

Lack of implementation and promotion. There is a lack of coordination among departments (academic affairs, home, and school) in ensuring effective digital implementation.

The key findings of digital condition in primary schools are: “outstanding results on the surface and poor circumstances below”. In other words, only a few regional schools, such as those in the Digital Comprehensive Reform Pilot Zone, demonstrate high aspirations and exceptional outcomes in digital development. However, many districts and schools remain in a more passive state. Due to limitations in funding, equipment, networks, and other factors, the integration of online and offline teaching is not commonly implemented (Yuan, 2023). Furthermore, young teachers are highly enthusiastic but often lack systematic training. Some veteran teachers resist adopting new technologies. The school organizes one or two annual information technology training sessions for all staff, but the content is overly theoretical and does not align with practical teaching contexts. Students are proficient in using technology but have limited awareness of information filtering and network security; some families lack smart devices. Thus, the digital transformation of primary schools is complex.

From the preliminary research findings, it is clear that the current digital leadership of primary school principals and digital condition in primary schools in Henan require great attention. Especially, the effectiveness of digital leadership of principals is influenced by external factors like regional economy, policy support, technological infrastructure, teachers’ digital behavioral intention and so on. And, the internal factors like principal’s digital vision and strategic planning, personal digital literacy, digital management ability, digital implementation and assurance ability and so on. In the research on the influencing factors of digital leadership of principals, there is too much uncertainty in external factors such as regional economy, policy and technology support. This research mainly focused on the digital leadership of principals themselves and the behavioral intention of the school teachers.

Referring to the primary standards and framework for principal digital leadership published by the International Society for Technology in Education (ISTE, 2023), Dig Comp Edu, UNESCO’s “Artificial Intelligence in Education,” and the Organization for Economic Cooperation and Development (OECD) “Education 2023” (See Table 1.7), it is evident that there is still significant progress needed to develop principals’ digital leadership and achieve the development of digital education in Henan. The interview results indicate that most primary school principals in Henan are weak in, or lack, a clear vision and strategic planning, personal literacy, implementation, promotion, assurance systems, and management mechanisms.

Table 1.7 Digital Leadership Standards for Principals Published by Major International Organizations and Institutions

Organization and Institution	Core Content
ISTE	·Equity and Citizenship Advocate ·Visionary Planner ·Empowering Leader ·Systems Designer ·Connected Learner
Dig Comp Edu	·Digital Qualities ·Digital Pedagogy ·Leadership & Policy
UNESCO	·Ensure technological fairness and inclusiveness. ·Promote the professional development of teachers. ·Leading artificial intelligence and data-driven decision-making.
OECD	The principal should possess digital leadership to promote innovation in the school and cultivate students' future skills.

Principal digital leadership is essential in developing infrastructure and the educational environment (Qu & Gao, 2022). As an innovative leadership paradigm, principal digital leadership addresses the needs of the digital transformation era. According to previous studies, it is evident that the situation of digital leadership of primary school principals in Henan is in sharp contrast to the urgent demand for principal digital leadership put forward by the rapid advancement of digital transformation, and the digital leadership standards for principals published by major international organizations and institutions (See Table 1.7), highlighting gaps that require attention. School development is like a boat sailing on the sea; it risks moving backward without forward momentum. In the context of the rapid development of digital technology and education, when faced with new requirements and challenges, do principals respond promptly to align with the digital era, or do they turn a blind eye and risk being left behind by history? This presents a critical challenge for every principal, demanding reflection and action (Wei, 2024). Given the crucial role of primary school principals in digital transformation and the existing shortcomings in digital leadership, developing a digital leadership model for these principals has become essential. By establishing such a model, we can define the specific skills and literacy principles needed in the digital era, provide scientific guidance and support, and foster the digital development of schools, teachers, and students.

1.3 Research Questions

Based on the research background and problem, the main research questions are:

What are current status of digital leadership of primary school principals and digital conditions in primary schools in Henan?

What core factors influence the effectiveness of digital leadership of primary school principals in Henan?

What is the digital leadership model for primary school principals in Henan?

1.4 Research Objectives

Considering the research questions above, the objectives of this study are:

To examine current status of digital leadership of primary school principals and digital conditions in primary schools in Henan.

To identify and analyze the core factors influencing the effectiveness of digital leadership of primary school principals in Henan.

To develop a digital leadership model for primary school principals in Henan.

1.5 Scope of Research

As a populous traditional province in central China, Henan Province has a large number of primary schools. The research problem above profoundly revealed the importance, necessity, and complexity of principal digital leadership in primary schools. Additionally, previous research and interviews indicate that, in primary schools, the principal is the most important person in school management. The digital leadership levels and literacy of many primary school principals need to be improved to adapt to the ongoing digital transformation, so primary school principals in Henan were selected as the research objects.

The research data, based on the “Digital Training Program,” initially involved six provincial-level education and training centers, including Henan University, Henan Normal University, Xinyang Normal University, Zhengzhou Normal College, Luoyang Normal College and Nanyang Normal College.

This research examined the core elements and indicators of principal digital leadership in primary schools in Henan Province and the current status of this leadership. It also addressed the development of digital leadership model to enhance principal digital leadership and achieve digital effectiveness. Based on the results of the semi-structured interviews and related research, the research problem, questions, and objectives were developed.

The population for this study comprised primary school principals in Henan Province who participated in the “Digital Training Program” during the Academic Year 2023-2026. According to statistics, there were approximately 16,400 primary school principals. To ensure the accuracy of the sample, this research used the principals who participated in the training in one phase.

1.6 Significance of Research

To achieve high-quality educational development, the Ministry of Education and related departments have issued numerous policy documents to facilitate the digital transformation of education. The primary school principal guides the school’s strategic direction and is primarily responsible for its operations. As the chief architect of the school’s digital progress, the principal’s leadership in digital initiatives is crucial. Therefore, this study focuses on developing a model of digital leadership among primary school principals, which has significant theoretical importance and

practical value for assessing the current state of digital leadership and for proposing strategies to enhance principal digital leadership.

Firstly, it enriches the theoretical research. The digital transformation of education in the smart era is imminent, with many studies focusing on teachers and students, whereas relatively few focus on principals. Guided by leadership theory, this study developed digital leadership model for primary school principals, enriching theoretical research on principal leadership and digital development in education. Additionally, research on developing principal digital leadership model remains scarce; this study contributes to the field of digital leadership. This provides significant theoretical insights for the digital development of education in the intelligent era.

It also expands the boundaries of digital leadership model development. With the rapid development of information technology and the ongoing advancement of educational digitization (Zhu, 2023), various aspects, including national strategy, school management, and principals' personal growth, increasingly demand improvements in school leaders' digital leadership. There is also a growing call for principals to enhance their digital leadership. A literature review indicates that although digital leadership among principals has garnered greater attention from scholars and experts, resulting in numerous promising research findings, further exploration of the principal digital leadership model remains necessary (Zhao, 2021). Drawing on systematic research on leadership theory and inspired by frameworks such as the contingency leadership model, this study broadens the scope and boundaries of research to develop the principal digital leadership model.

Then, it enriches and update educational theories. It offers innovative ideas for enhancing and updating educational and management theories in the age of artificial intelligence. Most work on pedagogy and educational management focuses on traditional classroom practices that do not align with current conditions and future educational requirements. Consequently, these approaches struggle to lead in future education management practices. In the era of digital education, the stability and balance sought in the digital transformation of school education should reflect a state (Hou, 2024). In other words, it is crucial to comprehensively and systematically consider all systems, organizations, resources, subjects, and other elements that drive change and develop a suitable mechanism to connect them to establish a new order. This is essential to ensure that the digital development of school education is effectively addressed.

Moreover, this study provides a tool for evaluating the development of digital leadership. Digital leadership is essential to the principal's professional development and significantly impacts educational reform, school growth, and staff training. The digital leadership model for primary school principals is a tool for assessing and measuring the level of principal digital leadership development within educational authorities. Specifically, it provides a scientific, comprehensive basis for understanding the current state of the principal's digital leadership development, clarifies the principal's ongoing tasks and outcomes, and helps identify future priorities for the principal's work. Additionally, it serves as a reference for educational authorities to enhance the digital leadership training of primary school principals. To some extent, this initiative enhances principal digital leadership, advances schools' digital evolution, and indirectly supports the realization of national educational digital

transformation and high-quality development.

Ultimately, this study provides effective strategies for primary schools to improve school quality. A high-quality digital development system is essential for building a high-quality education system. Currently, theorists focus more on policy guidance, conceptual discussions, and future patterns concerning the digital development of school education. However, few theorists emphasize the establishment of new mechanisms. To effectively manage the new elements and teaching modes, create a new order, and facilitate the high-quality development of digital transformation in school education (Hou, 2024), this study addresses the new objectives that digital transformation imposes on educational concepts, management systems, and mechanisms. It offers practical strategies for school administrators to enhance the efficient implementation and high-quality digital development in education, ultimately improving educational effectiveness and school quality.

1.7 Definition of Terms

To create a digital leadership model for primary school principals, several related terms require definition.

Digital Leadership

As human society enters the digital age, information technology has evolved into digital technology, encompassing block-chain, big data, artificial intelligence, and related technologies. New concepts such as digital society, digital government, and digital governance are driving changes in leadership activities, requiring leaders to leverage digital technologies to enhance operational efficiency. Consequently, the academic community has introduced the concept of “digital leadership,” which originates from “information leadership.” Western scholar El Sawy et al. (2016) defines “digital leadership” as the capacity of leaders to accurately forecast the success of a company’s digital strategy and its business ecosystem; Van Wart et al. (2019) posits that “digital leadership” encompasses a leader’s ability to effectively recognize and identify shifts in the digital environment, seamlessly integrate digital technology with traditional methods, and improve organizational performance.

The essential definition of digital leadership from UNESCO’s framework was adopted: Digital leadership is a systematic leadership capability of educational institution leaders in the digital age, grounded in the fundamental goal of education. Through vision planning, resource integration, cultural shaping, ethical governance, and other practices, digital technology is deeply integrated into the processes of teaching, management, evaluation, and service, ultimately improving educational quality, fairness, and inclusiveness (UNESCO, 2023).

Primary School Principal

The primary school principal is the professional leader of a school. Its core responsibility is to ensure children’s right to education and achieve the goal of comprehensive development in morality, intelligence, physical fitness, aesthetics, and labor through systematic actions such as planning school development, building a culture of education, leading curriculum teaching, promoting teacher growth, optimizing organizational management, and coordinating external environment within the framework of national education policies (Ministry of China Education, 2012).

Here, in the digital age, principals need to take on the additional role of "Chief Digital Development Officer," integrating technological empowerment with educational laws (UNESCO, 2023; Wang, 2024).

Digital Leadership of Primary School Principals

It refers to the key ability to perceive changes in the digital environment proactively, formulate the school's digital development vision, establish a digital governance framework for the school, lead the teaching team to carry out digital practices and assessment improvements, and ultimately aim at the development of digital literacy for both teachers and students in the context of the digital transformation of education (Ma et al., 2025).

Digital Leadership Model

In this research, the "digital leadership model" refers to a theoretical model and practical model that systematically explains the mechanisms underlying digital leadership among primary school principals in Henan Province. The structured framework identifies the core influencing factors of the effectiveness of principal as digital vision planning, digital management, digital literacy of principals, digital implementation assurance and teachers' digital behavioral intention.

It encompasses the comprehensive capability system and practical process in which the principal integrates personal digital literacy, digital vision planning, and digital implementation assurance through a specific context of digital transformation in basic education, with digital management as the core mediator, effectively promoting digital teaching efficiency, digital management optimization, teachers' digital development, and students' digital well-being under the key moderation role of teachers' digital behavioral intention, thereby leading the school to achieve deep digital effectiveness.

Effectiveness of Principals' Digital Leadership

It refers to the positive impacts and changes that a principal has on school members (mainly teachers), school organizational processes, and ultimately on teaching and learning through implementing a series of digital vision planning, construction, management, and support behaviors. The key is that it differs from "digital leadership" itself (behavior) and focuses more on the direct, observable intermediate-state changes triggered by leadership behaviors (Sheninger, 2022).

In this research, the effectiveness refers to the perceptible, measurable, and sustainable positive changes that the principal generates at the organizational level of the school through systematic digital leadership behavior and digital management practices in leading the digital transformation process of the school. It includes the effectively promoting digital teaching efficiency, digital management optimization, teachers' digital development, and students' digital well-being. So, it is not only the result presentation of the principal digital leadership, but also a symbol of examining the effectiveness of digital leadership of primary school principals.

CHAPTER 2

LITERATURE REVIEW

Principal digital leadership is the primary factor affecting the effectiveness of digital transformation in schools and constitutes a vast global strategic initiative (OECD, 2024). In this study, the researcher examined theories, concepts, and related studies on the model development of digital leadership among primary school principals to advance educational digital development. Key concepts and variables from various literature were analyzed, synthesized, and summarized to develop a model for this study. Essentially, this part includes nine main contents:

2.1 Primary School Principals

2.2 Digital Leadership and Influencing Factors

2.3 Model Development and Model Validation

2.4 Leadership Development Theories for Principals

2.5 Theories and Relationship Between Variables

2.6 Core Variables of the Study

2.7 Conceptual Framework

2.8 Hypotheses

2.9 Operationalization of Variables

The Statement of Literature Review

From the perspective of time series, developed countries such as the United States, the United Kingdom, Germany, and Singapore, as well as international organizations such as UNESCO, the Organization for Economic Cooperation and Development (OECD), and the European Union (EU) have released a series of policy documents on promoting the digital development of education around 2015 (Zhang & Xue, 2023). China has also officially elevated “Digital China” to a national strategy in the outline of the 13th Five-Year Plan and has vigorously promoted the development of digital education (Zhang & Wu, 2022). Therefore, this study limited the publication time from 2015 to 2024.

Six authoritative databases were selected, including Web of Science, EBSCO, SpringerLink, ScienceDirect, Scopus, and CNKI. The keywords “digital leadership” and “technological leadership” in English, respectively, are “ICT leadership,” “educational leadership,” “principal,” “artificial intelligence,” “digital transformation,” “digital development,” “digital effectiveness,” and “model construction”. Chinese keywords “education digitization,” “principal leadership,” “digital leadership,” “school leadership,” “educational leadership,” “model construction,” and “model validation” were searched to ensure the comprehensiveness of the literature review.

To ensure the quality and accuracy of the literature, this study developed a set of criteria for including and excluding literature (See Table 2.1).

Table 2.1 Criteria of Literature Inclusion and Exclusion

	Screening Criteria	Inclusion	Exclusion
1	Whether the literature is duplicated.	No	Yes
2	Whether the full text is available.	Yes	No
3	Whether it belongs to the discipline of education.	Yes	No
4	Whether the language is English or Chinese.	Yes	No
5	Whether it is an empirical study.	Yes	No
6	Whether the research problem is highly relevant to the study.	Yes	No
7	Whether objectives are principles or digital education development.	Yes	No
8	Whether the research process includes straightforward research questions, methods, and conclusions.	Yes	No

According to the analysis guide proposed in the published “Preferred Reporting Items for Systematic Reviews” and “Meta-Analyses” (Page et al.,2021), this study further identified the process of literature identification, screening, inclusion, and exclusion to enhance the scientificity and comparability of systematic reviews. The first round of screening, such as title, abstract, keywords, etc., excluded literature unrelated to the topic, and not empirical, and included literature in the field of Higher Education, Special Education, and Preschool Education.

Based on the full-text reading, studies with straightforward research questions, detailed research methods, clear conclusions, and highly relevant topics were further selected, and a snowball sampling approach was employed. Finally, 148 pieces of literature were selected, comprising 121 in English and 27 in Chinese.

The selection process is shown in Figure 2.1.

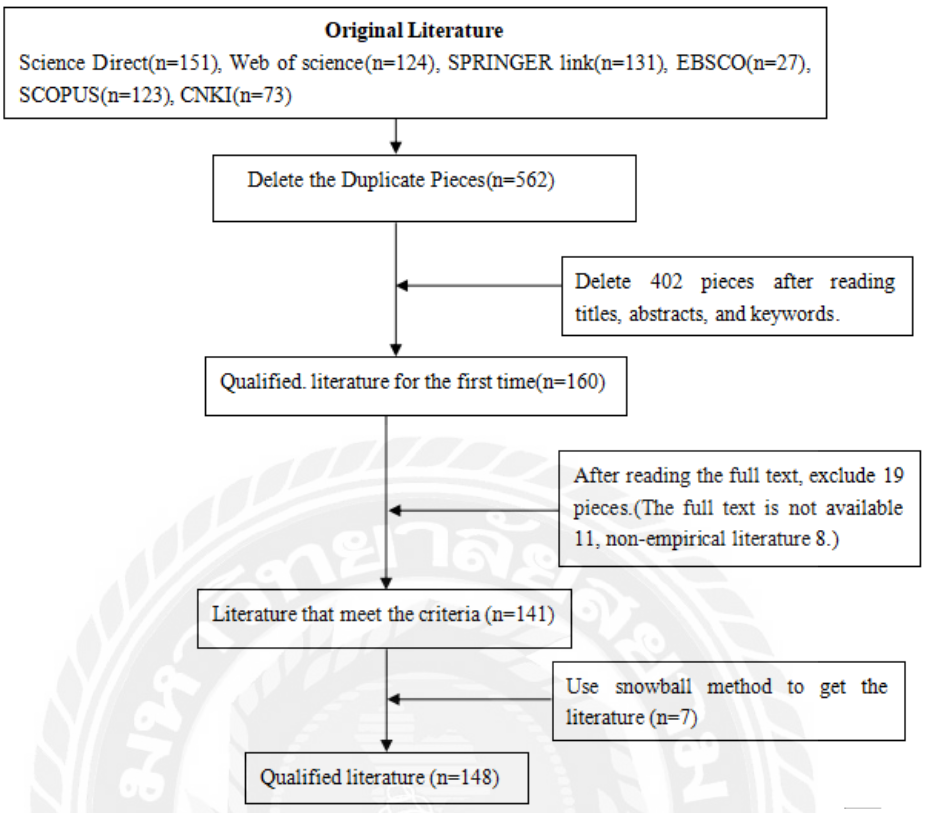

Figure 2.1 Process of Literature Screening

Since its publication, research on digital leadership of primary school principals and on the digital development of education in China and abroad has increased annually. From a regional perspective, the research subjects are distributed across 24 countries and regions, including 13 developed and 11 developing countries, with a relatively balanced distribution. From the perspective of journals, the selected literature appears in 52 journals, which is relatively broad.

Among them, foreign literature was published in journals on educational technology, teacher education, educational management, educational leadership, and related fields. Most of the selected literature in China was published in educational technology journals.

2.1 Primary School Principals

The Origin of Principal

In China, “principal” during the Qin and Han dynasties referred to lower-ranking military officers. By the end of the 19th century, Western learning had gradually been introduced to China and had become the dominant form of schooling. The new educational system divided schools into several levels, such as “primary school”, “middle school”, “high school”, and “university”. Until 1909, the administrative head of the school was referred to as “prime minister” or “supervisor”. The school was renamed in 1912 and later became an administrative supervisor, appointed by the National Education Administrative Department or other educational management

institutions. The school director was renamed as the principal and has been used ever since. Today, the position of principal is established in schools at all levels worldwide. The definition of "principal" in the "Comprehensive Dictionary of Education" is "the main person in charge of the school, appointed by the national education administrative department or by the management department of other educational institutions". The school is responsible for internal "school affairs," and the principal represents it externally (Zhou, 1992). The subjects of this study refer to the actual principals with management functions in schools.

The Multidimensional Elaboration of Definitions

Legal identity dimension: The principal is the legal representative of the school and exercises administrative management rights and educational leadership rights in accordance with the law. Item 26 of the "Compulsory Education Law of the People's Republic of China (2018)": "Schools implement the principal responsibility system, the principal is fully responsible for the school's work".

Professional function dimension: Principal is the primary person responsible for teaching leadership. Their core task lies in building a learning organization and promoting continuous improvement in curriculum and teaching. "Professional Standards for Principals of Basic Education Schools (2013)":Plan school development and set educational goals in line with children's development laws; lead curriculum and teaching, ensure the implementation of national curricula, and innovate teaching models; Hallinger's (2018) Teaching Leadership Model: Principals need to focus on the consistency construction of "curriculum-teaching-evaluation".

Organizational behavior dimension: The principal is the shaper and coordinator of school culture, and needs to balance multiple relationships such as government requirements, teacher development, parental expectations, and children's needs. Distributed leadership theory of Spillane (2006): "Principal achieves collaborative governance by empowering the teacher team"; Survey by the Chinese Academy of Educational Sciences (2020): "In resolving conflicts between home and school, the coordinating role of the principal accounts for 73.5%".

New Roles in the Digital Age: Under the era of digital transformation, the principal is the guardian of educational ethics and the architect of technological integration, and must possess the capabilities of data governance and child protection. "Guide for Principal Digital Leadership" of UNESCO (2023): "The principal must incorporate digital technology into the entire process of education and establish a mechanism for protecting children's data"; Wang (2024) empirical study: "The core of the digital leadership of a primary school principal is the ability of child-oriented design".

In Summary:

The primary school principal is the professional leader of a school. Its core responsibility is to ensure children's right to education and achieve the goal of comprehensive development in morality, intelligence, physical fitness, aesthetics, and labor through systematic actions such as planning school development, building a culture of education, leading curriculum teaching, promoting teacher growth, optimizing organizational management, and coordinating external environment within

the framework of national education policies (Ministry of Education of the People's Republic of China, 2013). In the digital age, principals need to take on the additional role of "Chief Digital Development Officer", deeply integrating technological empowerment with educational laws (Wang, 2024).

2.2 Digital Leadership and Influencing Factors

1. International Research on Digital Leadership

The literature review indicates that international research on digital leadership is primarily concentrated in educational research, behavioral science, and psychology. Analysis of their themes indicates that research on digital leadership primarily focuses on conceptual connotations, evaluation criteria, and empirical studies of influencing factors.

Connotations, Concepts, and Definitions Leadership

Leadership has long been a topic of significant interest. People try to explain leadership from different perspectives, such as traits, styles, behaviors, influence, and role positioning. However, due to the highly complex nature of leadership, there is no clear, widely accepted definition in academia, and one is unlikely to emerge in the future (Burk, 2001).

For example, Fred Fiedler (1971), founder of contingency management, once pointed out that "there are almost as many definitions of leadership as there are theories of leadership, and there are almost as many theories of leadership as there are researchers in the field." Despite the lack of a unified definition, it is necessary to systematically analyze the connotations of leadership before researching it. Regarding the definition of leadership, there are two mainstream academic viewpoints in the current academic discourse. One such view is the "competence" view. In the early days, scholars who held the "ability theory" mainly regarded leadership as the ability of individual leaders to study and discuss. However, with the introduction of the concept of team and the deepening of team spirit, leadership has also been regarded as the leadership of an organization or team in recent years. For example, Kouzes and Posner (2012) pointed out that leadership is the leader's ability to motivate others to make outstanding contributions to an organization voluntarily. Another view is the process view. Hersey (2006), founder of the Center for Leadership Studies (CLS), believed that leadership influences others to do things they might not do. Antonakis (2008) pointed out that, in principle, leadership can be defined according to the following two aspects: The interaction between the leader and the follower and its results; The process can be explained by the personality traits and behaviors of the leader, the cognition and characteristics of the followers, and the context in which the influence occurs.

Principal Leadership

Research on presidential leadership is relatively recent. As early as the 1930s, management researchers at Harvard University began discussing managerial leadership in education. In 1982, Corbett et al. (1982) first proposed to the National Association of High School Principals that principal leadership is a key element in promoting the use of computer technology in schools. At present, the concept of principal information leadership remains unclear, and greater emphasis is placed on

the principal's technical leadership, with a focus on the practical value of technology in education. This idea points out the direction for developing the principal's information leadership. Mojkowski (1986), an American scholar, proposed that principals with technological skills use new technologies as a starting point and motivation to rethink their work practices, thereby strengthening their leadership and management and creating high-quality campuses. The new technology here refers to the computer. The researcher emphasizes the importance of using computers to strengthen school principals' management abilities. With the continuous development of information technology, Dutch scholar Collis (1988) put forward the term "information technology leadership" for the first time in her book Computers, Courses, and Whole Class Teaching: Problems and Ideas, which mentioned that information leadership skills include the ability to acquire technical resources and technology application equipment. American scholar Murphy & Gunter (1997) pointed out that "information leadership means that leaders can support computer technology so that teachers can integrate technology into the curriculum more effectively." In the early stages of computer application in education, researchers focused on the use of computer hardware and on the effectiveness of technology in enabling principals to strengthen school teaching and management. Principals need to do more to encourage and guide teachers to use computer hardware in teaching and, at the same time, use computers to strengthen and facilitate their management. With the rapid development of information technology, which has had a tremendous influence on schools, principals' work has become increasingly complex, and more researchers have begun to broaden the research object to include school management teams, including principals.

In 1999, Sampson et al. (1999) pointed out that "information leadership refers to the application of information technology by principals and school administrators in all aspects and situations of education and teaching, thus playing a demonstration and driving role in realizing the educational reform in which the leadership gradually applies information technology to teachers' learning." By analyzing this connotation, it can be seen that at this time, the requirements for informatization leadership of principals have shifted from the support of hardware technology to the learning and construction of computer teaching software. At the same time, the central role of informatization leadership has expanded beyond the principal to the school administration team.

In 2012, the United States-based International Association for Educational Technology focused on school administrative leaders, describing the specific tasks and requirements of their information work within their job scope. Saban (2017) pointed out that the school principals, as IT leaders, need a long-term vision and commitment to coordinate and allocate the resources the school needs. While the connotation of principal leadership at this time centers on planning and designing the school's overall future development, Saban emphasizes that information technology planning entails not only allocating funds for technology development from the school budget but also a clear focus on technology-oriented educational understanding. With the rapid development of digital technologies such as the Internet, big data, and artificial intelligence, school principals must be prepared to face the challenges of the intelligent age and be equipped to transform and develop educational organizations and their students with digital native capabilities. In the future, holographic

technology, social media, and artificial intelligence will become the preferred teaching tools, and the informatization leadership of principals must develop in step with them, from focusing on the application of information technology in education and teaching to the digital leadership that uses digital technology to transform the education system and business processes.

Sheninger (2022), in his book Digital Leadership: Changing Paradigms for a Changing Era, pointed out that schools must change to encourage students to master the skills necessary to thrive in the information economy and that school leaders can improve student achievement and improve their skills by implementing the strategy of digital leadership, and proposes seven pillars of digital leadership. This includes communication, public relations, branding, professional growth and development, student engagement and learning, opportunities, learning environments, and spaces.

Information Technology Leadership

Informatization leadership is understood in different ways by scholars: International scholars generally use "technology leadership" to collectively refer to "technology leadership," "information technology leadership," and "informatization leadership." They do not carefully explore the evolution of the connotation of the concept of "technology leadership" with the advent of the informatization society. The academic circle can be divided into the following research perspectives on informatization leadership:

Knowing information technology leadership from the perspective of leadership ability: Scholar Burk (2001) pointed out that informatization leadership promotes leaders' rapid mastery and effective use of information technology by integrating their conventional management skills and technical literacy. Dutch scholar Huvila (2014) defined informatization leadership as a leader's ability to guide members of an organization to undertake informatization construction activities and to make accurate decisions regarding the application and management of information resources and equipment.

Understand information technology leadership from the perspective of the leadership process: Avolio et al. (2010) believed that information leadership is a process in which individual members or organizations change their ideas, values, attitudes, emotions, behaviors, or performance under the influence and promotion of information technology. Watson (2016) believed that the chief executive of an information system (CIO) establishes the organization's information development direction and creates commitments, mobilizes and coordinates resource allocation in terms of policy, system, and psychology to promote the implementation of information vision planning, and responds to environmental changes by adjusting information system modules. To realize the common goal of the information development of the organization. Northouse (2020) defined information leadership as a complex social process in which leaders influence subordinates through information means to achieve the entire organization's goals.

Knowing information technology leadership from the perspective of constituent elements: Chen & Preston (2007) argued that the informatization development strategy must conform to an organization's overall development strategy; therefore, leaders must have the ability to conduct informatization planning and make strategic

decisions. Harvard Business School professor Applegate & Elam (1992) argued that leaders' role in promoting, managing, and controlling information construction is indispensable. From a problem-solving perspective, Jablokow (2019) proposed that leaders should possess strong communication and coordination abilities, effective interdepartmental coordination, and the capacity to promote organizational adaptability when leading informatization construction.

Understand information technology leadership from the perspective of membership: Clarifying the connotation and extension of the relationship between "leadership" and "information leadership" is the logical starting point for further research on "information leadership" and "President's information leadership." In this regard, since the 1990s, many scholars in China and abroad have conducted extensive research on the influence of information technology on leadership and on the application of classical leadership theory in the information environment, yielding a series of findings. For example, Shamir (2015) noted that information technology provided leaders with an unprecedented ability to access information. On the one hand, it changes the leadership structure; on the other, it also changes the nature of leadership. Avolio et al. (2010) discussed the interaction between informatization and leadership. He believes that informationization provides a new environment for leadership. On the one hand, the interaction between informatization and leadership reshapes the leadership structure; on the other hand, it also promotes the application of information technology in management and underscores that informationization leadership is the product of this two-way interaction.

Drawing on research by scholars on the relationship between "leadership" and "information leadership," this study argues that "information leadership" is a new form of leadership derived from integrating "information" elements into work content within the context of informatization. From the perspective of membership alone, "information leadership" is the extension and development of "leadership" within the information context; in a sense, "information leadership" is a subordinate or derivative concept of "leadership".

Digital Leadership

In the literature, several terms refer to the new leadership style required in the digital era, with little to no difference in meaning, including technology leadership, e-leadership, leadership 4.0, and virtual leadership. Digital leadership is an umbrella term encompassing leadership models that aim to integrate digital technologies into organizational functioning and improvement (Karakose et al., 2022). In this study, digital leadership is defined as a school-level leadership construct that integrates leadership skills with digital competencies to establish digitally enabled schools that are responsive to a rapidly changing digital environment. As an innovative, change-oriented, and team-based leadership model, digital leadership is not only about using ICT or digital technologies in performing leadership functions at school but comprised several significant elements such as possessing particular leadership skills and qualities, providing professional development and support, establishing a digital-friendly culture, developing positive relationships, enabling systemic and structural improvement (Hamzah et al., 2021). The digital transformation of schools can be achieved by aligning the school's goals, vision, governance, structure, decision-making processes, values, culture, and climate with the new circumstances

(Eberl & Drews, 2021). In this process, certain qualities of digital leaders come to the fore in the realization and maintenance of this transformation. As defined in the literature, successful digital leaders are adaptable, open to new ideas, resilient, and agile, and are willing to explore and master new skills and knowledge of the latest technologies (Shin et al., 2023). Using these skills, digital leaders adapt to the fast-changing technology and innovation and promote the effective integration of these technologies into the teaching-learning environment through modeling and professional support (Hamzah et al., 2021).

According to a recent study by Karakose et al. (2021), digital leaders are good at using digital technologies, supporting digital transformation and technology-based professional development, building a digital learning culture, and employing leadership skills to optimize the benefits of digital technologies for learning. Similarly, Sheninger (2022) asserted that digital leadership is enacted in schools based on seven pillars: communication, public relations, branding, professional growth and development, student engagement and learning, learning environments and spaces, and the discovery of opportunities. Accordingly, in the digital era, establishing new communication channels through social media helps convey the school's mission to stakeholders, build professional partnerships, and construct a better understanding of the school. Thus, school leaders could enhance public relations and achieve successful school branding by cultivating a positive image among diverse school stakeholders. According to Sheninger (2022), social media can promote teachers' professional development by fostering professional learning communities in which teachers interact and exchange ideas with colleagues worldwide on using the latest technologies to benefit their students. This would undoubtedly enrich their experiences with technology, offer them new ways of thinking and acting, and support their confidence in using new technologies. By enhancing teachers' digital capabilities and enabling collaboration, digital leaders support schools' improvement and better functioning (Shin et al., 2023). The fifth pillar of digital leadership builds on student engagement and learning, aiming to equip students with the most up-to-date knowledge and competencies in digital technologies. This certainly requires establishing a learning environment and spaces around a shared vision that regards technology as the central component of teaching and learning, and equipping schools with the latest digital resources.

Finally, Sheninger (2022) suggested that digital leadership necessitates developing strategic partnerships with organizations outside schools, such as other schools and learning centers, universities, and corporate institutions, to identify new possibilities and opportunities and to form collaborations for innovative projects. He asserted that digital leaders are to "become more knowledgeable about society and look for opportunities to connect the real world to an educational system clinging to preparing students for an industrialized workforce that is no longer needed". As the above elements make clear, digital leadership is transformational and visionary, aiming to build an innovative school vision that can be updated rapidly in line with emerging opportunities, and to alter the culture and functioning of schools to align with the requirements of the digital era. As a result, scholars often cite transformational and visionary leadership as integral components of digital leadership (Karakose et al., 2022). Digital leaders serve as role models and initiators of digital transformation by continually upgrading their digital competencies and encouraging

teachers and students to do the same (Hamzah et al., 2021). Thus, they can build a schoolwide culture around the willingness and ability for change, an open and collaborative atmosphere reliant upon the transparent flow of information, self-responsibility, and proactive behavior, as well as work environments that are flexible enough to experiment with innovative technologies (Oberer & Erkollar, 2018; Shin et al., 2023).

Therefore, transformational leadership is integral to successful digital leadership (Amelda et al., 2021). On the other hand, the International Society for Technology in Education (ISTE) (2018) defines digital leadership as 'visionary leadership' in their Standards for Administrators, stating that, in the digital era, school leaders "inspire and lead development and implementation of a shared vision … of purposeful change that maximizes the use of digital-age resources to meet and exceed learning goals, support effective instructional practice, and maximize performance of district and school leaders", "engage in an ongoing process to develop, implement and communicate technology-infused strategic plans aligned with [this] shared vision … to create, promote and sustain a dynamic, digital age learning culture that provides a rigorous, relevant and engaging education for all students". Several researchers assert that digital leaders must be visionary to serve as role models for school staff and to provide effective mentoring that promotes their talents (Eberl & Drews, 2021). Visionary school leaders are more capable of optimizing the use of digital resources in school and fostering the effective integration of technology into the classroom (AlAjmi, 2022), and visionary leadership enacted through building an integrated technology vision and a technology plan to support all actors and stakeholders could be a significant sign of digital leadership in school (Zhong, 2017). By planning and implementing such a vision, digital leaders strive to pursue educational goals that are rapidly shaped by the digital environment surrounding schools (Shin et al., 2023).

Leadership is the capacity to guide a firm toward achieving its objectives and establishing a sustained competitive advantage. To maintain a sustainable competitive advantage, firms must possess technical products and systems that accelerate and enable production, communication, and cost reduction, and use these products and systems optimally (Uğural et al., 2020). In summary, firms must embrace digitization. To achieve sustainable, effective, and efficient digitalization, a robust digitalization plan requires leaders who can guide employees toward its implementation. The concept of a digital leader has become critical to determining an organization's ability to achieve its digitalization goals. Because this notion is often used interchangeably with e-leadership, its first appearance is attributed to Avolio et al. (2010). However, Fisk (2002) pioneered the concept of "digital leadership," distinct from e-leadership, as the focus of rigorous research. According to Fisk (2002), digital leaders are visionary motivators of change, capable of combining ideas within the business for projects and establishing connections by creating new opportunities for partnerships/joint ventures/outsourcing, and other forms of collaboration. The Upper Echelons Theory serves as the foundation for digital leadership. According to this idea, managerial background characteristics make organizational results (strategic choices and performance levels) more predictable. (Hambrick & Mason, 1984). As a result, it is claimed that organizations led by individuals who exhibit the attributes necessary for digital leadership are likewise digital. According to the definitions of Digital Leadership, Avolio et al.'s (2010) research on e-leadership is regarded as the "Concept

of Digital Leadership." According to Avolio, digital leadership is a "process of social transformation in which advanced information technology mediates to affect individuals, groups, and/or organizations' manners, attitudes, emotions, thoughts, and behaviors".

Fisk (2002) discussed the relationship between digital and transformational leadership. According to Fisk (2002), a digital leader is imaginative, pushing for change, capable of uniting the organization's ideas and objectives, and connecting firms through partnerships/joint ventures/outsourcing and creating new opportunities for them (Fisk, 2002). Wilson III (2004), by contrast, asserted that a digital leader is defined by their leadership in the fundamental sectors of the information society (information processing, communication, broadcasting, publication, and multimedia) and by their contributions to the information society's transition. The leadership established by Duan (2005) defines the fundamental fields of information technology (internet service providers, internet content providers, internet application providers, and other technology-based areas such as data processing, communication, and content). Kurubacak's (2006) perspective on digital leadership centers on digital leadership's role in social activism. He defines digital youth leadership as "vigorously preserving the power partnerships necessary for their purposes, respecting democratic practices that include citizens, appearing consistent for their policies to be represented, and playing autonomous roles for their online interactions." Borins (2010) examined digital leadership from a political perspective, examining former US President Obama's actions in the virtual world and concluding that a digital leader is a composite of channel selection (Virtual World), IT procurement, and organizational integration of ITs.

Sheninger (2022) discussed the digital leadership style required in education, stating that digital leadership is "capable of determining the direction, influencing others, and initiating sustainable change through information gathering and networking to anticipate the necessary changes for the school's future success." In his research, Altinay (2016) defined digital leadership as the capacity to follow current technology to reconstruct knowledge according to its fundamentals. Van Wart et al. (2017) stated that digital leadership is synonymous with e-leadership and the ability to effectively select and use information communication technologies to accomplish personal and organizational goals. In his research on Pope Francis's social media practices, Narbona (2016) defined digital leadership as a leadership style employed through digital means in the virtual world. According to Larjovuori et al. (2016), digital leadership is the capacity to identify and develop the skills and talents necessary to engage all people in the business in digitization. According to El Sawy et al. (2016), who researched the LEGO Company's digital transformation, digital leadership involves "demonstrating the appropriate behaviors for businesses and business ecosystems to digitalize strategically".

According to Zhong (2017), digital leadership entails leading and inspiring digital transformation, establishing and maintaining a digital learning culture, facilitating and enhancing professional growth through technology, and providing and sustaining a digital organization. Oberer & Erkollar (2018) analyzed the traits leaders should possess throughout the Industry 4.0 era and concluded that digital leaders are agile, cross-hierarchical, team-oriented, and embrace a collaborative approach with a

strong emphasis on innovation. Tanniru (2018) defined digital leadership as a process that requires agile IT and business architecture to bring ideas to life rapidly and to improve and sustain an innovation culture. According to Stana et al. (2018), digital leadership is a social influence process facilitated by technology that can occur at any organizational level and is intended to affect an individual's, group's, or organization's attitude, emotion, thinking, behavior, and performance. Despite widespread belief, Mihardjo et al. (2019) argued that digital leadership is a product of digital culture and skills. According to Antonopoulou et al. (2021), digital leadership entails achieving goals related to information and communication technologies while balancing human resources and their utilization.

Schiuma et al. (2021) examined the capabilities that leaders should possess regarding digital know-how in the present digital age. Finally, Peng (2023) stated that individuals or organizations in the digital age can transform teams, entire organizations, and employees into digital thinkers by leveraging digital insights, decision-making, implementation, and guidance to ensure their goals are met. He characterized digital leadership as "the capacity to influence people to embrace it."

Table 2.2 Literature Review of the Definition of Digital Leadership

Author	Year	Type	Definition	Keyword	Element
Avolio et al.	2010	Research Paper	Stage of social change mediated by Advanced Information Technology to produce a change in attitude, emotion, thought, behavior, and/or performance with individuals, groups, and/or organizations.	e-leadership, information technology	Information Technology, Social Change
Fisk	2002	Research Paper	Visionary, motivating for transformation, combining ideas within the organization for initiatives, connecting partnerships/joint ventures/ outsourcing and all collaborations by creating new possibilities.	Digital Transforma-tion	Vision, Transformat-ion Connection, Unity
Wilson III	2004	Book Chapter	Leadership in the essential sectors of the Information Society and its contributions to the transition to the information society.	Transforma-tional Leadership	Information Society, Leadership
Duan	2005	Thesis	Leadership in key sectors of information technology (internet service providers, internet content providers, internet application providers, and other technology areas such as computing, communications, and content).	Digital Leadership,	Information Society, Leadership

Author	Year	Type	Definition	Keyword	Element
Kurubacak	2006	Research Paper	Maintaining strong partnerships of power sufficient for their purpose, respecting civic and democratic practices, ensuring that their policies are ostensibly consistent so that they can be represented and play independent roles in their online interactions, interacting with multicultural unions, and engaging with various inquiries into the complex nature of digital youth leadership. It is a form of leadership that is tasked with representing the diversity of its ideologies.	Information society	Online interaction
Borrins	2010	Book Chapter	A leadership style with a mix of channel (Virtual World) selection, IT (Information Technology) procurement, and organizational integration of ITs.	Leadership	Information Technologie -s, Virtual World, Integration
Sheninger	2022	Research Report	Establishing relationships to set direction, influence others, and initiate sustainable change through access to information and anticipating changes necessary for future school success.		Sustainable Change, School Success
Altınay	2016	Research Paper	Managers defined digital leaders as organizers who follow modern technology to reconstruct knowledge.	China, Leadership,	Information, Modern Technology
Van Wart et al.	2019	Research Paper	Ability to effectively select and use information communication technologies to achieve personal and corporate goals.	Information Technology, Information Technology Leadership	Information Technologies, Goals
Narbona	2016	Research Paper	Leadership style applied with digital tools in the virtual world.	Digital Youth Leadership, Politics, Social Media, Social Activism,	Digital Tools, Virtual World, Leadership

Author	Year	Type	Definition	Keyword	Element
Larjovuori et al.	2016	Conference Paper	The ability to involve all organization members in digitization and recognize and develop the skills and abilities needed to achieve it.	Online interaction	Digitization, organization,
El Sawy et al.	2016	Research Paper	To strategically exhibit the right behaviors to ensure the digitalization of the business and business ecosystem.	Information Technologies, Social Media, Politics, Digital Leadership	Right Behaviors, digitalizatio -n
Oberer & Erkollar	2018	Research Paper	A fast, cross-hierarchical, team-oriented, and collaborative approach with a strong focus on innovation.	Digital management	Innovation, team oriented, speed
Tanniru	2018	Book Chapter	A process is necessary to develop and sustain a culture of innovation by rapidly translating ideas into practice through agile Information Technology and business architecture.	Knowledge construction	Innovation, business architecture, Information Technology
Stana et al.	2018	Conference Paper	A process of social influence mediated by technology that can occur at any hierarchical level in an organization and bring about a change in attitude, emotion, thought, behavior, and/or performance in individuals, groups, and/or organizations.	Leadership	Technology, Social Impact
Mihardjo et al.	2019	Research Paper	A combination of digital culture and digital competence.	Technology-assisted learning	Digital Culture, Digital Competence
Antono-poulu et al.	2021	Research Paper	To reach a goal related to information communication technologies that is in line with the use of human resources and information communication technologies.	E-leadership , ICT adoption, Government ICTs	Information Communica -tion technologies
Schiuma et al.	2021	Research Paper	The competence that leaders need to develop in today's digital age.	Digital Leadership, Pope Francis, Transcendent Leadership, Twitter	Digital Age, Competence

Author	Year	Type	Definition	Keyword	Element
Peng	2023	Research Paper	In the age of digital technology, individuals or organizations can guide teams, entire organizations, and employees to fully embrace digital thinking, using digital insight, decision-making, implementation, and guidance to ensure their goals are met.	Digital Leadership, Digitization, Organization, Digital Competence, Employee Welfare	Digital Thinking

Based on Table 2.2, the elements in the definitions of digital leadership can be identified and summarized through content analysis and frequency statistics. The top 10 are apparent (See Table 2.3): Information Technology Quality, Digital Vision, Transformation, Leadership, Innovation, Integration, Digital Culture, Digital Tools, Digital Thinking, and Digitization Assurance.

Table 2.3 Top 10 Elements of Digital Leadership from the Definitions

Element	Frequency	Element	Frequency
Information Technology Quality	9	Right Behaviors	1
Social Change	2	**Innovation**	7
Digital Vision	7	Team Oriented	1
Transformation	6	Speed	1
Connection	1	Business Architecture	1
Unity	2	Social Impact	1
Information Society	2	**Digital Culture**	9
Leadership	8	Digital Governance	3
Online Interaction	1	Information Communication	1
Virtual World	2	Digital Age	1
Integration	8	**Digital Thinking**	8
School Success	1	**Digitization Assurance**	7
Goals	1	**Digital Tools**	6

Digital Leadership of Primary School Principals

As human society enters the digital age, information technology has evolved to encompass technologies such as blockchain, big data, and artificial intelligence. New concepts such as digital society, digital government, and digital governance are transforming leadership activities and require leaders to use digital technologies to enhance the effectiveness of organizational operations. Therefore, “digital leadership” is proposed as a derivative of “information leadership.” El Sawy et al. (2016) defined “digital leadership” as a leader’s ability to accurately predict the success of the enterprise’s digital strategy and business ecosystem. Van Wart et al. (2019) defined “digital leadership” as a leader’s ability to accurately recognize and respond to

changes in the digital environment and to integrate digital and traditional technologies to improve organizational performance.

It is evident that scholars still primarily define “digital leadership” from the perspective of “competence theory”. The main differences between IT and “information leadership” are as follows: “Information leadership” generally focuses on leaders using information technology to play an intermediary role, while “digital leadership” requires leaders to perceive the changes in the digital environment and cultivate their own and employees’ digital thinking ability; “Information leadership” applies to leaders’ application of technology in the field of information work, while “digital leadership” applies to the field of digital governance, requiring leaders to actively adapt to and promote the all-round and multi-domain digital transformation of organizational form, structure and function. Therefore, “digital leadership” is necessarily based on “digital quality” but above “digital quality.” The so-called “digital quality” refers to people’s ability to understand, master, and use digital technologies in life and work (Tong et al., 2024), including four aspects: digital awareness, computational thinking, digital learning and innovation, and digital social responsibility. “Digital Leadership” requires that leaders not only possess digital competence but also the ability to use digital technologies to lead organizational members in achieving the organization’s digital transformation and development goals.

Based on the above analysis, this study defines “digital leadership of primary school principals” as: Based on digital quality, the principal of primary schools can perceive the changes in the digital environment of education and formulate the vision for the digital development of the school, make comprehensive use of digital technology and traditional technology, lead the staff and other stakeholders to change the way of thinking and the results of behavior, promote the digital transformation of the school, and achieve the goal of campus digital construction and high-quality development of the school (Zhang, 2023).

Specifically, in today’s digital age, primary school principals should demonstrate this kind of “digital leadership” in at least three aspects: First, to demonstrate and lead the formation and development of digital quality among faculty, students, parents, and other stakeholders; The second is to make good use of digital technology to realize the digital transformation of the school and achieve the goal of campus digital construction to play the role of planning and coordinating and promoting the implementation; The third is to play the role of a firm leader and a comprehensive coordination organizer in the fundamental goal of achieving the high-quality development of school education and the harmonious and comprehensive development of teachers and students’ physical and mental health through the construction of digital schools (Zhang & Xue, 2023). In this way, primary school principals not only need “digital leadership” to meet the educational challenges of today’s digital age but, more importantly, fully recognize the educational development opportunities embedded in digital challenges and consistently link digital transformation to the educational functions that schools must adhere to and achieve. Digital technology is always in the service of the healthy and comprehensive development of teachers and students. This shows that achieving the harmony and unity of digital technology and human development is the core value pursuit of

"digital leadership" that today's principals should possess, and it is precisely this core value pursuit that makes it different from the "digital leadership" that leaders in other fields should possess (See Table 2.4).

Table 2.4 Core Elements in the Definitions of Digital Leadership of Primary School Principals

Author	Year	Definition	Core Element
El Sawy et al.	2016	The leader's ability to make correct predictions for the enterprise's digital strategy and the success of the business ecosystem.	Make correct predictions, digital strategy
Van Wart et al.	2019	The leader's ability to accurately identify changes in the digital environment and to effectively integrate digital and traditional technologies to improve organizational performance.	Digital environment changes, digital technology, and organizational performance
Tong et al.	2024	"Digital leadership" is necessarily based on "digital quality" but above "digital quality." "Digital quality" refers to people's ability to understand, master, and use digital technologies in life and work.	Digital quality, digital technologies digital awareness, computational thinking, digital innovation, digital social responsibility
Zhang	2023	Based on digital quality, the principal of primary and secondary schools can perceive the changes in the digital environment of education and formulate the vision for the digital development of the school, make comprehensive use of digital technology and traditional technology, lead the staff and other stakeholders to change the way of thinking and the results of behavior, promote the digital transformation of the school, and achieve the goal of campus digital construction and high-quality development of the school.	Digital environment, digital vision, digital thinking, digital transformation, digital governance, results of behavior
Zhang & Xue	2023	To demonstrate and lead the formation and development of digital quality among faculty, students, parents, and other stakeholders; To make good use of digital technology to realize the digital transformation of the school and achieve the goal of campus digital construction to play the role of planning and coordinating	Digital technology, planning and coordinating digital technology digital vision, digital assurance

Author	Year	Definition	Core Element
		and promoting the implementation; To play the role of a firm leader and a comprehensive coordination organizer in the fundamental goal of achieving the high-quality development of school education and the harmonious and comprehensive development of teachers and students' physical and mental health through the construction of digital schools.	

Table 2.4 clearly shows the core elements of the definitions of digital leadership for primary school principals: Digital technology, Planning and coordination, Digital vision, Digital assurance, Digital governance, Digital quality, and Digital strategy.

The Related Evaluation Criterion

All roles and responsibilities should have clear standards and a scientific framework for evaluation, and the principal's information leadership is no exception. Educational institutions and organizations worldwide have researched and formulated corresponding standards of informatization leadership, which provide an important basis for evaluating and training informatization leadership of principals in various countries. The International Society for Technology in Education in the United States developed the National Educational Technology Standards for Administrators (NETS-A) in 2009, the most widely used and influential standard in schools. In addition, the United Kingdom, Australia, and other countries have studied and formulated corresponding informatization leadership standards, which are discussed in detail below.

In 2002, the International Educational Technology Association (ISTE) launched the first edition of the National Educational Technology Standards for Administrators (NETSA), which has not only been widely used in the United States but also triggered the formulation and interpretation of educational information standards and has become an important guide for educators to improve education and teaching. The unprecedented development of modern information technology poses a new challenge for educational administrators. To this end, ISTE consulted extensively and developed NETS-A Version 2 and NETS-A Version 3 in 2009 and 2018, respectively; the specific dimensions of these versions are shown in Table 2.5.

Table 2.5 ISTE National Educational Technology Standards for Administrators

Standard	Year	Dimension
	2002	Leadership and Vision
		Teaching and Learning
		Work efficiency and professional practice
		Assurance, management, and operation
		Evaluation
		Social, legal, and ethical issues

Standard	Year	Dimension
ISTE National Educational Technology Standards for Administrators	2009	Vision leadership
		Learning culture in the digital age
		Excellence in professional practice
		Systematic improvement
		Digital citizen
	2018	Equity and civic advocates
		A visionary planner
		Empowered leader
		System designer
		Connected learner

NETS-A (2002 edition) puts forward six dimensions of standards for leaders, which emphasize the traditional application and management ability of leaders, focus on mastering and applying information technology to lead teaching and learning, and evaluate teaching and management, pay attention to the social morality and legal system of information technology application, and require teachers and students to learn information technology together. Embodies the concept of "technology first". NETS-A (2009 edition) condenses the standards for managers into five dimensions, focusing on how managers use technology to carry out top-level design and emphasizing the importance of managers in promoting digital technology learning, culture innovation, and school systemic change in the intelligent era. This represents "a critical shift in NETSA's design philosophy from focusing on technical rationality to focusing on people themselves" (Li & Zhang, 2022). As education informatization in the United States enters the stage of innovative development, NETS-A (2018 edition) updates "education administrator" to "education leader," reflecting a shift in the focus of education standards. Compared with educational management, educational leadership must make higher-level decisions, not only to ensure the implementation of routine work. The idea behind this standard is to emphasize interaction, collaboration, communication, and connection among people.

It has become an important trend in the development of international basic education to improve principals' professional competence and school quality. The National Standards for Principals, introduced by the UK Teacher Training Authority (TTA) in 1998 and reviewed by the National Institute for School Leadership (NCSL), elaborate on the core objectives, the main results of leadership, expertise, skills, and specialties, and the principal's main areas of leadership responsibility. After entering the 21st century, the Ministry of Education and Skills (DFES) revised and improved it and launched a revised version of the "National Standard for Principals" in 2004, which made specific provisions on six aspects of the key areas of the work of principals, and in each key area, respectively from the knowledge, attitude, ability and concrete action of the four major sectors.

Compared with the 1998 edition, the 2004 edition has a more transparent structure and greater real-world relevance, permeating the British government's reform proposals. As the quality of education in the UK has declined, public attitudes towards the head teacher's role have become increasingly hostile, prompting the

British government to pay closer attention to head teacher leadership. In 2015, the British government issued the "National Standard for Excellent Principals," which added the word "excellent" to the name compared with the 2004 version. The standard positioned the role of school principals as "supporting and promoting the development of school students and teachers" and defined excellent principals in four areas. This standard does not clearly define the responsibilities and requirements of principals within the school governance system and applies only to exemplary principals. Hence, the British Ministry of Education launched a review of standards for principals in 2019 and, in 2020, formulated the "Standards for Primary and Secondary School Principals (2020)" based on opinions collected from all parties. This standard contains two significant contents. The first part outlines the moral character and professional ethics principles that should be possessed, which is the core part. The second part lists ten codes of conduct that principals should abide by. The first six are based on teacher standards, while the last four focus on the principal's management function. The principal is not only a professional who lead and managed the school but also a model for the school and the community it serves. The 2020 edition of the Standard enriches the connotation of the principal and makes precise and detailed regulations on the principal's behavior (See Table 2.6).

Table 2.6 Editions of the UK National Standards for Principals

Edition	Year	Content
National Standards for Principals	1998	Plan the future direction of the school Lead teaching and learning Manage employees Resource Accountability
	2004	Plan the future of the School Lead teaching and learning Self-development and cooperation with others Management organization Get support and fulfill responsibilities Strengthen cooperation with the community
National Standard for Excellent Principals	2015	Knowledge and accomplishment Teacher and student System and procedure A self-improving school system
Standards for primary and secondary School Principals	2020	Ethics and professional conduct: The Nolan Principles High Standards and Professional Conduct, Public trust in school leadership The school community and professional leaders

Edition	Year	Content
		Management behavior standard: School culture Teaching and learning Curriculum and Evaluation Behavior for Students with Additional Special Educational Needs and disabilities: Professional Development Organization Management Continuous school improvement Using partnerships for work Governance and accountability

In response to the opportunities and challenges posed by educational informatization, the Australian government is committed to building a high-quality team of teachers and school leaders to ensure that students receive high-quality education. In 2008, Australia began developing national leadership standards, and in 2011, the Australian Professional Standards for Principals were officially released (Altinay, 2016). This content comprises a plan and actions, evaluations, and reflections on three professional practice cycle models. The model framework emphasizes the key role of principals in school education, requiring them to have a clear understanding of the school's vision, possess high personal qualities, and lead the school's innovative development to achieve the goal of high-quality education. However, the language of this standard is more refined and lacks process guidance, which is not conducive to understanding the specific content of the front-line principals. It is challenging to implement in the actual leadership process, and the application is limited. To this end, the Australian Institute of Teaching and School Leadership has developed the Principal Leadership Framework (Altinay, 2016), translating professional standards for principals into actionable, implementable, and measurable leadership behaviors. Guided by leadership theory, the outline analyzes the nature and complexity of the principal's role. It constructs a model for the principal to achieve behavioral change, from awareness to attitude, knowledge, and action, and ultimately to behavior change. At the same time, the outline constructs a framework with three core lenses, including leadership practice, leadership requirements, and leadership priorities; each specifies the leadership behaviors that principals need to implement. This outline can help principals engage in self-reflection, promote professional growth, and provide a clear standard for educational administration departments to select, hire, test, and evaluate principals, as well as a development framework for training future excellent principals (See Table 2.7).

Table 2.7 Editions of the Australian Professional Standards for Principals

Edition	Year	Content	Dimension
		Leadership claims	Vision and Values Knowledge and understandings Personal qualities, social and interpersonal skills

Edition	Year	Content	Dimension
Australian Professional Standards for Principals	2011	Professional practice	Leadership teaching and learning Develops self and others' leadership for improvement, innovation, and change Lead the school management. Engage and work with the community.
The Outline of President's Leadership	2014	Leadership practice	Leadership teaching and learning Develops oneself and others, Leadership for improvement, innovation, and change Lead School management engagement Collaboration with the community
		Leadership requirement	Vision and values Knowledge and understanding Personal literacy, social, and interpersonal skills
		Leadership focus	Operating, relational, policy, system

The Related Influencing Factors

International scholars have systematically studied the issues related to the principal's information leadership practice. Navaridas-Nalda et al. (2020) analyzed the key elements of the digital transformation of schools, focusing on the strategic use of digital resources for teaching, from a strategic teaching perspective, with particular attention to principals' digital leadership. they tested 142 Spanish principals. The principal's use of digital resources was the most influential variable in the digital transformation of schools, alongside school background, principal's major, and leadership experience. To assess the development of information leadership among elementary school principals across the six areas of NEST-A, Grey-Bowen (2010) surveyed 103 elementary school principals in Miami. The results showed that principals performed best in productivity and professional practice and worst in information technology, particularly in teaching, management, and evaluation. The survey also showed that principals generally believe that the most important areas in NETS-A are leadership and vision, the areas most needed for further development and enhancement, followed by social, legal, and ethical, and the least important is assessment.

Karakose et al. (2022) conducted a study on the informatization leadership of primary and secondary school principals in some areas of Istanbul and found that the competency of principals in a particular dimension of informatization leadership is significantly related to their advanced ability, and principals with strong IT coordination ability perform better in the dimension of "teaching and learning." (Wei, 2024). Narbona (2016) conducted a survey and research on the informatization leadership of principals in Nebraska based on the six dimensions of NETS-A. The results showed that the respondents' level of informatization leadership was consistent with the National Educational Technology Standards for Administrators (ISTE, 2018). In addition to the empirical survey conducted directly with principals, Lin (2017) investigated the effectiveness of digital leadership communication and cooperation in supporting primary and secondary school students in implementing national college and career standards, using data from 254 public school teachers in five Mississippi school districts. Principals are most effective in supporting professional development and digital citizenship, while teacher age and teaching performance influence the effectiveness of principal digital leadership strategies. To determine the relationship between principal information leadership and teachers' technology integration. Thannimalai & Raman (2022) used a systematic random sampling approach to select 90 principals and 645 teachers and administered a survey to principals using the ISTE-A (2009) and technology experience. A survey of teachers measuring the use of ICT in curriculum tools reveals a significant relationship between principal IT leadership and teachers' technology integration. In addition, professional development significantly affects the relationship between these two variables; therefore, ICT professional development for principals is needed to support them in becoming technology leaders and to motivate teachers to integrate technology into the classroom (See Table 2.8).

Table 2.8 Summary of Related Influencing Factors of Principal Digital Leadership

Author	Main Content	Influencing Factor
Navaridas-Nalda et al. (2020)	Analyzed the key elements of the digital transformation of schools using digital resources for teaching from a strategic teaching perspective.	Digital resources, school background, principal's major, and leadership experience.
Grey-Bowen (2010)	Determined the development level of information leadership among elementary school principals in the six areas of NEST-A.	Productivity and professional practice, leadership, and vision.
Karakose et al. (2022)	A study on the information leadership of primary and secondary school principals in some areas of Istanbul.	IT coordination ability, teaching, and learning.
Narbona (2016)	A survey and research on the information leadership of principals in Nebraska based on the six dimensions of NETS-A.	ICT professional development, teachers' technology integration.

Author	Main Content	Influencing Factor
Lin (2017)	Investigated the effectiveness of digital leadership communication and cooperation in supporting primary school students in implementing national college and career standards.	Support professional development and digital citizenship, teacher age, and teaching performance.

From Table 2.8, the factors influencing the development and enhancement of digital leadership among primary school principals primarily comprise three aspects: guidance from the national digital development strategy and intelligent technology innovation, the driving force of principals' major, leadership experience, vision, professional practice and the practical demands for improving principals' digital literacy and teachers' teaching performance.

Foreign academic research on principal information leadership began earlier, and its conceptual connotations, evaluation criteria, influence factors and empirical research are relatively well developed. Therefore, further combining, synthesizing, and reflecting on their theoretical achievements and practical experience will significantly advance the development of Chinese digital leadership in primary schools.

2. Chinese Research on Digital Leadership

With the proposal of the education digital development strategy, education informatization has entered the digital stage, and digital leadership by principals has become a new era's direction and a key capability for principals to address the digital development of school education. Before that, most scholars focused on the theory and practice of principal information leadership. Based on this, in order to grasp the connotation and evolution of the digital leadership of principals and the characteristics of the times, this study used CNKI to search for "subject = 'Informatization leadership of principals' OR subject = 'informatization leadership of managers' OR subject = digital leadership of principals," and retrieved 121 relevant literatures. After manual screening, meeting notices, announcements, and other inconsistent literature were excluded, 117 types of literature closely related to the research theme were identified from 2015 to 2025.

The visual analysis software Cite Space was used to analyze keyword co-occurrence networks in this literature, and the top 14 keywords by frequency were identified. Based on the results and related literature, domestic research primarily focuses on four areas: the connotation evolution of informatization leadership, theoretical models, promotion strategies, and evaluation indices (See Table 2.9).

Table 2.9 Keywords of the Literature on Digital Leadership

Number	Keyword	Frequency
1	Informatization leadership	53
2	Principals	47
3	Educational informatization	33
4	Principal information leadership	27

Number	Keyword	Frequency
5	Primary and secondary school principal	15
6	Model construction	11
7	Informational	8
8	Promotion strategy	7
9	Information quality	6
10	Educational Informatization 2.0	5
11	School Informatization Leadership	4
12	Educational technology leadership	4
13	Information teaching leadership	3
14	Influencing factors	2

The Evolution of the Related Definition

In China, scholars and researchers often combine primary and secondary sources, so they are found in the literature simultaneously. Compared with foreign countries, research on the informatization leadership of principals in China started relatively late.

Principal Technical / Information Leadership

Xiao (2006) proposed the concept of "Principal technical leadership" for the first time in the paper "Overview of Research on Principal Technical Leadership." By combining, analyzing, and summarizing foreign research on school principal technical leadership and combining the definition of "leadership" by the American Association for Quality, it is pointed out that the principal's technical leadership is "a certain standard and accountability system for the use of technology established by the principal as the technology leader of the school." With the continued development of technology, the informatization of basic education has become an increasingly important focus of educational reform. Hu et al. (2007) argued that educational leadership is a core competence in education. As the direction of education shifts toward the macro strategic development of informatization, educational leadership become a research focus. Based on this, Wang et al. (2007) emphasized the importance of principal informatization leadership for the development of school education informatization. They pointed out that principals' informational leadership should have "information quality." Based on analyzing the contents involved in school informatization, Sun (2010) proposed in a general way that the principal's informatization leadership refers to the ability and wisdom of the principal or school manager to plan and build the vision of school education informatization development and influence and drive all teachers, students, and staff to realize the vision together.

Jiang (2010) pointed out that informatization leadership is not only the ability and behavior of the principal or senior administrative leader but also the collective's and the leaders' response under the principal's leadership. He emphasized that informatization leadership requires capable leaders and drawn on collective wisdom-using "decentralized" leadership to unite teachers and students in building and developing school informatization.

In addition to the “process theory” and “ability theory” mentioned above, Zhao (2017) examined the development of principal information leadership from the perspective of technology integration and regarded it as the product of the two-dimensional integration of technical and leadership abilities. Based on careful consideration of technical methods and leadership practices, composite leadership ability is developed through leadership planning, design, organization, implementation, evaluation, and promotion. Zhang (2021) discussed the composition of principal information leadership from a management process perspective and argued that it should include information technology management ability.

In 2022, China implemented a strategic digitalization initiative in education to advance the realization of educational digital transformation, and the connotations and structures of principal information leadership will inevitably change.

Qu & Gao (2022) pointed out that digitization empowered principals’ informatization leadership, indicating that digital leadership become an inevitable choice for advancing educational digitization. The professional characteristics of educational services in the intelligent era are prominent. Principals must go beyond treating technology as merely a tool and actively adapt to digital technologies, provide professional, innovative, and intelligent educational services across teaching, learning, testing, management, evaluation, research, and other areas, and ultimately realize the value of education.

Principal Digital Leadership

Qi et al. (2024) identified three connotations of principal digital leadership. Principal digital leadership is a form of leadership that has gradually emerged with the development of the digital age. Given the current state of digital development in China, principals’ digital leadership is at a critical juncture of transformation. It not only encompasses the thinking inertia formed over the past two decades of informatization but also imperceptibly integrates the unique behavioral logic of the digital age. Therefore, determining the era position of principal digital leadership is a key issue in analyzing its connotation.

Principal digital leadership is the manifestation of principal leadership in the digital age. Generally speaking, leadership is regarded as a collection of various traits, such as a leader’s ability, character, and values, and is a practical ability aimed at achieving collective demands, interests, or development. In the digital age, the “precision” and “customization” of the digital spirit resonate with the goal of high-quality education that pursues excellence and fairness.

Principal digital leadership is a unique form of digital leadership for the principal group. The term “leadership” originated in the field of enterprise management and was later introduced into school management. Unlike the binary structure of “leader-follower” in most enterprises, schools have a ternary structure of “leader (principal)-follower (teachers and other education staff)-beneficiary (students)”. In this structure, the principal is responsible not only for the school staff but also for student development, which is contrary to the management practices of most enterprises. Therefore, the role of “principal” cannot be equated with the general concept of “enterprise manager”.

Digital Leadership of Primary School Principals

Digital leadership for primary and secondary school principals refers to the ability and characteristics of school leaders to transform their own cognitive thinking and leadership approaches in the context of educational digital transformation, and to guide all teachers and students in the school to jointly achieve the school's digital development plan and individual digital growth goals (Qi et al., 2024).

Digital leadership refers to the key ability to perceive changes in the digital environment proactively, formulate the school's digital development vision, establish a digital governance framework for the school, lead the teaching team to carry out digital practices and assessment improvements, and ultimately aim at the development of digital literacy for both teachers and students in the context of the digital transformation of education (Ma et al., 2025).

The Related Development of Theoretical Models

Digital transformation of education is an important policy for national educational development, requiring principals to possess digital leadership. In promoting education informatization 4.0, researchers have made significant contributions and developed models to clarify the relationships among components and the roles they play. The following are the main theoretical models.

Sun (2010) divided the president's informational leadership into leadership power and personal influence. In the context of informatization leadership, the planning and construction of the school informatization system and the development of school informatization human resources are fundamental; the application and management of school informatization teaching are the core; and the experience summary and evaluation in the virtualization construction of school departments serve as the guarantee. The construction of school information culture is the goal of the principal information leadership. Personal influence encompasses many aspects, such as character and accomplishments, which are essential to principal information leadership (See Figure 2.2).

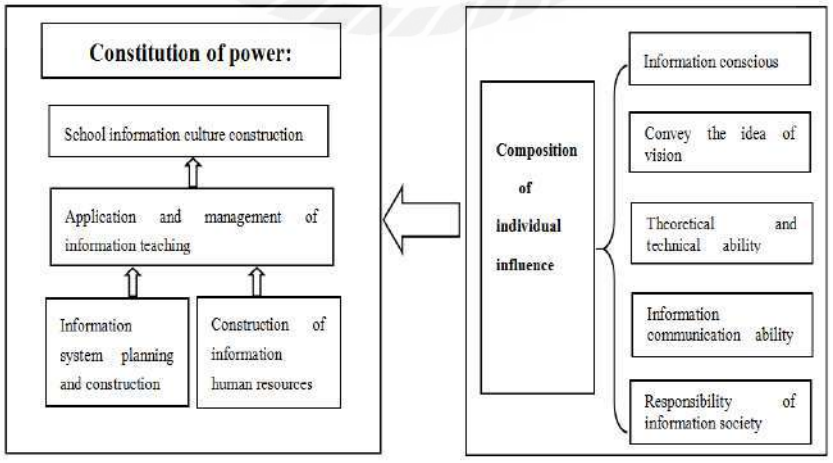

Figure 2.2 Development Model of Principal Informatization Leadership

From the organizational change perspective, Zhang (2021) first discussed the significant impact of information technology on organizations. In higher education institutions, he argues that IT is the only means for colleges and universities to advance in the information and societal domains by deepening their organizational change. On this basis, Zhang developed a theoretical model of information leadership for university leaders, focusing on the essential characteristics of its elements, relations, and structure.

According to the content, type, and stage model of organizational change, this study designs organizational change mediated by information technology across the three stages of thawing, reforming, and refreezing, and focuses on the capabilities college leaders need at each stage and their connotations (See Figure 2.3).

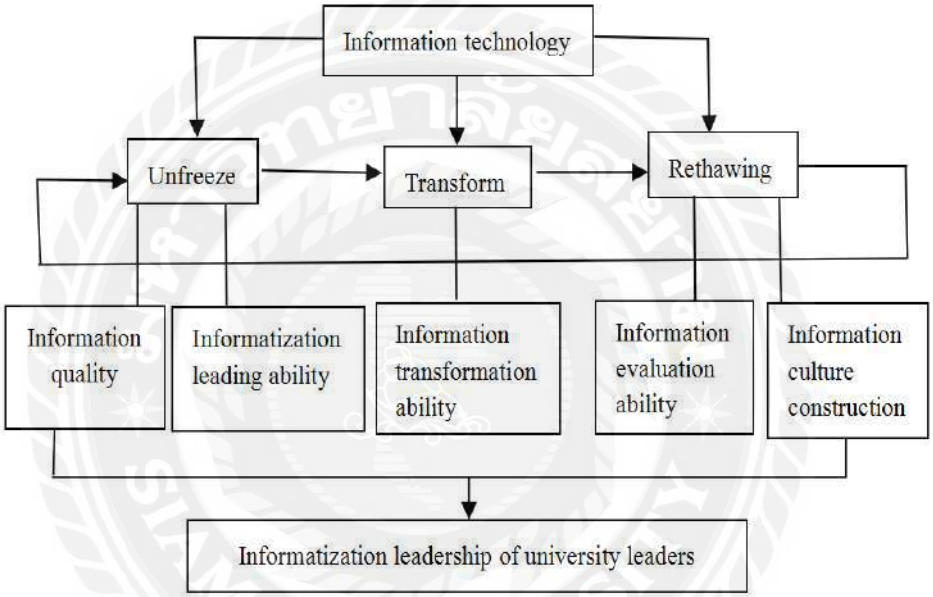

Figure 2.3 Theoretical Model of Informatization Leadership of University Leaders

Yang et al. (2019) focused on the principal information teaching leadership, believing that the principal's information teaching leadership includes the management and guidance of information teaching; that is, the process of the principal leading the development of information teaching is a stage of school education information construction, and the principal information teaching leadership is the next concept of the principal information teaching leadership. After establishing a foundation for constructing school information infrastructure and resources, the principal's information-teaching leadership must be carefully considered and studied first. Yang et al. (2019) summarized the standard points using an in-depth analysis of six leadership models. They developed a three-level model of principal informatization teaching leadership, comprising elements, leadership processes, and leadership behaviors, to address the requirements for principals' management responsibilities in the Standards for Informatization Leadership of Primary and Secondary School Principals (Trial).

Xiao (2009) explained principal's technical leadership from four dimensions: technology decision-making, management, service, and evaluation, based on the specific application of information technology in school education and teaching work (See Figure 2.4).

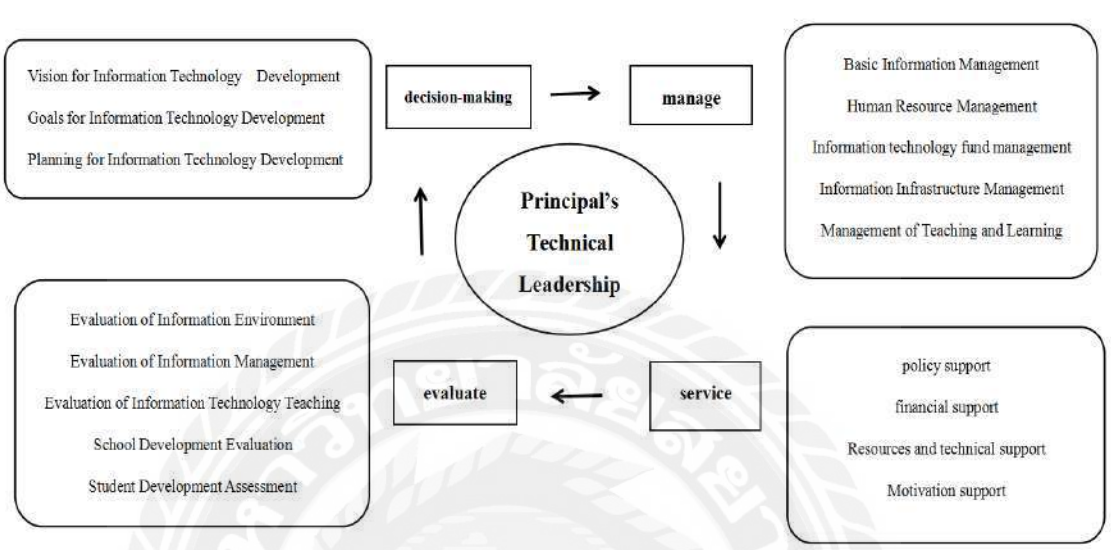

Figure 2.4 Dimensions of Principal's Information Technology Leadership Structure

Based on research findings on principal information leadership, Zhang (2019) constructed a structural model of principal information leadership in primary and secondary schools, comprising two dimensions: the composition of principal information leadership work and information quality (See Figure 2.5).

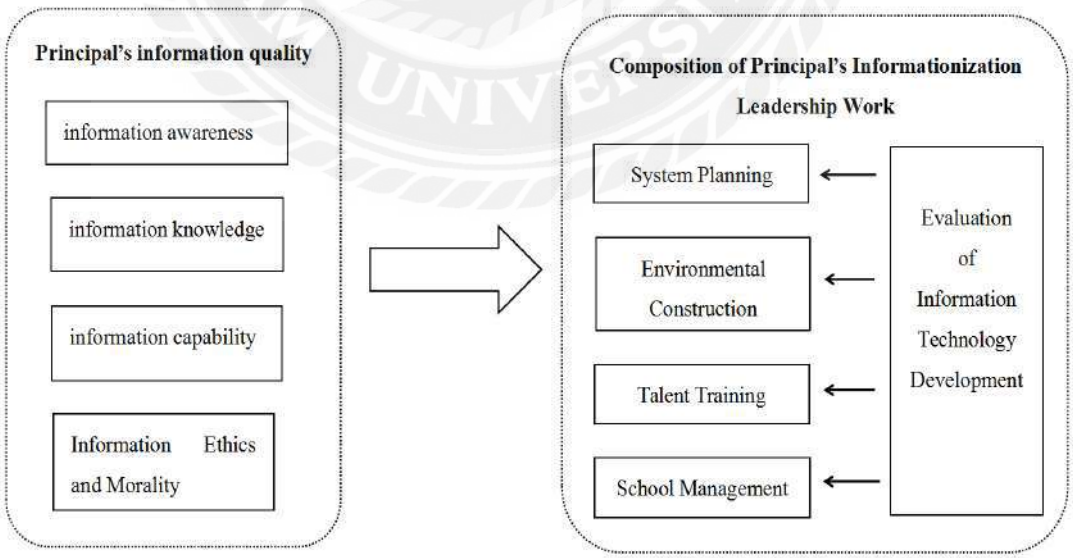

Figure 2.5 Principal's Information Leadership Structure Model

Shi (2013) pointed out in his article "Difficulties and Breakthroughs in the Development of Information Leadership of Primary School Principals from the

Perspective of Educational Modernization" that the information construction of schools is difficult to carry out smoothly without the strong leadership and support of principals, that the principal's information leadership mainly includes five aspects: technological awareness and attitude, technological planning and evaluation, technological theory and norms, technological knowledge and skills, and technological integration and application (See Figure 2.6).

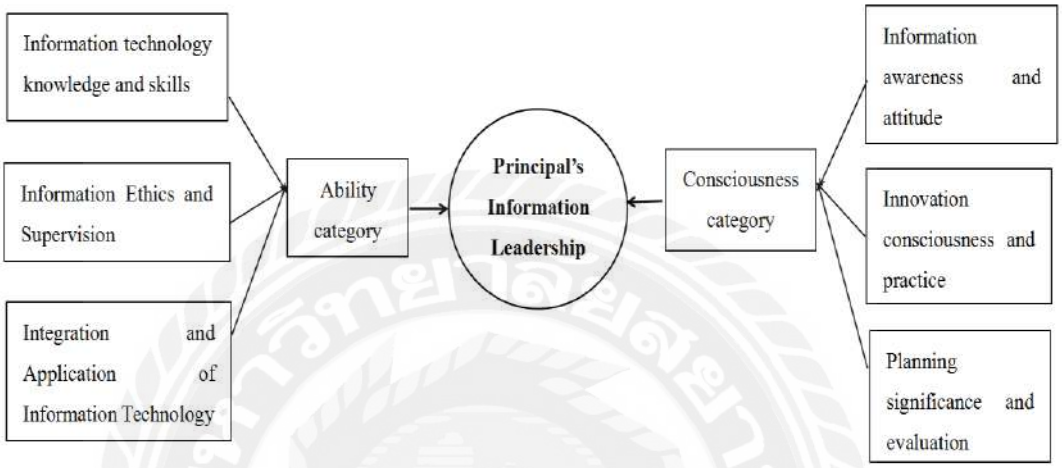

Figure 2.6 Composition of Principal's Information Leadership

Lei et al. (2021) argued that, in the era of educational information 2.0, the construction of educational information must reflect various educational concepts and the specific requirements of the country and society across various aspects of school information construction. Lei and others examined the macro-level development strategy of educational information, the promotion route, and the micro-level school information practice to construct a leadership structure model for principal information in the era of educational information 2.0 (See Figure 2.7).

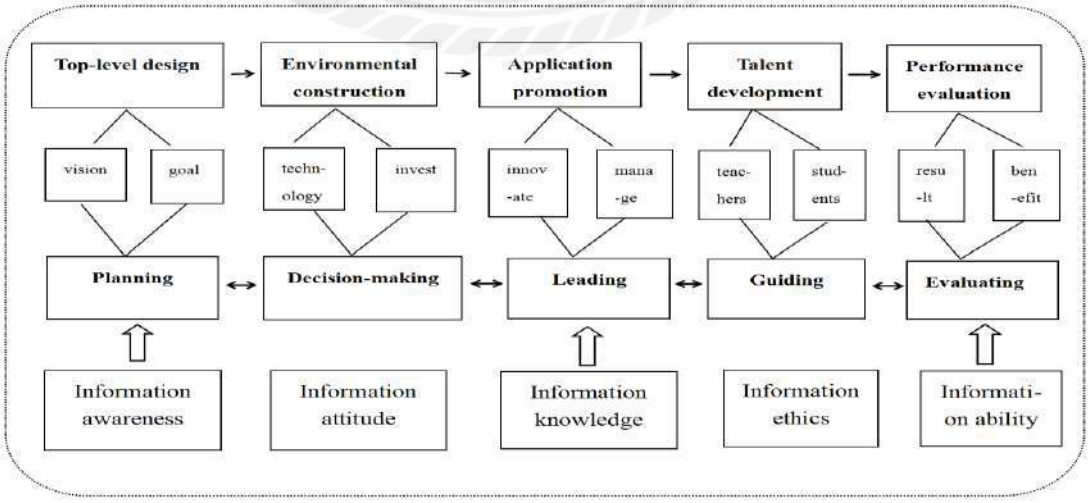

Figure 2.7 Leadership Model of Principal Information

The Promotion Strategy of Principal Digital Leadership

The explosive development of digital technology has triggered the digital transformation of education and has also put forward new requirements for the digital leadership of principals. How can principals improve their digital leadership to enable the high-quality development of school education and cultivate competitive talents? This has become an important issue for researchers to address. Reviewing the existing literature indicates that research on the strategy and path of promoting digital leadership among principals is roughly divided into two areas: theoretical elaboration and empirical investigation.

In terms of theoretical elaboration, Yin (2019) pointed out that decision-making power and executive power are the primary focus for improving principals' informatization leadership. They should not only understand the relevant standards of education informatization construction published at home and abroad, grasp the key points of school informatization construction at all levels, but also consider the overall informatization development direction of the school from the perspective of technology application, integrate data resources, and improve the quality of school informatization. We will promote reform and innovation in the education system. This research aims to decompose leadership, analyze its key elements, and propose strategies for improvement. Pan (2020), on the other hand, puts forward strategies for improving the leadership of principals in informatization from two aspects: internal and external factors, emphasizing that it is necessary not only to cultivate oneself and improve the awareness and ability to apply information technology, but also to actively participate in training and assessment, update ideas, and learn from each other's strengths. The principal's informatization leadership requires him to improve his personal qualities and abilities, and the education system should proactively adapt to the changes and developments of the information age. Sun & Tang(2023) discussed how to improve principals' informatization leadership from the perspective of technology change education. First, they emphasized that the application of information technology in education depends primarily on teachers' teaching processes. Therefore, principals should monitor the information quality of teachers and students and foster a sense of responsibility among teachers, students, and members of the management team. Second, principals should base themselves on the present, initiate change, strengthen cooperation and exchanges with the community and other schools, and achieve standard progress and development.

Li & Li (2017) analyzed and summarized the current situation and influencing factors of informatization construction in rural schools in western China, and based on the factors that affect the informatization leadership of rural principals, they constructed strategies for improving informatization leadership of rural principals, including "structure and reorganization," "crowdfunding and outsourcing," and "leading and exploring." With the significant impact of digital technology on social life, the digital transformation of education has become the trend of The Times. In this context, Qu & Gao (2022) argued that principal-level informatization planning should shift from technology-driven to education-driven, and that the objectives of informatization leadership planning should be grounded in comprehensive education. At the same time, it innovatively proposes to rely on intelligent technology to support home-school-community collaborative information education governance.

In an empirical investigation, Li Wenhong and Xiao Bei (Wei, 2024) surveyed first-line primary and secondary school teachers, junior middle school students, and parents using questionnaires and interviews. Through the feedback of teachers, students, and society on the informatization construction of principals, they analyzed and excavated existing problems, identified constraints, and put forward a targeted proposal of "improving the information feedback mechanism and establishing common goals: Strengthen information exchange and interaction, promote teacher-student collaboration; Strengthening teachers' self-decision-making mechanism" and other three feasible suggestions to improve the leadership of primary and secondary school principals. From the above suggestions, it is evident that this study emphasizes the important role of principal information leadership in shaping teachers' behavior, attitudes, and willingness to use information technology in teaching. Zhang (2021) employed a structural equation modeling approach to empirically examine the constructed model of university leaders' informatization leadership from the perspective of organizational change. He offers ten recommendations for presidents to improve informatization leadership across the three levels of government, universities, and individuals. It emphasizes the need to strengthen the requirements for the selection, appointment, and assessment of leading cadres. It indicates that evaluation is a key element in promoting the principal's information leadership.

Jiang & Zhang (2018) surveyed primary and secondary school principals in selected areas of Fujian Province. They propose improvement strategies for information quality, the communication and coordination capabilities of informatization, and the application and guidance capabilities, with a focus on the types of regular training for principal informatization leadership, including theoretical interpretation of the integration of information technology and disciplines. It is also necessary to conduct activities such as case analysis, practical problem-solving research, and one-on-one guidance by experts. In addition, other researchers have conducted numerous empirical investigations across different regions and proposed corresponding countermeasures.

The Related Evaluation Criterion

School education informatization is a systemic project, and school principals' informatization leadership directly affects the development of the school's informatization process. Several issues, such as the specific work carried out by the principals, the results achieved, the shortcomings, and the future development direction, require scientific evaluation using established indicators. Chinese researchers have done much research on it.

Xiao (2009), drawing on the index system provided by the STAR project in the United States, constructed a school education informatization evaluation index system comprising five first-level dimensions and 18 second-level dimensions: education information environment, information management, information teaching, student development, and school development. The system puts teaching, management, and student development benefits at the core. Attach importance to teachers' leading role and students' central role. Under the guidance of the system theory, Yang & Wang (2017) used the factor method to construct an evaluation index system for informatization leadership of primary and secondary school principals, which

included five first-level indicators and 12 second-level indicators, including informatization system planning ability, informatization application leadership ability, informatization education's leadership ability for people, informatization culture construction ability and principals' intrinsic information quality. Hua & Yang (2017) improved the system based on this framework and added an index of information, communication, and coordination abilities. Xie & Zhang (2019) analyzed school education informatization from a systematic perspective. They held that the informatization leadership of school principals should be evaluated across four aspects: information awareness and information technology capability, information decision-making and planning capability, information organization and management capability, and information evaluation and development capability. Among them, information awareness and skills are the foundation. The other three aspects involve the specific application of school informatization and three essential factors. Zhang Qizhi (Wei, 2024), by analyzing the professional roles and work behaviors of principals, argued that principal leadership evaluation should be organized into three categories: leaders, educators, and managers. One of the significant changes brought about by information technology is the realization of information spread and sharing across time and space. In addition to the principal, Sun & Ren (2016) developed the information leadership evaluation index system for the middle management team from the perspective of the middle management team of the school through literature research, investigation, and analysis, including six first-level indicators such as construction planning ability, teaching and learning guidance ability, and 26 second-level indicators. Moreover, the analytic hierarchy process is used to assign weights to all levels of the indicators. To enhance the information leadership of primary and secondary school principals, China's Ministry of Education issued the "Professional Standards for Primary and Secondary School Principals" in 2013, which specify the basic requirements for the professional competence of qualified principals in compulsory education schools. In 2014, it issued the "Primary and Secondary School Principals Informatization Leadership Standards (Trial)," which set specific requirements for the informatization work of primary and secondary school principals across six areas: planning, design, organization, implementation, evaluation, and promotion. Various state policy documents and scholars' construction of evaluation systems have provided the theoretical basis and methodological guidance for this study.

In Summary:

Chinese scholars began to pay attention to principals' informatization leadership in 2006. They found that domestic researchers primarily conducted theoretical research on the connotation model, promotion strategy, and evaluation index of this leadership. With the advancement of educational informatization toward the digital transformation of education, digitalization provides new impetus to this leadership.

Objectively evaluating the development of principals' digital leadership in the new era, constructing a model of principal digital leadership, and proposing corresponding improvement measures are urgent issues that must be addressed. The core of digital transformation in education is to promote the digital transformation of all elements, tasks, fields, and processes. This process is not simply about applying technology to teaching; it emphasizes the deep integration of information technology

into education and instruction. From the school's overall perspective, it is necessary not only to leverage the school principal's digital leadership for systematic strategic planning but also to comprehensively and continuously enhance the digital awareness and thinking of teachers and students, conduct digital capacity building, and, ultimately, build an innovative campus.

3. The Effectiveness of Principal Digital Leadership

The concept of "effectiveness of principal digital leadership" is rooted in the broader "effectiveness of educational leadership" theoretical framework and has acquired new connotations in the digital age. The main theoretical foundations include:

The series of studies by Hallinger & Heck (1998) laid the foundation for research on the influence of principal leadership on school effectiveness (School Effectiveness) and student learning (Student Learning). They proposed the "leadership impact model," which posits that principal leadership primarily influences student outcomes by indirectly shaping the school's organizational conditions (e.g., school goals and the teaching environment).

The research by Leithwood & Sun (2012) on the effectiveness of "transformational leadership" in school contexts emphasized the effects of leadership in stimulating teachers' intrinsic motivation and commitment, and in changing organizational culture.

The evolution and focus of this concept in the digital context include:

When leadership research focuses on the "digital" domain, "effectiveness" research also shifts from generalized school effectiveness to more specific, proximal, and distal outcomes of the digital transformation process.

The effectiveness of principal digital leadership, in essence, refers to the positive impacts and changes that a principal has on school members (mainly teachers), school organizational processes, and ultimately on teaching and learning through implementing a series of digital vision planning, construction, management, and support behaviors. The key is that it differs from "digital leadership" itself (behavior) and focuses more on the direct, observable intermediate-state changes triggered by leadership behaviors (Wei, 2024). The effectiveness of principal digital leadership is a multi-level and multi-dimensional construct. Based on comprehensive literature research, the following three core elements can be summarized (See Table 2.10).

Table 2.10 Core Elements of Effectiveness of Principal Digital Leadership

Core element	Main content
School members (mainly principals and teachers)	Improvement of digital teaching competence; Enhancement of innovation willingness and behavior: Collaboration and sharing.
Processes of school organization	Effective utilization of digital resources and infrastructure; Open, shared, innovative, digital-driven, and digital culture.

Core element	Main content
Processes of teaching and learning	Transformation of teaching paradigm; Rich teaching experiences for students; Innovative assessment methods.

Therefore, the effectiveness of principal digital leadership is mainly influenced by school members, the processes of school organization (principals' digital organization, implementation, and assurance ability), the processes of teaching and learning (teachers' digital teaching experiences for students and innovative assessment methods).

In Summary:

The Influencing Factors of Effectiveness of Principal Digital Leadership

Combining the literature review of some scholars on the "constituent elements of digital leadership of principals", with the core elements in the definitions of principal digital leadership (Table 2.4), the related influencing factors of principal digital leadership (Table 2.8), the core elements of effectiveness of principal digital leadership (Table 2.10) in this study, it is evident that the influencing factors of effectiveness of principal digital leadership can be divided into three aspects: School members, the processes of school organization, and the processes of teaching and learning. All of these can be divided into external influencing factors (Digital resources, school background, teaching and learning, teachers' technology integration, digital behavioral intention) and internal influencing factors (principal's major and leadership experience, productivity and professional practice, digital vision, IT coordination ability, ICT professional development ability).

According to the semi-structured interviews in Chapter 1, in the research on the influencing factors of digital leadership of principals, there is too much uncertainty in external factors such as regional economy, policy and technology support. The research mainly focuses on the digital leadership of principals themselves and the behavioral intention of the school teachers (Yuan, 2023). And, most primary school principals in Henan are weak in, or lack, a clear vision and strategic planning, personal literacy, implementation, promotion, assurance systems, and management mechanisms. Combine them with the results from literature reviews, the study get the influencing factors of effectiveness of principal digital leadership (See Table 2.11)

Table 2.11 Influencing Factors of Effectiveness of Principal Digital Leadership

Number	Element
1	Digital teaching and learning ability
2	Digital management mechanism
3	Digital vision and strategic planning
4	Digital assurance ability
5	Digital vision
6	Digital planning strategic

Number	Element
7	Digital organizational ability
8	Digital implementation ability
9	Personal digital literacy
10	Teachers' digital behavioral intention

As shown in Table 2.11, some elements are repeated or included. After deleting the repetitive ones and recombining the included ones, and referring to the expression of wording of "Informationization Leadership Standards for Primary and Secondary School Principals (Trial)" issued by the Teacher Work Department of the Ministry of Education, Last, it restructured and reserved 5 core influencing factors (See Table 2.12): Digital vision planning, Digital management, Digital literacy of principals, Digital implementation assurance and Teachers' digital behavioral intention.

Table 2.12 Summary of Core Influencing Factors of Effectiveness of Principal Digital Leadership

Core Influencing Factors of Effectiveness of Principal Digital Leadership
Digital management
Digital implementation assurance
Digital vision planning
Digital literacy of principals
Teachers' digital behavioral intention

So, the core influencing factors of effectiveness of digital leadership of primary school principals in this study comprises 5 elements: digital vision planning, digital management, digital literacy of principals, digital implementation assurance and teachers' digital behavioral intention.

2.3 Model Development and Model Validation

The Typical Leadership Models

Internationally, there are many leadership models tailored to specific professions and identities, the best-known being the WICS model proposed by American psychologist Sternberg and his team, which is grounded in the theory of successful intelligence. It encompasses wisdom, intelligence, and creativity, and their mutual synthesis, indicating that leadership is a decision-making process grounded in intelligence, in which intelligence and creativity develop in parallel, and the three should be coordinated and synthesized (Giber, 2013).

Bolden (2011) summarized the development, evolution, and composition of Western leadership and identified several representative leadership models. Specifically, in the leadership model for senior civil servants, leaders need to possess six abilities: interpreting intentions and directions, demonstrating personal influence, highlighting strategic thinking, stimulating team potential, learning and improving,

and strengthening communication; The Leadership Association found through analysis of numerous basic data that leadership consists of three dimensions: thinking ability, task ability, and interpersonal relationship ability; The leadership model constructed by the International Monetary Fund (IMF) consists of five dimensions: intellectual leadership, work management, interpersonal relationships, communication, and employee management (Yukl & VanFleet, 1992).

The "Scientific and Technological Leadership Research Group" of the Chinese Academy of Sciences has conducted a systematic study on leadership and proposed a "Five Leadership Models," including foresight, charisma, influence, determination, and control (Ren et al., 2019). Bu Anxun, Chu Jianwei, and others proposed the "5C" leadership development model, grounded in China's national context. The model includes five dimensions: change, backbone, customer, assessment, and culture (Luo, 2017). Ling & Fang (2003) were the first to analyze leadership behavior quantitatively. Drawing on the PM scale used by Japanese scholars and the actual situation in China, they conducted empirical research on both the "explicit" and "implicit" aspects to derive the "CPM" model of Chinese leadership behavior. This model consists of three dimensions: individual character C, work performance P, and group maintenance M, (Ling & Fang, 2003). Xie (2018) proposed the 5M leadership model at the "Leadership Forum" held at the School of Economics and Management, Tsinghua University. He pointed out that, as a leader, self-management should be the foundation for effectively managing relationships with superiors, colleagues, subordinates, and external partners. Leadership is divided into five dimensions: Manage Yourself (MY), Manage Your Boss (MB), Manage Young Members (MM), Manage Young Colleagues (MC), and Manage Your Partners (MP). Zhang (2021) proposed a biomimetic model of outstanding leaders comprising six components: vision, leadership art, personality charm, adaptive business ability, efficient coaching ability, and execution ability. Each component is like the structure of the human body, forming an organic whole that cannot be called "excellent".

The Methods of Model Development

The core of model construction lies in clearly defining "core dimensions (variables)", "relationships between dimensions", and "boundary of influence". Common methods include theory-driven, empirical induction, mixed, and system dynamics methods. The details are as follows:

Theory-driven Method

The core idea is based on existing classical theories, combined with the characteristics of digital technology and the needs of education, and derived the core dimensions and relationships of principal digital leadership. The Applicable scenarios are suitable for initially constructing a model or expanding an existing model to ensure a solid theoretical foundation. The first step of this method is to select basic theories, such as transformational leadership theory (emphasizing vision, leadership, and change promotion), distributed leadership theory (emphasizing team collaboration and delegation of power), and the technology acceptance model (focusing on the perceived usefulness and usability of technology), among others. Second, integrate digital education characteristics: Embed the relevant elements of "digital technology" in the dimensions of the basic theory, for example, expand "vision inspiration" of

transformational leadership to “digital education vision construction”, and expand “empowering subordinates” to “teacher digital capability empowerment”. At the same time, clarify the logical relationship of dimensions: Through theoretical deduction, determine the hierarchical relationship (such as individual level→organizational level→external level) or causal relationship (such as “digital literacy” → “change decision-making” → “school digital transformation”) of each dimension (Wei,2024). For example, Al-Zahrani (2020), based on the transformational leadership theory, proposed a 5-dimensional model of principal digital leadership: digital vision leadership, digital culture shaping, teacher digital empowerment, technology resource integration, and digital ethics norms, with each dimension linked through the “change promotion” mechanism.

Empirical Induction Method

The core idea is grounded in empirical data (e.g., interviews, questionnaires, and case studies). Through qualitative or quantitative analysis, model dimensions and relationships are refined, emphasizing “The research is from practice”. The specific steps are as follows.

The Grounded theory: Conduct in-depth interviews with school principals, teachers, and educational administrators (Zhong, 2017). Through open coding, axial coding, and selective coding, core dimensions (e.g., “digital risk decision-making” and “teachers’ digital resistance coping”) are gradually refined, and the logical connections among dimensions are constructed. Then, make the factor analysis: Design an initial questionnaire (covering potential variables such as individuals, organizations, and external factors), extract key factors (such as “digital literacy foundation” and “institutional support”) through exploratory factor analysis (EFA), and then verify the rationality of the factor structure through confirmatory factor analysis (CFA). Finally, use the case study method: Select successful or failed school cases in digital transformation, compare and analyze differences in the behaviors of school principals, and summarize the key paths of digital leadership (such as “policy interpretation→resource integration→teacher training→classroom application”). For example, Zheng & Wang (2022) conducted in-depth interviews with 12 primary and secondary school principals. They used grounded theory to refine the 4 core dimensions of school principals’ digital leadership: digital cognitive ability, digital decision-making ability, teacher digital support ability, and external digital resource linking ability. Each dimension acts on school digital transformation through the “problem-solving” mechanism.

Mixed Method

The core idea is to leverage the advantages of both theoretical guidance and empirical induction: first, propose a preliminary model framework through theoretical reasoning; then, verify and refine the model using empirical data (questionnaires, interviews); and finally, form a “theory-practice” two-way verification model. The specific steps are as follows: Firstly, do the theoretical reasoning. Based on leadership theory and digital education policies, propose an initial model (such as including three primary dimensions: “Individual Digital Literacy”, “Organizational Digital Culture”, and “Regional Policy Support”). Then conduct empirical testing by collecting data via questionnaire surveys ($n \geq 300$) and using structural equation modeling (SEM) to test

path relationships among dimensions (e.g., whether “Regional Policy Support” mediates the effect of “Organizational System” on “Principal Digital Decision-making”). Moreover, make the model refinement. Incorporate interview data (such as the principal’s feedback that “Digital Ethical Risks” was not included), supplement or adjust dimensions (such as adding the “Digital Ethical Control” dimension), and finally form a refined model. For example, Li & Wong (2021) first proposed an initial model based on the distributed leadership theory, and then conducted SEM analysis on the questionnaire data of 500 principals, finding that “Teacher Digital Collaboration” plays a mediating role between “Principal Digital Empowerment” and “Classroom Digital Effectiveness”, and accordingly refined the model path.

System Dynamics Method

The core idea is to treat the principal’s digital leadership as a dynamic system. By analyzing the feedback relationships (positive and negative) among variables (e.g., the principal’s digital literacy, teachers’ acceptance, and funding investment), construct a causal loop diagram or stock-flow model to reveal the dynamic mechanisms underlying the leadership’s effects. The applicable scenarios are suitable for analyzing the multi-factor interaction relationships in complex systems (such as “improvement of the principal’s risk-taking awareness” to “increase in technological investment” to “strengthening of teacher training” to “improvement of classroom digital effect” to further encouragement of the principal’s investment). For example, Zhang (2023) used system dynamics to construct a model of the principal’s digital leadership effect, identifying 3 key feedback loops: digital resource investment-teacher capability improvement loop, policy support-institutional improvement loop, and parents’ digital participation-school digital recognition loop, providing a basis for the dynamic optimization of the model. Here is a summary of the methods described above for model construction (See Table 2.13).

Table 2.13 Methods of Model Development

Method	Core Advantage	Applicability	Notes
Theory-driven method	Solid theoretical foundation and clear logic.	Initial model construction or theoretical expansion.	It is necessary to avoid becoming divorced from reality and to incorporate empirical evidence to correct errors.
Empirical induction method	Closely related to practice, with more targeted dimensions.	Exploring unknown dimensions or complex scenarios.	It is necessary to ensure the representativeness of the samples and the quality of the data.
Mixed method	Taking into account both theory and practice, the model becomes more robust.	The stage of medium-sized and large-scale research or model optimization.	It is necessary to design the connection between theory and empirical research reasonably.

Method	Core Advantage	Applicability	Notes
System dynamics method	Reveal dynamic interactive relationships.	Analyzing the long-term mechanisms of interactions among multiple factors.	It is necessary to define the variables and the feedback relationships accurately.

The Methods of Model Validation

After the model is constructed, it must be validated for applicability, effectiveness, and practicability through multidimensional validation. Common methods include reliability and validity tests, empirical validation, practical effectiveness evaluation, expert review and triangulation.

Reliability and Validity Tests

The core objective is to assess the stability (reliability) and accuracy (validity) of the model dimensions, ensuring that measurement tools (e.g., questionnaires) effectively reflect the core variables. Reliability testing refers to internal consistency reliability. The internal consistency of each dimension scale is assessed using Cronbach's α coefficient ($\alpha \geq 0.7$ is acceptable). Validity testing encompasses content validity and structural validity. Content validity entails inviting experts in educational technology and educational management (5-8 people) to review the model dimensions and measurement items to ensure that they align with the research objectives. Structural validity refers to the dimension structure being tested for fit with the data through exploratory factor analysis (EFA; KMO≥0.7; Bartlett's sphericity test significant) and confirmatory factor analysis (CFA; adaptation indicators such as $\chi^2/df < 3$, RMSEA < 0.08, CFI > 0.9) (Zhu, 2023).

Empirical Validation

The core objective is to verify whether the assumed relationships among the model's variables hold. The specific methods are as followed: A multiple linear regression analysis, with principal's digital leadership as the independent variable and school's digital transformation outcomes (e.g., teachers' use of digital tools) as the dependent variable, was used to test the impact effect (β value and P value). Structural equation modeling (SEM) is used to examine complex relationships among multiple variables (e.g., mediating and moderating effects). The multiple-group analysis compares differences in model paths across school types (e.g., urban and rural schools, different grade levels) and testes the applicability boundaries of the model (Wade, 2019). For example, Chen (2023), through SEM, verified that the direct effect of principals' "digital resource integration ability" on "smart campus construction level" is 0.32 ($P < 0.001$). It indirectly affects through "teacher digital training quality" (mediating effect 0.21), with a total effect of 0.53.

Practical Effectiveness Evaluation

The core objective is to test the model's effectiveness in practical applications, specifically whether the digital transformation has achieved significant improvements following the model-based intervention. The method is a pre-test-post-test comparison. Before (T1) and after (T2, e.g., one year later) the application of the model, measure key indicators (e.g., the frequency of teachers' digital teaching) and analyze the

differences using a paired-samples t-test (Zhang, 2023). Do the control group experiment, select the experimental group (schools applying the model) and the control group (schools not applying the model), and compare the differences in digital transformation outcomes through an independent sample t-test. The qualitative assessment, based on teacher interviews, classroom observations, and analysis of school digital project documents, evaluates the model's value for guiding practice (Tong et al., 2024). For example, an education department in a certain region conducted training based on the "Three-Dimensional Model of Principal Digital Leadership" (individual -organization-external), and one year later, the score of teachers' digital teaching ability in the experimental group schools (M =4.2/5) was significantly higher than that in the control group (M =3.5/5, t =3.82, P < 0.01).

Expert Review and Triangulation Validation

The core objective is to ensure, through cross-validation across multiple subjects and data sources, that the model is rational and comprehensive. Firstly, the study invite the principal, educational technology experts, and policy researchers to rate the model across three aspects: practical feasibility, theoretical rigor, and policy compatibility (using a 5-point Likert scale). Based on the opinions, revise the model (e.g., by simplifying overly complex dimensions) (Wade, 2019). Then, triangulation verification is performed by comparing the support levels of different data sources (e.g., questionnaire data, interview records, and school digital reports) for the model dimensions. If the results are consistent, this strengthens the model's credibility (for example, the questionnaire indicates that "resource integration" is important, and the principal frequently mentions this ability in interviews). Here is a summary of the above methods of model validation (See Table 2.14).

Table 2.14 Methods of Model Validation

Method	Core Advantage	Applicability	Notes
Reliability and Validity Tests	Ensure the measuring tools are reliable and effective.	Model dimension and scale development stage.	The sample size should be adequate (factor analysis requires 300 samples).
Empirical validation	Quantitative test of the hypothesis regarding the relationship between variables.	Model path and mechanism verification stage.	Confounding variables need to be controlled.
Practical effectiveness evaluation	Verify the practical application value of the model.	Model extension or intervention effect verification.	It is necessary to set up appropriate intervention periods and evaluation indicators.
Expert review and triangulation validation	Ensure the model's rationality and comprehensiveness.	Cross-validation using multiple subjects and multiple data sources.	Refine the model based on the opinions of the three parties.

Based on the above content, the method for developing the digital leadership model of primary school principals employs a mixed-methods approach, combines the qualitative and quantitative research, because it is necessary to design the connection between digital leadership theory and empirical research reasonably. And, model validation primarily relies on structural equation modeling (SEM), and expert review and triangulation validation by the follow-up interviews, focus groups, and a structured evaluation questionnaire for experts.

2.4 Leadership Development Theories for Principals

Professional development of primary school principals' leadership has emerged as a critical area of inquiry in educational leadership research, driven by the growing responsibilities of principals and the accountability-driven context in which they operate (Daniëls et al., 2019). Leadership in education has gained substantial attention over the past decades, with scholars increasingly recognizing that effective principals are essential for creating learning environments that enhance both teacher performance and student outcomes (Hallinger & Heck, 1998). In light of the title of this study — "A Development of Digital Leadership Model for Primary School Principals in Henan"—it is imperative to situate the model within the broader scholarly discourse on leadership development for primary school principals. This supplementary literature review focuses on the theoretical foundations, core dimensions, and developmental pathways of principal leadership, with particular attention to the primary school context.

Theoretical Foundations of Principal Leadership Development

The study of principal leadership development is anchored in several foundational leadership theories that have been extensively applied and adapted in educational settings. Daniëls et al. (2019) in their comprehensive review of 75 empirical studies, identified five major leadership theories that underpin contemporary research on school leadership: instructional leadership, situational leadership, transformational leadership, distributed leadership, and Leadership for Learning. These theories shaped the understanding of how principals can effectively lead schools and informed the design of leadership development programs worldwide.

Instructional leadership, one of the most influential frameworks in the field, emphasizes the principal's role in shaping curriculum, supervising instruction, and monitoring student progress (Hallinger, 2018). This theory positions the principal as the primary agent of instructional improvement, focusing on the alignment of goals, curriculum, and assessment (Hallinger & Heck, 1998). The instructional leadership framework has been extensively validated across diverse school contexts and continues to inform principal evaluation and development systems globally (Daniëls et al., 2019).

Transformational leadership, as articulated by Bass and Riggio (2006), focuses on the leader's ability to inspire and motivate followers to transcend their self-interests for the sake of the organization. In school settings, transformational principals articulate a compelling vision, model desired behaviors, provide intellectual stimulation, and offer individualized support to teachers (Leithwood & Sun, 2012). This theoretical perspective is particularly relevant to the present study, as digital transformation in schools requires principals to inspire change and build collective commitment to new technological practices.

Distributed leadership, as developed by Spillane (2006), conceptualizes leadership as a shared, collaborative practice distributed across multiple individuals and roles within the school organization. In this view, the principal serves as a coordinating node rather than the sole decision-maker, empowering teacher leaders and administrative staff to take active roles in school improvement. This theoretical perspective aligns closely with the recognition in the present study that teachers' digital behavioral intention serves as a moderating variable, reflecting the distributed nature of digital leadership enactment in primary schools (Zhong, 2017).

Situational leadership, proposed by Hersey (2006), posits that effective leadership requires adapting one's style to the developmental level of followers and the demands of the specific context. This theory has particular relevance for primary school principals, as leadership approaches must be tailored to the unique characteristics of elementary school settings, including the developmental needs of young children and the professional growth stages of teachers. A systematic literature review of 47 peer-reviewed publications found that elementary contexts require distinct leadership approaches emphasizing concrete behavioral modeling and developmentally appropriate strategies, distinguishing them from secondary school leadership (Paryati et al., 2025).

Core Competencies and Dimensions of Principal Leadership Development

Research on principal leadership development has identified several core competencies that effective principals must cultivate. These competencies typically encompass multiple dimensions, including strategic visioning, instructional leadership, organizational management, and relational capacity (Hall et al., 2016). In the Australian context, the Australian Professional Standard for Principals articulates three key leadership requirements—vision and values, knowledge and understanding, and personal qualities—across five professional practices: leading teaching and learning, developing self and others, leading improvement and innovation, leading the school management, and engaging with the community (Australian Institute for Teaching and School Leadership, 2011).

A comprehensive systematic review by Paryati et al. (2025) identified six interconnected leadership dimensions contributing to positive culture development in elementary schools: visionary direction setting (present in 89% of reviewed studies), teacher empowerment through professional development (83%), effective communication (79%), exemplary modeling behavior (74%), digital leadership competence (60%), and collaborative culture development (emergent theme). These findings are directly relevant to the present study, as they confirm the multidimensional nature of principal leadership and highlight the growing importance of digital leadership competence in contemporary elementary school contexts.

In China, research on principal leadership development has gained momentum since the early 2000s, with scholars focusing on issues of principal professionalization, leadership competencies, and the cultivation of "educator-type principals" (Zhang, 2023). The Ministry of Education's Professional Standards for Primary and Secondary School Principals (2013) established basic requirements for principal competencies across six domains: planning school development, cultivating educational culture, leading curriculum and teaching, promoting teacher growth, optimizing organizational

management, and coordinating the external environment. These standards provide an important framework for understanding principal leadership development in the Chinese context and have informed the design of principal training and evaluation systems nationwide.

Recent research has also begun to address the leadership development needs of early-career principals. Lovely (2004) identified distinct stages in the principal induction process: the first year characterized by orientation and survival, and the second year marked by acquisition, when staff, parents, and the community begin to view the new principal as a genuine member of the team. These developmental stages underscore the importance of phased, differentiated professional development approaches that address principals' evolving needs as they progress through their careers.

Professional Development Approaches for School Principals

Effective professional development for school principals is characterized by several key features. Daniëls et al. (2019) concluded that professional development activities for principals are most effective when they are contextualized, sustained over time, and embedded in authentic leadership practices. These activities typically include mentoring and coaching programs, professional learning communities, action research projects, and formal leadership training courses. The review by Paryati et al. (2025) emphasized the urgent need for comprehensive principal preparation programs addressing culture-building competencies and ongoing professional development supporting digital leadership capacity.

In the digital age, leadership development has increasingly incorporated digital competencies as a core dimension of principal preparation. Research by Masoudi et al. (2024) developed and validated a comprehensive coaching leadership model for elementary school principals, finding that such models significantly improve principals' competencies in instructional leadership, organizational management, and relationship-building. The study identified key strategies such as professional growth, networking, and organizational support as crucial for effective coaching in elementary school settings. This phased approach recognizes that principals' developmental needs change as they gain experience and face new challenges. Similarly, the School Leader Paradigm identifies four phases of principal development—Aspiring, Launching, Building, and Mastering—each with unique core needs for support (Vilardo, 2020).

In summary, the literature on leadership development for primary school principals provides a robust theoretical foundation for the present study. The core dimensions identified in the literature—visionary leadership, instructional leadership, organizational management, relational capacity, and increasingly digital competence—align closely with the variables in the proposed digital leadership model.

Practical Guidelines for Principal Digital Leadership

1. Samuel Nix's Six-Step Leadership Cycle

A comprehensive six-step leadership cycle designed specifically for school leaders is presented by Samuel Nix (Nix, 2024) in his book Six Steps to a Strong School Culture: A Leadership Cycle for Educational Success. This field-tested leadership cycle, developed from years of extensive work in educational

administration, comprised six sequential steps that guide principals through a complete cycle of school improvement.

The six steps are: Step 1: Clarify the Mission; Step 2: Plan Strategically and Make Decisions; Step 3: Empower Yourself and Others; Step 4: Measure and Gather Feedback; Step 5: Adjust and Improve; Step 6: Be Accountable and Give Rewards (Nix, 2024). This framework provides a complete multi-step structure that parallels the cyclical logic of the present study's six-step guidelines, which begin with diagnosis and conclude with evaluation. According to Nix, this six-step leadership cycle is designed with practical strategies and abundant insight for school leaders and principals to become leaders of learning and establish a school culture of accountability and student improvement. Each step applies to every strategic-planning and decision-making scenario encountered by school leaders. The six steps of the leadership cycle empower leaders to transform their thinking, shift their mindset from reactive firefighting to proactive planning and action, and develop a future-oriented vision for academic achievement and student success. This framework directly supports the present study's six-step approach, particularly in its emphasis on mission clarification (corresponding to planning), strategic decision-making (focusing), measurement and feedback (diagnosis and evaluation), adjustment (strengthening), and accountability (inspiring).

2. Desravines, Aquino, and Fenton's Breakthrough Principals Framework

Another comprehensive multi-step framework is presented by Desravines et al. (2016) in Breakthrough Principals: A Step-By-Step Guide to Building Stronger Schools. This guide provides a structured four-step planning process that aligns with the diagnostic and planning phases of the present study's guidelines. Part 1 of the book focuses on "Diagnosing Your School's Stages of Development," which directly corresponds to the diagnosis step of the present study.

The authors then outline a four-step planning process: Step 1: Using Multiple Data Points to Diagnose School Practices; Step 2: Bringing the Outputs of the Diagnosis Together to Identify Priorities; Step 3: Set Goals, Identify Strategies, and Create an Action Plan; Step 4: Monitor and Adjust Action Plan (Desravines et al. 2016).

This four-step approach represents a complete cycle that begins with diagnosis and concludes with monitoring and adjustment, mirroring the iterative logic of the present study's six-step guidelines. The authors emphasize that this different approach to school planning requires school leaders to use multiple data points, bring diagnostic outputs together to identify priorities, set goals with identified strategies, and continuously monitor and adjust action plans. This framework provides direct support for the diagnostic, planning, and evaluation steps of the present study.

3. NASSP Building Ranks Framework of Six-Step Process Circle

The National Association of Secondary School Principals has developed a comprehensive Six-Step Process Circle as part of the Building Ranks framework for effective school leaders. This six-step process is specifically designed to plan and implement successful initiatives in schools (NASSP, 2018). According to the Building Ranks framework, school leaders are instructed to follow the steps to collect data, plan strategies, train, monitor, and adjust their programs.

The six-step process circle is one of three key planning tools provided in the Building Ranks framework, which also includes a Personnel Planning Matrix for identifying stakeholders with the appropriate knowledge, skills, and attitudes, and a Timeline for Planning Tool for sorting strategies by implementation times (immediately implement, semester planning, and long-term planning of 2-5 years). Used together, these tools provide a comprehensive view of the work that needs to be done on designated improvements or areas of focus. The Building Ranks framework's emphasis on collecting data (diagnosis), planning strategies (planning), training (strengthening), monitoring (focusing), and adjusting (evaluation) aligns closely with the present study's six-step guidelines.

4. Kotter's Eight-Step Change Model

Although originally developed for organizational change management, Kotter's eight-step change model has been extensively applied in educational leadership contexts and provides a complete multi-stage framework that parallels the present study's six steps.

Kotter's (1996) model consists of: Step 1: Create a Sense of Urgency; Step 2: Build a Guiding Coalition; Step 3: Form a Strategic Vision and Initiatives; Step 4: Enlist a Volunteer Army; Step 5: Enable Action by Removing Barriers; Step 6: Generate Short-Term Wins; Step 7: Sustain Acceleration; Step 8: Institute Change. In educational leadership research, Kotter's framework has been used to guide the implementation of new technology in schools and to analyze organizational change strategies in educational institutions. The model's eight steps can be mapped onto the present study's six-step guidelines: creating urgency and building a coalition correspond to diagnosis; forming a vision corresponds to planning; enabling action and removing barriers correspond to strengthening; generating short-term wins and sustaining acceleration correspond to focusing; enlisting volunteers corresponds to inspiring; and instituting change corresponds to evaluation. Kotter's eight-step plan outlines what is needed to lead change in an organization and can be used as a guide to implementing new technology in schools.

5.Fullan's Six Secrets of Change and the Six-A Innovation Model

Fullan's "Six Secrets of Change" provides another comprehensive multi-stage framework for understanding and leading educational change. Fullan's six secrets include: Love Your Employees; Connect Peers with Purpose; Capacity Building Prevails; Learning Is the Work; Transparency Rules; and Systems Learn (Fullan, 2008). This framework has been used as a lens through which to view the process of educational change and has informed studies of principal leadership in school improvement contexts. Additionally, the "Six-A Innovation Model" developed from Fullan's earlier work outlines six themes necessary for successful curriculum implementation: Vision Building; Initiative Taking; Staff Development and Empowering; Resource Management; Monitoring; Problem Solving and Planning. These six themes—vision building (diagnosis and planning), initiative taking and staff development (strengthening and inspiring), resource management (strengthening), monitoring (focusing), and problem solving and planning (evaluation)—resonate with the present study's six-step approach.

6.Five-Phase Improvement Process Model

A five-phase improvement process designed specifically for school and district leaders to lead change through disciplined inquiry has been proposed in the literature. This model includes the following phases: Phase 1: Understanding the Problem and the System; Phase 2: Focusing Efforts; Phase 3: Generating Change Ideas; Phase 4: Testing through Plan–Do–Study–Act (PDSA) Cycles; Phase 5: Spreading What Works (Shepard, 2025). This five-phase model provides a complete multi-stage framework that begins with diagnosis (understanding the problem) and proceeds through focusing, generating ideas, testing, and scaling up—all of which correspond to the present study's six steps.

In Summary:

The literature reviewed in this section demonstrates that the six-step practical guidelines developed in this study—Diagnosis, Planning, Strengthening, Focusing, Inspiring, and Evaluation—are consistent with established multi-stage leadership and school improvement frameworks. While each framework described above presents a slightly different number of steps or phases, they collectively provide a robust theoretical foundation for the six-step approach.

2.5 Theories and Relationship Between Variables

This study aims to develop a digital leadership model for primary school principals to enhance the digital effectiveness of the whole school. Some well-known theories from scientific research and educational administration can be applied, and the relationships among variables can be examined. The details are below.

Grounded Theory

Grounded theory has evolved into three major categories (Zhu, 2023). Classical grounded theory emphasizes the "natural emergence" of theory and opposes imposing structure on data. Researchers should maintain "theoretical sensitivity" and employ continuous comparison to advance the abstraction of concepts. Proceduralized grounded theory provides more specific, step-by-step coding procedures (open coding, axial coding, and selective coding) and analytical tools (such as paradigm models), making the method easier for beginners to master and apply (Burns, 1978). Constructivist grounded theory, in its proceduralization, incorporates constructivist epistemology, acknowledging that researchers and data jointly construct theory within a specific spatiotemporal context, and emphasizes the researcher's reflexivity and the social process.

In this study, Grounded theory was used to conduct three-level coding analysis, including open coding, axial coding, and selective coding, to explore the intrinsic connections among the data, in order to ensure the current situation of digital leadership among primary school principals, the state of digital condition in primary schools and the research problems and questions.

Educational Change Theory (ECT)

It is a theoretical framework for studying how the education system changes, adapts, and improves. Educational reform is any meaningful change in the current state of education (Havelock, 1973), and the essence of educational digitization is

innovation and promotion of educational reform. It focuses on the driving forces, processes, influencing factors, and strategies for implementing educational reform to improve educational quality, promote equity, and adapt to social development needs (Chen, 2022). It contains two primary theoretical bases:

Kurt Lewin's model of change (Zhang, 2021): Unfreeze, breaking through existing inertia and creating demand for change. Change, implementing new methods or systems. Refreeze, stabilize new changes, and do their routine practices.

Fullan's (2008) theory of educational change emphasizes the role of teachers and school leaders. Change should be driven from the grassroots level rather than simply from the top down. It requires long-term investment and attention to culture, values, and relationships.

Digital transformation in education is a comprehensive process that leverages digital technologies and methods to revolutionize traditional educational concepts, management models, and learning experiences. Specifically at the school level, digital transformation in education involves upgrading school infrastructure, developing digital teaching resources, innovating teaching methods, and enhancing teachers' and students' digital literacy.

In this study, Lewin's Change Model provides a systematic approach for the development of school digitalization. "Unfreeze" is the preparatory stage at the beginning of organizational change, where the principal breaks the established cognitive patterns and uses various means to initiate the phased digital development process of the school; "Change" is the process where the principal inspires the school staff to create a new digital transformation atmosphere within the school and drive the school towards the transformation goal, which is also the process of the principal updating their digital thinking and cognition; In "Re-freeze" stage, the principal leads teachers and students to consolidate the achievements of the "Change" stage, and the school's organization and operation re-enter a relatively stable stage. The principal needs to use scientific means to evaluate the transformed results and thus bring the digital organization into a new, balanced state to develop the effectiveness of principal digital leadership.

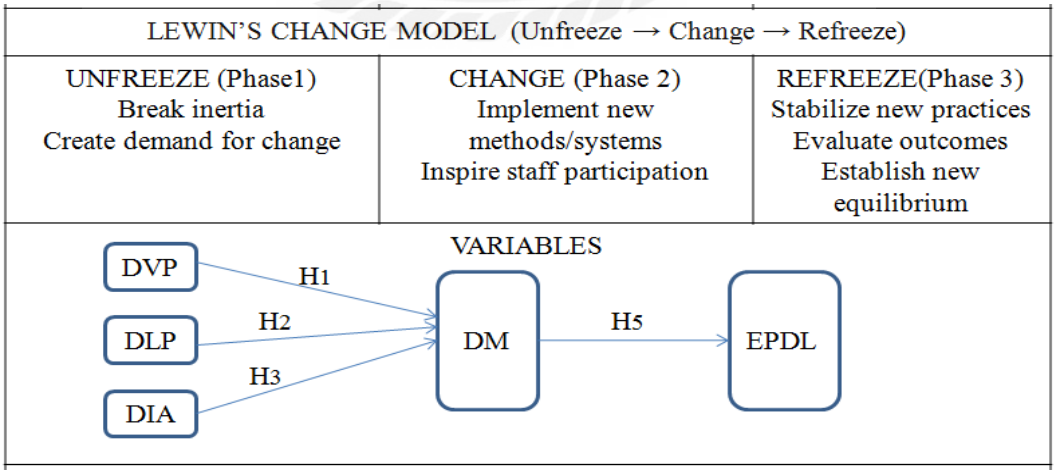

Figure 2.8 Relationship Diagram of the Direct Effect

Leadership Development Theory (LDT)

Leadership Development Theory is a framework for explaining key concepts of leadership. It primarily encompasses Transformational Leadership Theory, Distributed Leadership Theory, and Situational Leadership Theory.

In research on the digital leadership of primary school principals, leadership development theory offers a comprehensive perspective for analyzing the multiple dimensions and elements of this leadership, as well as their interactions. Its core is to regard the digital leadership of primary school principals as a complex phenomenon influenced by multiple key variables, including leadership knowledge, leadership ability, and leadership behavior. Exploring the interrelationships among these key variables and their effects on leadership functioning helps researchers better understand the nature of digital leadership among primary school principals and develop a digital leadership model. The specific leadership theories are listed in Table 2.15.

Table 2.15 Leadership Development Theory

Theoretical Framework	Core Viewpoint	Model Application	Source of Literature
Transformational Leadership Theory	The principal drives organizational transformation through vision, inspiration, and personalized care.	Explaining the cultural and knowledge change in digital transformation.	Bass & Riggio (2006)
Distributed Leadership Theory	Leadership is distributed among the organization's members, with the principal serving as the coordinating node.	Design "Principal-Teacher Digital Development Community".	Spillane (2006)
Situational Leadership Theory	Leadership behavior needs to be adapted to the organizational development stage and the external environment.	Differentiating the development paths of urban and rural school principals.	Hersey (2006)

Theory of Planned Behavior (TPB)

Theory of Planned Behavior (TPB) was developed by Ajzen (1991) from the Theory of Reasoned Action (TRA) and was primarily used to predict and explain individuals' intentional behavior. It suggests that individual behavior is planned and directly influenced by behavioral intention, which is determined by three key factors: Attitude (ATT), the individual's positive or negative evaluation of a specific behavior. Subjective Norms (SN): The social pressure that an individual feels, which refers to the degree of support or opposition from others (such as peers, leaders, society) towards the behavior. Perceived Behavioral Control (PBC): An individual's

confidence and sense of control over their ability to successfully implement the behavior. These factors collectively determine an individual's behavioral intention, affecting their behavior.

Drawing on leadership development theory, this study encourages principals to make significant efforts to advance schools' digital development. They also enhance teachers' enthusiasm for their work, promote continuous learning, improve the efficiency of teachers' digital instruction, and ultimately enhance the digital effectiveness of the whole school. So, teachers are the link between principals' digital leadership and digital effectiveness. Teachers' behavioral intentions are influenced by principals, and teachers' digital behavioral intentions can serve as a moderating variable affecting the results of digital effectiveness.

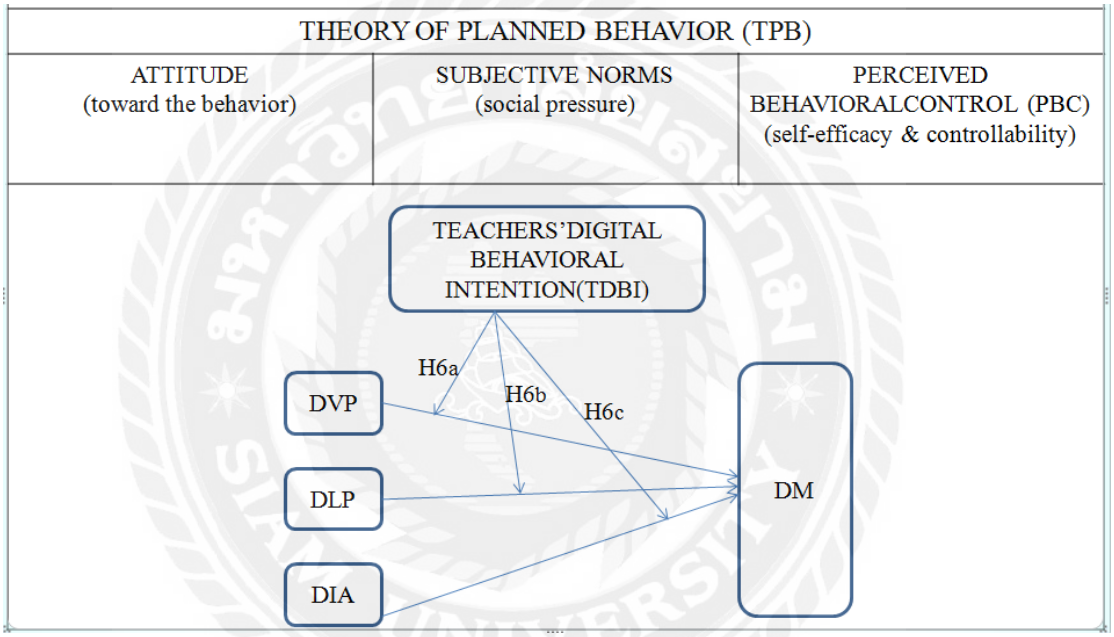

Figure 2.9 Relationship Diagram of the Moderating Effect

Self-Determination Theory (SDT)

It is a motivational theory proposed by Ryan & Deci (2000) that aims to understand an individual's motivation, development, and mental health. It emphasizes that human behavior is driven by intrinsic and extrinsic motivation and by the degree to which individual needs are met. SDT pays special attention to the impact of the three basic psychological needs of autonomy, competence, and relatedness on individual motivation and developmental outcomes.

Autonomy: Individuals feel free and in control when making choices and decisions. Competence: Individuals perceive themselves as possessing the necessary skills and abilities to address challenges and achieve expected goals while performing tasks successfully. Relevance: The relationship that an individual establishes and maintains with others, feeling accepted, understood, and supported by them. Once these needs are met, they can enhance an individual's intrinsic motivation and promote active and sustained participation in behaviors and activities.

In this study, the digital management of principals is linked to the overall digitalization of schools' development. It is reflected in various aspects of digital vision planning, digital literacy, digital implementation, and digital assurance. So, the digital management of principal can serve as a mediating variable among various elements of digital leadership and digital vision planning, digital literacy, digital implementation assurance can be the independent variables.

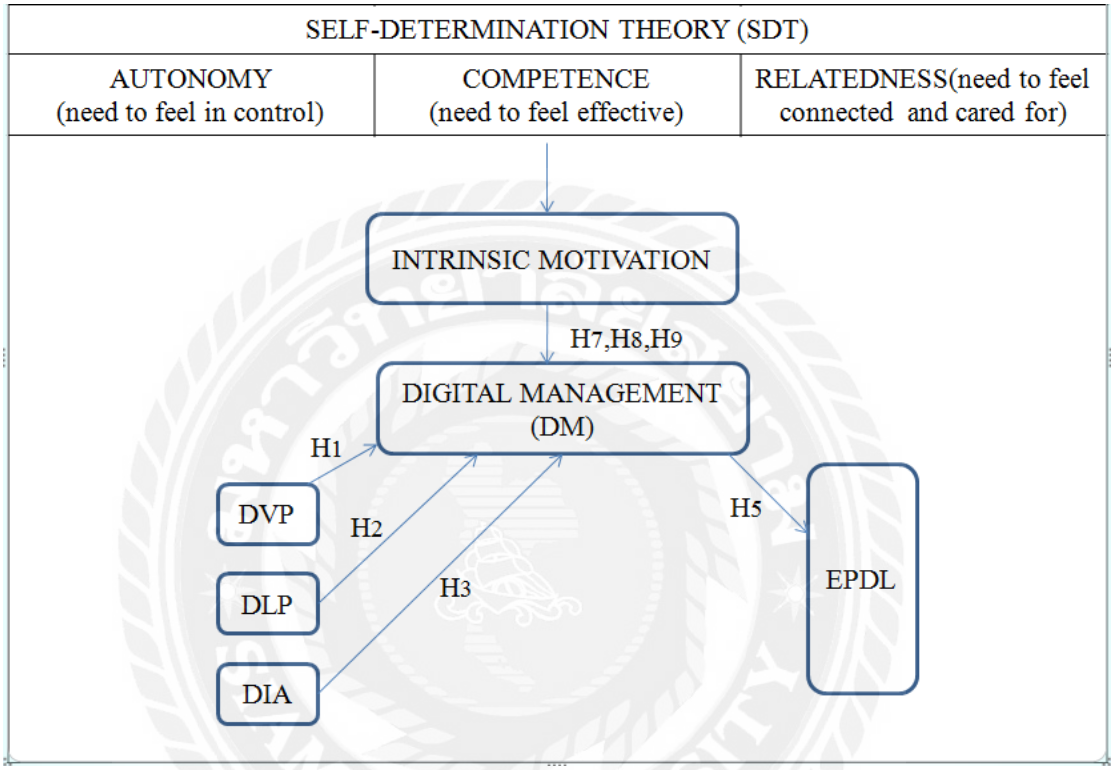

Figure 2.10 Relationship Diagram of the Mediating Effect

2.6 Core Variables of the Study

Digital leadership is key to promoting and enhancing primary schools' digital effectiveness and high-quality development (Wei, 2024). Primary schools are a key link in the digital development of education. Primary school principals serve as leaders, promoters, and practitioners of educational reform and play a bridging role in the specific practice of national education digitalization planning and school digital development (Chen, 2022). Based on the literature review and relevant theoretical research, and the relationship between variables mentioned above, the core variables of this study are:

The Independent Variables (IV)

From the content above, the digital leadership model of primary school principals includes three independent variables: digital vision planning, digital literacy of principals, and digital implementation assurance.

The Mediating Variable (MV)

According to Self-Determination Theory (SDT) in this study, the digital management of principals is related to the digitalization of the overall development of schools, and it is reflected in various aspects of digital vision planning, digital literacy of principals, and digital implementation assurance. As a stock of human capital, digital management of principals directly affects the efficiency with which principals convert the digital resources (equipment, training, systems) allocated to them into teaching behavior. So, the digital management of principal can serve as a mediating variable among various factors of digital leadership.

The Moderating Variables (MO)

Based on Situational Leadership Theory, "no absolute best theory applies to any situation. Leadership behavior and situational factors should be combined when examining leadership styles, as leadership is a dynamic interaction process between leaders, followers, and their environmental factors" (Hu et al. 2024). And, in line with Transformational Leadership Theory, a school principal can encourage teachers to make significant efforts to advance the school's digital development. They can also enhance teachers' enthusiasm for their work, promote continuous learning, improve teachers' digital teaching efficiency, and ultimately enhance the school's overall digital transformation. Also, from the literature review, it was confirmed that teachers' behavioral intention is an important influencing factor in the digital leadership of principals (Chen, 2022); the teachers' digital behavioral intention is the good adjustment between digital leadership of principals and the digital effectiveness, so teachers' digital behavioral intention can be considered as a moderating variable.

The Dependent Variables (DV)

The effectiveness of principal leadership is rooted in the broader "effectiveness of educational leadership" theoretical framework and has acquired new connotations in the digital age. When leadership research focuses on the "digital" domain, "effectiveness" research also shifts from generalized school effectiveness to more specific, proximal, and distal outcomes of the digital transformation process.

The effectiveness of principals' digital leadership refers to the positive impacts and changes that a principal has on school members (mainly teachers), school organizational processes, and ultimately on teaching and learning through implementing a series of digital vision planning, construction, management, and implementation assurance.

In Summary:

To identify the study's core variables, this research drew on prior research and a large body of literature, concepts, and related theories. It summarizes the connotation, qualities, core elements of digital leadership, core influencing factors of the effectiveness of principal digital leadership. And, ultimately, the independent, dependent, mediating, and moderating variables become clear.

Independent Variables:

Digital Vision Planning (DVP)

Digital Vision Planning emphasizes that principals can clearly outline the vision

for developing digital construction in schools, formulate digital development goals and plans that align with the school's context, and propose digital innovation measures (Wang, 2024). The planning involves multiple aspects, including the school's digital construction environment, teacher IT training plans, and subject-level IT integration.

Digital Literacy of Principals (DLP)

Digital literacy is a comprehensive skill that principals should possess in the digital transformation of education (Wang, 2024). It includes digital awareness, attitudes toward information technology, a basic understanding of digital knowledge, and digital ethical security.

Digital Implementation Assurance (DIA)

Digital implementation assurance capability, such as planning and management, encompasses aspects including school system construction, infrastructure development, teacher instruction, and student learning. This study divided principals' digital implementation assurance ability into evaluating teachers' digital teaching level, students' digital learning ability, school digital environment construction, and digital-related system construction.

Dependent Variable:

Effectiveness of Principal Digital Leadership (EPDL)

It refers to the positive impacts and changes that a principal has on school members (mainly teachers), school organizational processes, and ultimately on teaching and learning through implementing a series of digital vision planning, construction, management, and support behaviors (Sun, 2010).

Mediating Variable:

Digital Management (DM)

Promoting digital transformation in schools cannot be separated from effective principal management (Wang, 2023). This study defined the principals' digital management ability as encompassing the management of the school's digital construction environment, the digital management team, teachers' digital teaching, students' digital learning, and communication and coordination with families, schools, and society.

Moderating Variable:

Teachers' Digital Behavioral Intention (TDBI)

The teachers' digital behavioral intention in this study includes their acceptance of educational digital transformation, their active participation in various information technology and teaching training organized both inside and outside the school, their level of digital teaching in everyday teaching situations (Sun & Tang, 2023), and whether they provide their suggestions or feedback on the school's digital construction.

Based on the literature review, the concepts, theories, and definitions of digital leadership, digital effectiveness, and related constructs indicate that each variable

comprises more than two indicators. The indicators of the above variables are presented below (See Table 2.16).

Table 2.16 Variables and Indicators of the Study

Variable	Indicator
Digital Vision Planning (DVP)	Outline the vision for the development of digital construction.
	Formulate digital development goals and a plan.
	Propose digital innovation measures.
Digital Management (DM)	Management of the school's digital construction environment.
	Management of the school's digital management team.
	Management of teachers' digital teaching.
	Management of students' digital learning.
	Digital communication and coordination platforms.
Digital Implementation Assurance (DIA)	Teachers' digital teaching level.
	Students' digital learning ability.
	School digital environment construction.
	Related digital system construction.
Teachers' Digital Behavioral Intention (TDBI)	Accept digital transformation and participate in digital training.
	The level of digital teaching that meets the daily requirements.
	Teachers provide their suggestions or feedback to the school.
Digital Literacy of Principals (DLP)	Digital awareness.
	Attitude towards information technology.
	Basic understanding of digital knowledge.
	Quality of digital ethical security.
Effectiveness of Principal Digital Leadership (EPDL)	Support for funding, technology, and related areas provides indispensable conditions for developing school digital construction.
	The hardware (computers and multimedia teaching equipment) and software meet the teaching and learning needs of teachers and students.
	The school's digital planning and institutional construction are sound, and the digital environment is intense.
	Empowers teachers by transforming their knowledge, beliefs, and behaviors.
	Rich learning experiences and Innovative assessment methods for students.

2.7 Conceptual Framework

The framework is designed to explore the relations among independent, dependent, mediating, and moderating variables by analyzing their relationships.

Direct Effects:

Digital Leadership (DVP, DLP, DIA) and Digital Management (DM) are expected to have direct effects on the Effectiveness of Principal Digital Leadership (EPDL).

Digital Vision Planning (DVP), Digital Literacy of Principals (DLP), and Digital Implementation Assurance (DIA) are expected to have direct effects on Digital Management (DM).

Mediating Effects:

Digital Management (DM) is expected to mediate the relationships between the independent variables: Digital Vision Planning (DVP), Digital Literacy of Principals (DLP), and Digital Implementation Assurance (DIA), and the dependent variable: Effectiveness of Principal Digital Leadership (EPDL).

Moderating Effects:

Teachers' Digital Behavioral Intention (TDBI) is expected to moderate the relationships between the independent variables: Digital Vision Planning (DVP), Digital Literacy of Principals (DLP), and Digital Implementation Assurance (DIA) and the mediating variable: Digital Management (DM).

The conceptual framework is shown in Figure 2.11.

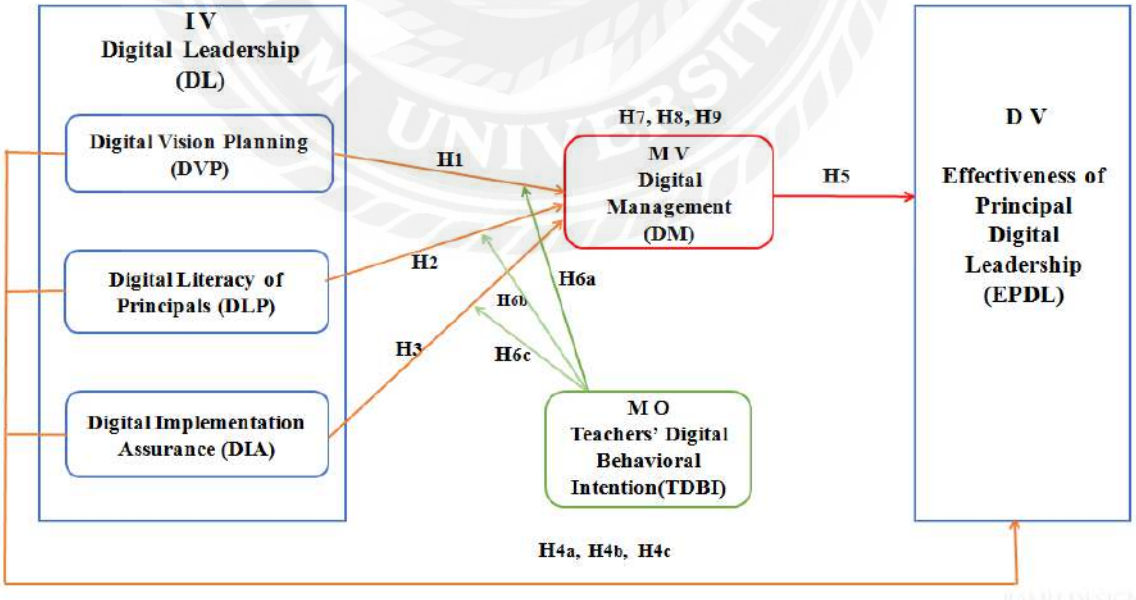

Figure 2.11 Conceptual Framework of the Study

2.8 Hypotheses

H1: There is a significant positive relationship between Digital Vision Planning and Digital Management.

H2: There is a significant positive relationship between Digital Literacy of Principals and Digital Management.

H3: There is a significant positive relationship between Digital Implementation Assurance and Digital Management.

H4a: There is a significant positive relationship between Digital Vision Planning and Effectiveness of Principal Digital Leadership.

H4b: There is a significant positive relationship between Digital Literacy of Principals and Effectiveness of Principal Digital Leadership.

H4c: There is a significant positive relationship between Digital Implementation Assurance and Effectiveness of Principal Digital Leadership.

H5: There is a significant positive relationship between Digital Management and Effectiveness of Principal Digital Leadership.

H6a: Teachers' Digital Behavioral Intention has a positive moderating effect on the relationship between Digital Vision Planning and Digital Management.

H6b: Teachers' Digital Behavioral Intention has a positive moderating effect on the relationship between Digital Literacy of Principals and Digital Management.

H6c: Teachers' Digital Behavioral Intention has a positive moderating effect on the relationship between Digital Implementation Assurance and Digital Management.

H7: Digital Management has a mediating effect on the relationship between Digital Vision Planning and Effectiveness of Principal Digital Leadership.

H8: Digital Management has a mediating effect on the relationship between Digital Literacy of Principals and Effectiveness of Principal Digital Leadership.

H9: Digital Management has a mediating effect on the relationship between Digital Implementation Assurance and Effectiveness of Principal Digital Leadership.

2.9 Operationalization of Variables

With reference to the above literature, the operationalization of the variables is presented in Table 2.17.

Table 2.17 Operationalization of Variables

Variable	Operationalization Definition	Scale Items	Reference	Likert Scale
Digital Vision	It emphasizes that principals can clearly outline the vision for developing digital construction in schools,	1. The principal can depict the digital vision of school education and establish digital development goals.	Peng (2023)	5-point scale

Variable	Operationalization Definition	Scale Items	Reference	Likert Scale
Planning (DVP)	formulate digital development goals and plans aligned with the school's context, and propose digital innovation measures.	2. The principal has prepared the school's digital development plan and action plan. 3. Be able to propose innovative measures for digital construction based on the school's situation and promote educational reform.		
Digital Management (DM)	This study determines the principals' digital management ability, the school's digital construction environment, the digital management team, teachers' digital teaching, students' digital learning, and the communication and coordination ability with families, schools, and society.	1. The principal is constantly improving the digital infrastructure construction of the school. 2. Establish or improve a digital management team for the school, clarifying the division of labor and responsibilities among team members. 3. Take measures to encourage teachers to use digital devices for teaching, organize teacher training, promote online educational resources, and innovate teaching models. 4. Encourage students to actively participate in the Information and Digital Quality Knowledge Competition and Digital Innovation Ability Competition.	Schiuma et al. (2021)	5-point scale

Variable	Operationalization Definition	Scale Items	Reference	Likert Scale
		5. Be able to use digital technology platforms to effectively communicate and interact with teachers, parents, students, and others.		
Digital Implementation Assurance (DIA)	This study divides principals' digital implementation assurance ability into evaluating teachers' digital teaching level, students' digital learning ability, school digital environment construction, and digital-related system construction.	1. The principal can use reasonable methods to evaluate and assure teachers' digital quality and teaching ability. 2. The principal can assess and assure students' digital quality and learning ability. 3. Be able to evaluate and assure the school's digital hardware and software construction status of facilities. 4. Evaluate the implementation and effectiveness of various digital school policies or systems and provide improvement suggestions.	El Sawy (2016)	5-point scale
Digital Literacy of Principals (DLP)	Digital literacy is a comprehensive ability that principals should possess in the digital transformation of education. It includes digital awareness, attitudes toward information technology, a basic understanding of digital knowledge, and digital ethical security.	1. Have a digital awareness and pay attention to and understand the related digital education policies issued by the country. 2. Be willing to accept emerging digital information technologies and actively utilize the Internet for	Zhang (2021)	5-point scale

Variable	Operationalization Definition	Scale Items	Reference	Likert Scale
		self-directed learning. 3. Have a basic grasp of digital technology knowledge and possess the ability to identify and use information. 4. Be familiar with intellectual property, data, and information security issues related to the application of digital technology.		
Effectiveness of Principal Digital Leadership (EPDL)	It refers to the positive impacts and changes that a principal has on school members (mainly teachers), school organizational processes, and ultimately on teaching and learning through implementing a series of digital vision planning, construction, management, and support behaviors.	1. Support from higher education departments regarding funding, resources, technology, etc., provides indispensable conditions for developing school digital construction. 2. The school's hardware and software can meet teachers' and students' teaching and learning needs. 3. The school's digital planning and institutional construction are reasonable, and the digital atmosphere is intense. 4. Teachers' work enthusiasm continues to improve, and teaching levels and effectiveness can be improved effectively. Teachers will provide suggestions or feedback on the school's digital construction.	Betchoo (2016)	5-point scale

Variable	Operationalization Definition	Scale Items	Reference	Likert Scale
		5. Students are highly accepting of reforms, especially digital information reforms. Their overall learning performance has improved, and their digital quality and innovative learning ability have been effectively enhanced.		
Teachers' Digital Behavioral Intention (TDBI)	It includes their acceptance of educational digital transformation, their active participation in various information technology and teacher training programs organized both inside and outside the school, their level of digital teaching in everyday teaching situations, and whether they will provide suggestions or feedback on the school's digital development.	1. Teachers have a high acceptance of reforms, especially digital information reforms. 2. Teachers can actively participate in various digital training organized both inside and outside the school, and the level of digital teaching can meet the requirements of daily teaching. 3. Teachers will provide their own suggestions or feedback on the digital construction and effectiveness of schools.	Wang (2021)	5-point scale

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Research Design

This study argued that the principal remains an important factor influencing digital transformation and development in primary schools. Digital leadership among primary school principals determines the extent and quality of the school's educational digital transformation.

This study aimed to develop a digital leadership model for primary school principals and enhance their digital effectiveness, employing a mixed methods research design combining quantitative surveys with qualitative interviews. The quantitative survey collected data using questionnaires to quantify the core influencing factors and their indicators of the effectiveness of digital leadership of primary school principals and to gain insight into the current state of digital leadership among these principals. The qualitative method collected data through follow-up interviews and focus group discussion with principals, school administrative staff, and front-line teachers, trainers and experts by using Nvivo.14 qualitative analysis software and Grounded Theory to verify the research hypotheses and the developed model. Research methods are as follows.

Questionnaire Survey Method

The questionnaire survey method is a commonly used data-collection tool in social research. A questionnaire is a set of questions related to the research objective, designed in detail and comprehensively (Han, 2021). Respondents are required to answer the questions, and sociological statistical methods are applied to describe and analyze the data quantitatively, thereby obtaining the required survey data.

This study developed a questionnaire (See Appendix E) and selected primary school principals in Henan Province to conduct a questionnaire survey. The aim is to empirically investigate and apply the digital leadership model's development to verify its effectiveness and feasibility, and ultimately to enhance the school's overall digital development.

Follow-up Interview Method

This study conducted follow-up online interviews with the same 5 respondents of the preliminary study: 2 primary school principals, 2 frontline teachers, and 1 school administrative staff member. The purpose is to examine whether the causal relationship depicted by this final model aligns more closely with the actual situation than initially discussed, and whether a crucial factor in the success of digital effectiveness in schools has been overlooked.

The follow-up interview questions of principals,teachers and school staff member were shown in Appendix C (See Appendix C), and the follow-up interview outline were shown in Appendix D (See Appendix D).

Focus Group Discussion Method

It is a structured approach to gathering insights, advice, or recommendations from specialists in a particular field. It is widely used in decision-making, research, policy development, and problem-solving. This study organized a Ding Talk discussion and invited 7 experts in the fields of educational administration and digital transformation to provide opinions and suggestions on the digital leadership of primary school principals. Among the experts were 2 experienced primary school principals, 1 school board member, 2 education trainers, and 2 additional experienced staff members from the local education bureau.

The consent letter and outlines of focus group discussion of this study were shown in Appendix J (See Appendix J).

In the end, to systematically evaluate the theoretical rigor and practical value of the research model in this study, 8 Ph.D. experts majoring in education and management were invited to complete a structured evaluation questionnaire using a five-point Likert scale (1-5 Scores) to evaluate the "Propriety, Feasibility, and Utility" of the model.

3.2 Population and Sample

Population

The population of this study was primary school principals across Henan Province. Henan has the third-largest population in China (according to government statistics in 2023). The scale of basic education is vast, and the number of primary school principals is substantial; therefore, it is impossible to distribute questionnaires to every member. There are 17 cities in Henan Province; the total number of primary schools is approximately 16,400, and the number of principals is approximately 16,400 (See Table 3.1).

Table 3.1 Location and Primary Schools in Henan Province

No.	City	Location	Number of Schools
1	Sanmenxia	Northwest	589
2	Zhengzhou	Middle	655
3	Puyang	Northeast	674
4	Xuchang	Middle	489
5	Shangqiu	Southeast	875
6	Zhoukou	Southeast	587
7	Jiyuan	Northwest	763
8	Hebi	Northeast	754
9	Xinyang	Southeast	955
10	Anyang	Northeast	858
11	Xinxiang	Northwest	663
12	Luoyang	Middle	760
13	Pingdingshan	Middle	869
14	Nanyang	Southwest	751
15	Luohe	Middle	366

No.	City	Location	Number of Schools
16	Kaifeng	Middle	475
17	Jiaozuo	Southeast	435
	Total		16,410

According to the general training schedule for the "Digital Training Program" in Table 1.2, approximately 2,730 principals participated in the offline training each time. This study conducted a survey to eligible principals at the six education and training centers (See Table 3.2).

Table 3.2 Basic Information of Six Training Centers

No.	Education Training Center	Province	Level	Nature	Focus
1	Henan University	Henan	Graduate	Public	Comprehensive
2	Henan Normal University	Henan	Graduate	Public	Normal Education
3	Xinyang Normal University	Henan	Graduate	Public	Comprehensive
4	Zhengzhou Normal College	Henan	Undergraduate	Public	Comprehensive
5	Luoyang Normal College	Henan	Undergraduate	Public	Normal Education
6	Nanyang Normal College	Henan	Undergraduate	Public	Normal Education

Sample

Determining an appropriate sample size is crucial to ensuring that the study has sufficient statistical power to detect meaningful relationships among variables.

The calculation was based on the total population of 2,730 principals in the training program. According to Cochran's sample size formula for finite populations, the following equation was used:

$$\mathbf{n}=\frac{Z^2\times(P\times(1-P))}{E^2}$$

n is the sample size
Z is the Z value (1.96 for a 95% confidence level
P is the estimated proportion of the population set at 0.5 to maximize variance
E is the margin of error (set at 5%)

Entering the population size 2,730 into the above formula yielded a sample size of 385.

Next, it was necessary to determine whether an adjustment was needed. According to Cochran, if the initial sample size (n) exceeds 5% of the total N (i.e., n/N > 0.05), the sample size should be adjusted.

Here, the initial n=385, the equation result: 385 / 2730 ≈ 14.1%

14.1% > 5%, so the sample size needed to be adjusted. To adjust for potential non-responses by increasing it by 20%, the calculation was as follows:

$$n_{\text{adjusted}} = \text{n} \times (1 + \text{Adjust the scale})$$

$$n_{\text{adjusted}} = 385 \times (1 + 0.20)$$

$$n_{\text{adjusted}} = 462$$

Ultimately, this study's sample size was approximately 462 primary school principals.

This strategy ensures that the number of mailed surveys or scheduled interviews exceeds the minimum required to maintain the specified level of confidence and precision (Sudman, 1976). After accounting for a 20% increase to manage non-responses, the recommended sample size was approximately 462.This adjustment ensured that, even if some participants did not respond, the study would maintain a sufficient sample size to meet the desired confidence and precision levels. This sample size was appropriate to ensure that the study's findings are statistically significant and representative.

3.3 Sampling

Purposive Sampling

Purposive sampling is a strategy that intentionally selects participants based on specific criteria. Unlike methods that rely on a predetermined theoretical framework or strict rules regarding participant numbers, purposive sampling relies on researchers actively identifying and inviting individuals or groups who can provide rich information based on their professional knowledge or practical experience, thereby aligning with the research objectives (Bernard, 2002). This technique, commonly used in qualitative research, aims to utilize limited resources most efficiently by identifying and selecting information-rich cases (Patton, 2002), thereby demonstrating its practicality and effectiveness.

In the study, the main research subjects were primary school principals. The platform relied on six training centers in Henan Province. Therefore, the purposive sampling method was adopted by selecting principals who participated in the education training.

Stratified Random Sampling

In this study, a stratified random sampling method was employed to ensure that the sample was representative of the entire population of primary school principals. Its first advantage is improved representativeness: compared with simple random sampling, it ensures that each category is fully represented and avoids overlooking

certain groups. Its second advantage is that it reduces sampling error; when individuals within a layer are relatively similar, the overall estimation error is smaller than that of simple random sampling. The third advantage is improved efficiency, particularly when there are significant internal differences within the population; stratified sampling is more efficient than simple random sampling.

In this study, 2,730 principals were randomly assigned to six training centers for 10 training days simultaneously. Therefore, the training centers served as the sampling layer, and random sampling was conducted within each layer: samples were randomly selected from each layer according to a specified proportion or a fixed number. Because 2,730 principals were randomly and evenly distributed to each training base, about 450-500 principals were in each training base. In order to get a 462 sample size, the sample size for each layer was about 70-80. After adjustment, the specific selection of each training base is shown in the following table (See Table 3.3).

Table 3.3 Proportion of the Sampling Selection in the Six Training Centers

Education and Training Center	Number of Trainers	Percentage	Sample Size
Henan University	455	16.67%	77
Henan Normal University	465	17.03%	79
Xinyang Normal University	450	16.48%	74
Zhengzhou Normal College	455	16.67%	79
Luoyang Normal College	450	16.48%	74
Nanyang Normal College	455	16.67%	79
Total	**2730**	**100%**	**462**

3.4 Research Instrument

Survey Questionnaire

Questionnaire Development

A questionnaire survey is the most widely used data collection method in social survey research. Based on the conceptual framework of the study, items for the independent variables, the mediator, the moderator variable and the dependent variables were developed. All items in the questionnaire were derived from published research by related scholars.

Measurement of Independent Variables:

Digital Vision Planning (DVP): Based on Hoy & Miskel's (2013) educational leadership framework and Hallinger & Murphy's (1985) teaching management behavior scale, measuring from three dimensions: vision clarity, communication frequency, and action plan transformation.

Digital Literacy of Principals (DLP): Based on the ISTE (2018) educational leadership standards, referencing Morales et al. (2008) self-assessment scale for technological literacy, and incorporating suggestions from experts, two localized questions were added.

Digital Implementation Assurance (DIA): Drawing on Eisenhardt's (1989) organizational assurance theory and combining with Wang & Woo's (2007) information technology integration framework, DIA was measured from four dimensions.

Measurement of Dependent Variable:

Effectiveness of Principal Digital Leadership (EPDL): Based on Leithwood & Sun's (2012) leadership effectiveness framework and Anderson & Dexter's (2005) technology leadership research, combined with previous interview recommendations, a comprehensive scale was constructed that includes five dimensions.

Measurement of Mediator Variable:

Digital Management (DM): Based on Yukl's (2012) Management Behavior Theory and referencing Hallinger's (2018) research on educational change management, the measurement was conducted from five dimensions.

Measurement of Moderator Variable:

Teachers' Digital Behavioral Intention (TDBI): Using the classic scale in Davis' (1989) Technology Acceptance Model (TAM), it was measured from two core dimensions: perceived usefulness and perceived ease of use. At the same time, in order to capture the "team atmosphere" effect discovered in this study, referring to Scherer et al.'s (2019) teacher TAM study, one additional item measuring the digital atmosphere of teaching groups was added.

To make the questionnaire more suitable for the research setting, the items were revised and refined to measure the variables related to principal digital leadership.

The questionnaire is divided into three parts:

The first part covers basic information about principals, including gender, age, highest level of education, years of service as a principal, and the school's location and area.

The second part examines the core influencing factors of principal digital leadership.

The third part concerns principals' suggestions for digital leadership and digital effectiveness.

The second part all use the Likert (5-point) scale method, and the higher the score, the higher the degree of identification or conformity, and the third part is open-ended questions for personal opinions.

The scoring criteria of the scale in the second part are as follows:

In the box "Current situation" in the questionnaire, from left to right: A score of 5 means the current situation is at the highest level, a score of 4 means a better level, a score of 3 means a moderate level, a score of 2 means a low level, and a score of 1 means the lowest level.

Pilot Study

A pilot study was then conducted after the questionnaire was constructed.

The questionnaire was first tested with a small-scale sample (7 principals) to check the readability, comprehension, logic, and reasonableness of the question setting in the questionnaire (See Table 3.4). They identified issues and revised the questionnaire based

on interviews, feedback, and observations of participants' completion processes to ensure that the wording was precise and unambiguous.

Table 3.4 Basic Information of Pilot Study Participants

No.	Identity	Gender	Age	Education Background	Years of working
1	Principal	Female	51	Bachelor Degree	21
2	Principal	Female	46	Master Degree	17
3	Principal	Male	53	Bachelor Degree	22
4	Principal	Female	39	Master Degree	10
5	Principal	Male	42	Master Degree	13
6	Principal	Male	48	Bachelor Degree	19
7	Principal	Male	38	Master Degree	10

IOC Testing (Item-Objective Congruence) (Appendix F)

IOC testing is mainly used to evaluate the content validity of a questionnaire, that is, the consistency between items and research objectives. Usually evaluated by five experts, the IOC value of each item is calculated to determine whether a question should be retained, modified, or deleted. Selecting questions with an IOC value of 0.50 or higher is suitable for the selection standards and has content validity (Rovinelli & Hambleton, 1977), according to the following formula: $IOC = \sum r / N$.

Among them, the IOC represents the consensus index, with a value between -1 and +1; $\sum r$ denotes the sum of expert opinion scores; and N denotes the number of experts. The experts in the IOC testing are listed in Table 3.5.

Table 3.5 List of Experts for IOC of Research Instrument

No.	Name	Organization	Position	Graduation Institution	Education Level	Years of Experience
1	Zhang Weiping	Tsinghua University	Professor / Doctoral supervisor	China University of Political Science and Law	Ph.D in Education	30
2	Zhang Mingjun	Shanghai Jiao Tong University	Professor / Doctoral supervisor	Renmin University of China	Ph.D. in Philosophy	28
3	Zhou Donghui	Guizhou Normal University	Professor / Doctoral supervisor	Tianjin Normal University	Ph.D. in Education	17

No.	Name	Organization	Position	Graduation Institution	Education Level	Years of Experience
4	Zhang Lei	Central China Normal University	Associate Professor	University of Macau	Ph.D. in Education	11
5	Tan Minda	Shandong Normal University	Associate Professor	Pennsylvania State University	Ph.D. in Philosophy	10

The five experts reviewed and rated all the questionnaire items. Items with IOC values greater than 0.50 were considered acceptable, while those above 0.75 were deemed highly relevant and logically coherent with the construct. Items that failed to meet the threshold were revised or removed in response to expert feedback. The results of the IOC analysis confirmed the logical validity and content alignment of all final items (See Appendix H).

Reliability Test (Cronbach's Alpha, 30 Informants)

To further improve the questionnaire, following the five experts' guidance and modifications, the questionnaire was distributed and tested on a small scale to assess potential reliability issues in the measurement, 30 primary school principals participated in the reliability test (See Table 3.6). The Cronbach's alpha coefficient is a method used to test the reliability of questionnaire dimensions, that is, to test whether they have internal consistency, measure the reliability of the questionnaire, and determine whether items in each measurement dimension need to be modified or deleted.

Table 3.6 Basic Information of Participants of Reliability Test

Basic information		Quantity	Percentage
Gender	Male	16	53.3%
	Female	14	46.7%
Age	More than 50 years old	8	26.7%
	35-50 years old	12	40.0%
	Less than 35 years old	10	33.3%
Education Background	Doctor Degree	1	3.3%
	Master Degree	16	53.3%
	Bachelor Degree	13	43.4%
School Location	City	9	30.0%
	Country/ Town	12	40.0%
	Village	9	30.0%
Years of being a principal	More than 15 years	6	20.0%

Basic information		Quantity	Percentage
The Times of Participating in the Principal Training	8-15 years	19	63.3%
	Less than 8 years	5	16.7%
	More than 10 times	5	16.7%
	4-10 times	19	63.3%
	Less than 4 times	6	20.0%
The Times of organized technology or digital training for teachers	More than 10 times	7	23.3%
	4-10 times	12	40%
	Less than 4 times	11	36.7%
Total		**30**	**100%**

By using SPSS 26.0 software and testing the reliability of questionnaire items, generally, a Cronbach's alpha coefficient of 0.70 or higher is acceptable, and below 0.35 must be rejected (Tavakol & Dennick, 2011) (See Table 3.7).

Table 3.7 Cronbach's Alpha Coefficient Size Guidelines

Alpha Coefficient Range	Strength of Association
< 0.6	Poor
0.6 to < 0.7	Moderate
0.7 to < 0.8	Good
0.8 to < 0.9	Very Good
≧ 0.9	Excellent

The result of reliability test of the pilot study is presented in Table 3.8.

Table 3.8 Cronbach's Alpha Coefficient of Pilot Study

No of Items	No of Participants	Cronbach's Alpha
24	30	0.923

Translation of Research Instruments

The research tools were translated from English to Chinese and back to English to ensure semantic accuracy. They were back-translated by two different English experts (See Appendix G). ZhangYan is an English teacher with a Master's degree in English (Level 8) from Beijing Foreign Studies University. Jennifer Miller is an American teacher who has taught English at Wuhan University for three years (See Table 3.9).

Table 3.9 Basic Information of English Experts

No.	Identity	Nationality	Gender	Age	Work Place	Years of Working
1	English teacher	Chinese	Male	47	Beijing Foreign Studies University	16

No.	Identity	Nationality	Gender	Age	Work Place	Years of Working
2	English teacher	American	Female	36	Wuhan University	9

3.5 Data Collection

(1) Questionnaire Data

A standardized questionnaire was designed to study the current situations of digital leadership for primary school principals. The questionnaires were distributed by a professional online platform Wen Juan Xing (WJX for short) and through the training centers conducted by Henan University, Henan Normal University, Xinyang Normal University, Zhengzhou Normal College, Luoyang Normal College and Nanyang Normal College. After developing the questionnaire, a QR code and a website link were generated. Respondents could easily access the survey by scanning the QR code with their mobile phones or visiting the WJX website via the link.

(2) Follow-up Interview Data

This study conducted follow-up interviews with 5 participants (See Table 3.10), 2 primary school principals, 2 front-line teachers and 1 school administrative staff. The interview was short for about 20 minutes and online. The interviewees were coded with principal P2 and P4, front-line teacher T2 and T3, and school administrative staff S1 (The same coding with the interview in the first stage). By sending emails, 5 participants were asked to carefully fill in their feedback according to their work roles in school. The author collected the 5 feedback forms and compiled each dialogue into a separate Word document sentence by sentence. In the document, the questions and answers were marked with [Q] and [A](See Appendix C and D).

Table 3.10 Basic Information of Follow-up Interviews

Number	Identity	Gender	Age	Education Background
P2	Primary school principal	Male	42	Master Degree
P4	Primary school principal	Female	51	Bachelor Degree
S1	School administrative staff	Female	37	Master Degree
T2	Teacher	Male	42	Bachelor Degree
T3	Teacher	Female	34	Master Degree

(3) Focus Group Discussion Data

Focus group discussion was used to gather insights, advice, or recommendations from specialists to validate the relationships in the framework and lay the foundation for subsequent quantitative evaluation. The study organized a Ding Talk discussion and invited 7 experts in the field of education and digital transformation who have not participated in this research before to provide opinions and suggestions. 2 of the experts are experienced primary school principals, 1 is the member of school board, 2 of them are experts from education and training center, and another 2 of them are experts from the local education bureau (See Table 3.11).

Table 3.11 Basic Information of Focus Group Members

Number	Identity	Gender	Age	Work location	Duration
P1	Primary school principal	Male	49	Primary school	24
P2	Primary school principal	Male	54	Primary school	28
S3	School board member	Female	49	Local community	17
E4	Education trainer	Female	43	Education Training Center	16
E5	Education trainer	Male	46	Education Training Center	19
B6	Director of Information Technology	Male	45	Local Education Bureau	15
B7	Information policymaker	Female	42	Local Education Bureau	13

3.6 Data Analysis

The data analysis in this mixed-methods study combined descriptive statistics, content analysis, and confirmatory factor analysis to examine the collected data and draw meaningful conclusions thoroughly.

Quantitative Data Analysis

After the data were collected and preliminary sorted, various types of analyses were conducted, including variable impact analysis, mediation effect analysis, and moderator effect analysis. The data were analyzed using SPSS 26.0 and AMOS 23.0 software, with a significance level of 0.05 for all statistical tests.

The variable impact analysis included examining interactions among three independent variables (Digital Vision Planning (DVP), Digital Literacy of Principals (DLP) and Digital Implementation Assurance (DIA)), a mediator (Digital Management (DM)), a moderating variable (Teachers' Digital Behavioral Intention (TDBI)), and a dependent variable (Effectiveness of Principal Digital Leadership (EPDL)).

The mediation effect analysis examined whether the mediator (Digital Management (DM)) plays a significant role in the relationship between the independent and dependent variables. The moderation effect analysis examined whether the moderator (Teachers' Digital Behavioral Intention (TDBI)) plays a significant role in the relationship between the independent and mediating variable.

Qualitative Data Analysis

Follow-up Interviews Data Analysis

The qualitative data were analyzed using content analysis with specifically classified answers. A "Follow-up Verification" project was created by using Nvivo.14 software, 5 documents were imported to establish a dedicated coding node system. The researcher carefully read the transcript and classified each paragraph of the interviewee's description into nodes. Any factors not included in the model that were repeatedly or strongly mentioned by respondents were identified and immediately new nodes were created. After analyzing 5 documents, important theoretical

categories that could correct the model and the existing categories that were fully explained and were judged as “theoretical saturation”. Then the researcher conducted three-level coding analysis to find out whether the causal relationship depicted by this model was in line with the actual situation in primary school and digital leadership of primary school principals.

Focus Group Discussion Data Analysis

According to the focus group discussion outline (See Appendix J), all experts’ suggestions were divided into three areas: consensus confirmation, in-depth suggestions, and application prospects. In order to scientifically identify consensus, disagreement, and determine priority from numerous suggestions, a viewpoint matrix was first constructed and all original suggestions were included for matrix analysis. Based on the results of the analysis, it was decided which suggestion belonged to the categories of ‘consensus confirmation of all these experts,’ ‘limitations that need to be explained in the discussion’, or ‘recommendations for future research’, and to lay the foundation for further analysis.

CHAPTER 4

DATA ANALYSIS AND RESEARCH RESULTS

This study employed a mixed-methods approach that combines qualitative and quantitative methods to systematically develop and validate a digital leadership model for primary school principals in Henan, China, to enhance the effectiveness of their leadership practices. The research design was grounded in Grounded Theory, Educational Change Theory, Leadership Development Theory, Theory of Planned Behavior, and Self-Determination Theory.

In the quantitative analysis section, data were collected via structured questionnaires, and descriptive statistics were analyzed using SPSS 26.0. Confirmatory factor analysis and structural equation modeling were performed using AMOS 23.0 to elucidate the structural relationships and pathways among variables. In the qualitative analysis phase, a preliminary exploration of research problems and questions was conducted through semi-structured interviews. In the second stage, the study conducted follow-up interviews with 5 respondents: 2 primary school principals, 2 front-line teachers, and 1 school administrative staff member. The purpose was to examine whether the causal relationship depicted by this final model is more consistent with the actual situation than initially discussed, and whether a crucial factor for the success of digital effectiveness in schools has been overlooked, in order to identify deeper meanings in the development of the digital leadership model. Further in-depth opinions were collected through focus group discussions to triangulate the quantitative analysis results, and 8 Ph.D. experts in Education and Management validated the model's propriety, feasibility, and utility.

This chapter presents the empirical results, integrating the literature review and conceptual framework in Chapter 2, the methodology in Chapter 3, and quantitative and qualitative data analyses and findings for discussion, thereby providing a basis for subsequent model development and theoretical interpretation.

4.1 Quantitative Statistical Analysis and Hypothesis Testing

Analysis of Sample Demographic Characteristics

To facilitate statistical analysis and improve data validity, the questionnaire for this study was designed and distributed using the online platform Wen Juan Xing (Questionnaire Star). An anonymous data collection mode was adopted to protect respondents' privacy, with a clear emphasis on the strict confidentiality of all questionnaire responses and data, thereby ensuring the authenticity and validity of the survey data. A total of 481 electronic questionnaires were distributed in this survey; 462 were valid, yielding an effective response rate of 96.05%. Descriptive statistical analysis was conducted on the basic demographic characteristics of the sample, and the specific results are presented in the table below (See Table 4.1)

Table 4.1 Basic Characteristics of the Sample (n=462)

Characteristic	Option	Frequency	Percentage%
Gender	Male	264	57.143
	Female	198	42.857
Age	More than 50 years old	135	29.221
	35-50 years old	260	56.277
	Less than 35 years old	67	14.502
Highest educational level	Doctoral Degree	73	15.801
	Master's Degree	248	53.68
	Bachelor's Degree	141	30.519
School located	City	234	50.649
	County/Town	154	33.333
	Village	74	16.017
The number of years you have been a principal	More than 15 years	82	17.749
	8-15 years	213	46.104
	Less than 8 years	167	36.147
Times of the relevant principals' digital training	More than 10 times	262	56.71
	4-10 times	152	32.9
	Less than 4 times	48	10.39
Times of teaching training for school staff, especially for teachers	More than 10 times	235	50.866
	4-10 times	171	37.013
	Less than 4 times	56	12.121
		462	100

Regarding gender distribution, 264 respondents were male (57.14%), and 198 were female (42.86%). Males accounted for a slightly higher proportion than females in this study. Although there was a slight disparity in the gender distribution of the sample, the overall structure was relatively balanced.

In terms of age structure, respondents aged 50 and above constituted the largest group, accounting for 29.22% (135 people); those aged 35 to 50 numbered 260, accounting for 56.28%; and respondents under 35 were the smallest group, accounting for 14.50% (67 people). The research subjects were predominantly middle-aged and elderly school principals, with a relatively small proportion of young principals.

In terms of educational background, the overall educational level of the

respondents was relatively high. Among them, 248 respondents held a master's degree (53.68%), forming the dominant group; 73 held a doctoral degree (15.80%); and 141 held a bachelor's degree (30.52%). No respondents had an educational background below a bachelor's degree, indicating that the current group of school principals has a high overall level of educational attainment.

In terms of school location, principals from urban schools accounted for the largest share (234 respondents, 50.65%); those from township schools numbered 154 (33.33%); and those from village schools numbered 74 (16.02%). The sample distribution is basically consistent with the overall layout characteristics of urban and rural schools in China, with a relatively higher proportion of urban schools.

In terms of principal tenure, principals with 8 to 15 years of tenure constituted the core group, with 213 people accounting for 46.10%; Those with less than 8 years of tenure numbered 167 (36.15%); and senior principals with more than 15 years of tenure were 82, making up 17.75%. Overall, the research subjects were primarily principals with short-to medium-term tenure, with a relatively low proportion of senior principals.

Regarding participation in digital training, 262 principals had participated in relevant information technology or digital training more than 10 times (56.71%); 152 had participated 4 to 10 times (32.90%); and only 48 had participated fewer than 4 times (10.39%). This indicates that the vast majority of principals have participated in digital-related training multiple times, with a high overall level of training participation.

In terms of the organization of on-campus digital training, 235 principals had organized relevant information technology or digital teaching training for faculty and staff more than 10 times, accounting for 50.87%; 171 had organized such training 4 to 10 times (37.01%); and 56 had organized it less than 4 times (12.12%). Consistent with their own training participation, most principals can actively organize digital-related training for on-campus faculty and teachers to promote the development of digital teaching in schools.

Overall, the sample in this study was reasonably well distributed across dimensions such as gender, school location, and principal tenure. All research subjects were school principals, with a high level of education and a high frequency of participation in and organization of digital training. The sample characteristics are consistent with the study's research objectives, and the sample is reasonably representative, providing robust data to support subsequent research and analysis.

Descriptive Statistical Analysis of Variables

Descriptive statistical analysis was conducted on six core research variables in this study, namely Digital Vision Planning (DVP), Digital Literacy of Principals (DLP), Digital Implementation Assurance (DIA), Effectiveness of Principal Digital Leadership (EPDL), Digital Management (DM), and Teachers' Digital Behavioral Intention (TDBI), to explore the overall distribution characteristics of each variable. The analysis results were based on 462 valid samples, and the specific values are presented in the table below (See Table 4.2).

Table 4.2 Descriptive Statistics of Variables (n=462)

Variable	Minimum	Maximum	Mean	Std	Skewness	Kurtosis
Digital Vision Planning	1.000	5.000	3.263	0.985	0.040	-0.848
Digital Literacy of Principals	1.000	5.000	3.265	0.990	0.063	-0.967
Digital Implementation Assurance	1.250	5.000	3.368	0.966	-0.039	-0.884
Effectiveness of Principal Digital Leadership	1.200	5.000	3.316	0.964	0.020	-1.012
Digital Management	1.200	5.000	3.309	1.001	0.099	-1.141
Teachers' Digital Behavioral Intention	1.000	5.000	3.365	1.021	-0.023	-1.000

All research variables were measured using a 5-point Likert scale, with higher scores indicating stronger performance levels.

In terms of mean values, the six core variables ranged from 3.263 to 3.368, all at the medium level of the scale. Among the six variables, Digital Implementation Assurance (M=3.368) and Teachers' Digital Behavioral Intention (M=3.365) had the highest means, whereas Digital Vision Planning (M=3.263) had the lowest. This indicates that the respondents had a relatively good level of perceptual assurance regarding digital implementation, but a relatively weak level of perceptual assurance regarding digital vision planning, and that the overall perceptual levels of the other variables were moderate and relatively balanced.

In terms of dispersion, the standard deviations of all variables ranged from 0.964 to 1.021. Teachers' Digital Behavioral Intention (SD=1.021) had the largest standard deviation, and Effectiveness of Principal Digital Leadership (SD=0.964) had the smallest. The overall differences in the standard deviations of each variable were small, and none exceeded 1.1. This indicates that the dispersion of respondents' answers across each core variable was moderate, with no extreme divergence of opinions, and that the overall distribution of data was relatively concentrated.

Skewness values for the six core variables ranged from -0.039 to 0.099. The absolute values of skewness for all variables were far less than 1, which meets the skewness criterion for normal distribution. This suggests that the distributions of each variable were approximately symmetric, with no clear left-or right-skew. Kurtosis values for all variables ranged from -1.141 to -0.848, all negative. This indicates that each variable exhibited a platykurtic distribution; compared with the standard normal distribution, the data were flatter, with no pronounced leptokurtic characteristics.

Based on skewness and kurtosis, the distributions of the six core variables in this study exhibited the basic characteristics of normality. The absolute values of kurtosis were all less than 3, indicating that the current data were approximately normal; the skewness values were all close to 0, indicating that the current data were approximately normal.

Reliability Analysis

In this study, Cronbach's α was used as the index of internal consistency. Meanwhile, the Corrected Item-Total Correlation (CITC) and the Cronbach's α coefficient if an item is deleted were combined to test the reliability and rationality of each item in the scale, to judge the internal consistency of the scale, and the scientificity of item screening. The judgment criteria for the reliability test are as follows: a CITC value greater than 0.4 and a Cronbach's α coefficient if item deleted not higher than the overall Cronbach's α coefficient of the scale indicate that the item has good discriminability; a Cronbach's α coefficient greater than 0.7 means acceptable reliability, a value greater than 0.8 indicates that the scale has good internal consistency, and a value greater than 0.9 represents excellent reliability. This reliability test was conducted based on 462 valid samples, and the test results are presented in the table below (See Table 4.3)

Table 4.3 Reliability Test (n=462)

Dimension	Name	Corrected Item-Total Correlation (CITC)	Cronbach's Alpha if Item Deleted	Cronbach's Alpha Coefficient	Overall, Cronbach's α Coefficient
Digital Vision Planning (DVP)	DVP1	0.648	0.729	0.802	0.923
	DVP2	0.635	0.743	0.802	0.923
	DVP3	0.660	0.717	0.802	0.923
Digital Literacy of Principals (DLP)	DLP1	0.698	0.821	0.858	0.923
	DLP2	0.699	0.820	0.858	0.923
	DLP3	0.704	0.819	0.858	0.923
	DLP4	0.707	0.817	0.858	0.923
Digital Implementation Assurance (DIA)	DIA1	0.669	0.836	0.860	0.923
	DIA2	0.712	0.819	0.860	0.923
	DIA3	0.714	0.817	0.860	0.923
	DIA4	0.726	0.813	0.860	0.923
Effectiveness of Principal Digital Leadership (EPDL)	EPDL1	0.723	0.860	0.885	0.923
	EPDL2	0.728	0.859	0.885	0.923
	EPDL3	0.748	0.854	0.885	0.923
	EPDL4	0.711	0.863	0.885	0.923
	EPDL5	0.700	0.865	0.885	0.923
Digital Management (DM)	DM1	0.744	0.862	0.889	0.923
	DM2	0.721	0.867	0.889	0.923
	DM3	0.728	0.865	0.889	0.923
	DM4	0.725	0.866	0.889	0.923
	DM5	0.732	0.865	0.889	0.923
Teachers' Digital Behavioral Intention (TDBI)	TDBI1	0.678	0.746	0.820	0.923
	TDBI2	0.682	0.742	0.820	0.923
	TDBI3	0.658	0.767	0.820	0.923

In terms of the Corrected Item-Total Correlation (CITC) values of items across all dimensions, the CITC values of all items under the six dimensions of this study—Digital Vision Planning (DVP), Digital Literacy of Principals (DLP), Digital Implementation Assurance (DIA), Effectiveness of Principal Digital Leadership (EPDL), Digital Management (DM), and Teachers' Digital Behavioral Intention (TDBI) —ranged from 0.635 to 0.748, all far exceeding the critical value of 0.4. In addition, the Cronbach's α coefficient when an item was deleted, corresponding to all items, was lower than the Cronbach's α coefficient of their respective dimensions. These results indicate that all items within each dimension exhibited good discriminability and item adaptability, with no need for item deletion, supporting the scientific and rational design of the scale items.

In terms of the Cronbach's α coefficient of each dimension, the reliability coefficients of the six dimensions all reached a high level: the Cronbach's α coefficient of Digital Vision Planning (DVP) was 0.802, and that of Teachers' Digital Behavioral Intention (TDBI) was 0.820, both above 0.8, which demonstrates good internal consistency within these two dimensions. The Cronbach's α coefficients of Digital Literacy of Principals (DLP) and Digital Implementation Assurance (DIA) stood at 0.858 and 0.860, respectively. At the same time, the Effectiveness of Principal Digital Leadership (EPDL) and Digital Management (DM) indices rose further to 0.885 and 0.889. All the above coefficients exceeded 0.8, indicating excellent internal consistency of the scales for these four dimensions, as well as strong correlations and homogeneity among the items.

In terms of the overall reliability of the research scale, the total Cronbach's α coefficient of the entire scale in this study reached 0.923, far surpassing the critical value of 0.9. This indicates that the research scale as a whole exhibited extremely high internal consistency reliability.

Validity Analysis

1. Construct Validity

Validity refers to the degree to which the measured results reflect the content to be examined. The more consistent the measured results are with the content to be examined, the higher the validity; conversely, the lower the validity. The validity test should assess the significance of the KMO coefficient and the Bartlett spherical test, with the KMO coefficient ranging from 0 to 1. The closer the KMO coefficient is to 1, the better the structural validity of the questionnaire. If Bartlett's spherical test is significant at $p < 0.05$, the questionnaire has good structural validity (See Table 4.4).

Table 4.4 KMO and Bartlett Test

KMO Sampling suitability quantity		0.921
Bartlett's spherical test	Approximately chi-squared	5759.262
	freedom	276.000
	p value	0.000

Validity was verified using the KMO and Bartlett tests, which yielded a coefficient of 0.921 and a chi-square value of 5759.262(SIG. = 0.000(0.01) for the Bartlett test, describing the overall validity of the questionnaire excellent.

Table 4.5 Explanation Rate of Variance

Factor number	Characteristic root			Explanation rate of variance before rotation			Explanation of the rate of variance after rotation		
	Total	Explanation rate of variance%	Accumulation%	Total	Explanation rate of variance%	Accumulation%	Total	Explanation rate of variance%	Accumulation%
1	8.710	36.292	36.292	8.710	36.292	36.292	3.475	14.481	14.481
2	1.984	8.265	44.557	1.984	8.265	44.557	3.468	14.451	28.932
3	1.914	7.976	52.533	1.914	7.976	52.533	2.841	11.837	40.769
4	1.674	6.976	59.509	1.674	6.976	59.509	2.824	11.767	52.536
5	1.372	5.716	65.225	1.372	5.716	65.225	2.196	9.149	61.685
6	1.283	5.347	70.572	1.283	5.347	70.572	2.133	8.887	70.572
7	0.569	2.371	72.943						
8	0.530	2.208	75.150						
9	0.517	2.155	77.306						
10	0.469	1.955	79.261						
11	0.467	1.945	81.206						
12	0.435	1.813	83.019						
13	0.424	1.769	84.788						
14	0.399	1.662	86.450						
15	0.388	1.616	88.066						
16	0.383	1.597	89.663						
17	0.365	1.523	91.186						
18	0.348	1.449	92.634						
19	0.341	1.420	94.055						
20	0.315	1.312	95.366						
21	0.300	1.250	96.617						
22	0.296	1.234	97.850						
23	0.259	1.080	98.931						
24	0.257	1.069	100.000						

Extraction method: principal component analysis.

Table 4.5 above analyzes the factor extraction results and the information volume extracted by the factors. As can be seen from the table, a total of 6 factors were extracted through factor analysis, all with eigenvalues greater than 1; the rotated variance explanation rates of these 6 factors were 14.481%, 14.451%, 11.837%, 11.767%, 9.149%, and 8.887%, respectively, with the rotated cumulative variance explanation rate reaching 70.572%.

Table 4.6 Rotated Loading

Name	Factor Load Coefficient						Commonality (common factor variance)
	factor1	factor2	factor3	factor4	factor5	factor6	
DVP1	0.131	0.193	0.155	0.102	0.133	**0.780**	0.716
DVP2	0.187	0.158	0.149	0.110	0.151	**0.762**	0.697
DVP3	0.129	0.167	0.202	0.093	0.065	**0.802**	0.741
DLP1	0.173	0.142	**0.764**	0.132	0.157	0.138	0.695
DLP2	0.141	0.174	**0.767**	0.142	0.116	0.159	0.698
DLP3	0.134	0.139	**0.778**	0.130	0.156	0.146	0.705
DLP4	0.163	0.125	**0.788**	0.103	0.143	0.117	0.707
DIA1	0.159	0.108	0.060	**0.770**	0.189	0.116	0.683
DIA2	0.166	0.189	0.148	**0.787**	0.065	0.070	0.714
DIA3	0.158	0.208	0.185	**0.778**	0.059	0.084	0.718
DIA4	0.151	0.196	0.115	**0.800**	0.087	0.072	0.728
EPDL1	**0.795**	0.116	0.117	0.136	0.074	0.106	0.695
EPDL2	**0.782**	0.142	0.104	0.150	0.176	0.066	0.700
EPDL3	**0.791**	0.163	0.122	0.149	0.069	0.167	0.722
EPDL4	**0.758**	0.180	0.173	0.116	0.091	0.101	0.669
EPDL5	**0.759**	0.136	0.143	0.137	0.106	0.099	0.656

Name	Factor Load Coefficient						Commonality (common factor variance)
	factor1	factor2	factor3	factor4	factor5	factor6	
DM1	0.159	**0.769**	0.148	0.215	0.152	0.077	0.713
DM2	0.167	**0.784**	0.104	0.122	0.069	0.134	0.691
DM3	0.220	**0.752**	0.173	0.146	0.084	0.150	0.695
DM4	0.140	**0.768**	0.137	0.149	0.138	0.130	0.686
DM5	0.091	**0.782**	0.099	0.161	0.162	0.150	0.704
TDBI1	0.145	0.143	0.141	0.127	**0.816**	0.112	0.755
TDBI2	0.130	0.182	0.153	0.124	**0.796**	0.145	0.743
TDBI3	0.153	0.163	0.241	0.111	**0.760**	0.092	0.707

Methods: principal component analysis, rotation: Varimax with Kaiser Normalization
Note: The numbers in the table in green indicate that the absolute value of the load coefficient is greater than 0.4

The data in Table 4.6 were rotated using the maximum-variance rotation method (varimax) to identify the correspondence between factors and research items. The table above presents the information extracted for the study items and the correspondence between the factors and the study items. From Table 4.6, it is observed that the similarity among all items exceeds 0.4, indicating a strong correlation between items and factors, and that factors can effectively extract information. After ensuring that the factors can account for most of the information in the study items, the relationship between each factor and each item was analyzed (when the absolute value of the factor load coefficient exceeds 0.4, the relationship is considered significant).

2. Convergent Validity

Confirmatory factor analysis (CFA) was performed on valid data from 462 respondents using AMOS 23.0 to verify that all latent factors and their observed variables conformed to the a priori theoretical relationships proposed. According to the fitting indices of the measurement model presented in the table, the ratio of chi-square to degrees of freedom (χ^2/df) was 1.134, which was less than the critical value of 3. The root mean square error of approximation (RMSEA) was 0.017, and the root mean square residual (RMR) was 0.034, both meeting the criteria of being lower than 0.05 and 0.8 respectively.

The adjusted goodness-of-fit index (AGFI) was 0.942, exceeding the standard value of 0.8, indicating acceptable model fit. Additionally, the values of the goodness-of-fit index (GFI), incremental fit index (IFI), normed fit index (NFI), comparative fit index (CFI), and Tucker-Lewis index (TLI) all exceeded 0.9 (See Table 4.7). These results demonstrate that the measurement model of this study achieved a good fit with the sample data, justifying further statistical analysis.

Table 4.7 Model Fitting Index

Common Index	**χ2**	**df**	**χ2/df**	**RMSEA**	**RMR**	**CFI**	**NFI**	**IFI**	**TLI**	**GFI**	**AGFI**
Judging standard	-	-	<3	<0.08	<0.05	>0.9	>0.8	>0.9	>0.8	>0.8	>0.8
Value	268.765	237	1.134	0.017	0.034	0.994	0.954	0.994	0.993	0.955	0.942

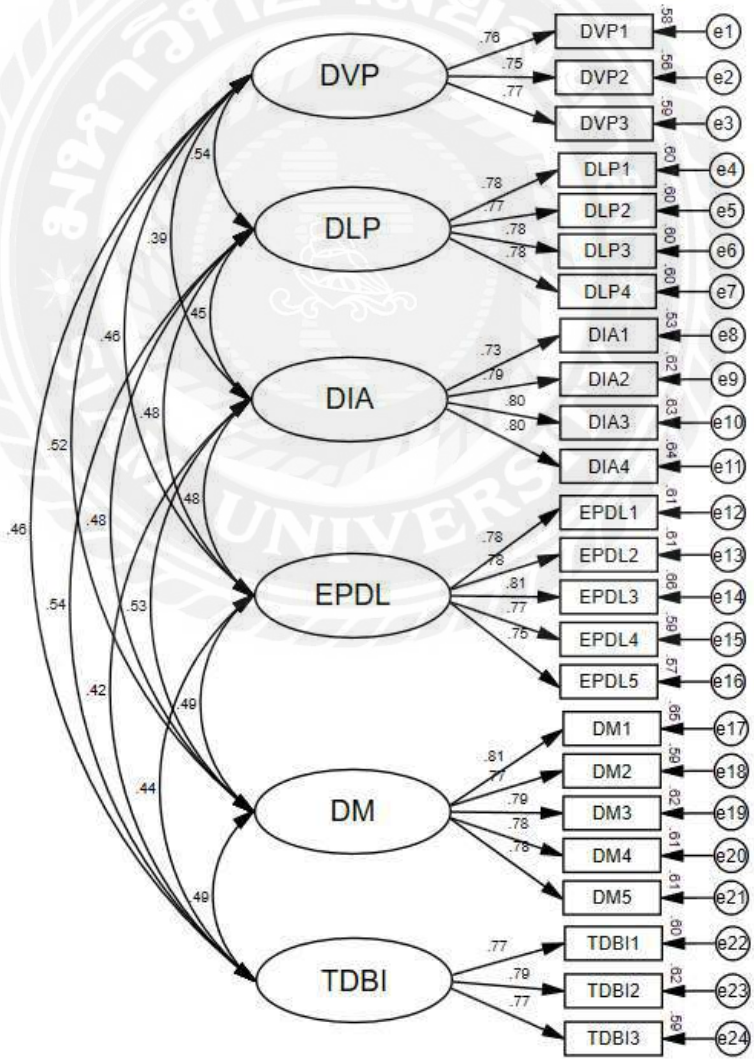

Figure 4.1 Confirmatory Factor Model Diagram

The main criteria for evaluating convergent validity in a sample comprise three aspects: standardized factor loadings, composite reliability (CR), and average variance extracted (AVE). These indicators are generally defined by the following thresholds: standardized factor loading > 0.6, CR > 0.7, and AVE > 0.5.

Table 4.8 Factor Load Coefficients

Factor	Measured Item	Non-Standard Load Factor	S.E.	C.R.	p	Standard Load Factor
Digital Vision Planning（DVP)	DVP1	1	-	-	0.000***	0.760
	DVP2	0.986	0.069	14.267	0.000***	0.747
	DVP3	1.032	0.071	14.514	0.000***	0.767
Digital Literacy of Principals (DLP)	DLP1	1	-	-	0.000***	0.775
	DLP2	1.012	0.061	16.536	0.000***	0.775
	DLP3	1.029	0.062	16.594	0.000***	0.777
	DLP4	1.002	0.061	16.559	0.000***	0.776
Digital Implementation Assurance (DIA)	DIA1	1	-	-	0.000***	0.731
	DIA2	1.045	0.066	15.808	0.000***	0.788
	DIA3	1.123	0.070	15.950	0.000***	0.796
	DIA4	1.100	0.069	15.986	0.000***	0.798
Effectiveness of Principal Digital Leadership (EPDL)	EPDL1	1	-	-	0.000***	0.779
	EPDL2	1.022	0.059	17.417	0.000***	0.784
	EPDL3	1.055	0.058	18.109	0.000***	0.811
	EPDL4	1.017	0.060	16.977	0.000***	0.767
	EPDL5	0.965	0.058	16.606	0.000***	0.752
Digital Management (DM)	DM1	1	-	-	0.000***	0.805
	DM2	0.920	0.052	17.734	0.000***	0.767
	DM3	0.965	0.053	18.327	0.000***	0.787
	DM4	0.922	0.051	18.117	0.000***	0.780
	DM5	0.956	0.053	18.198	0.000***	0.783
Teachers' Digital Behavioral Intention (TDBI)	TDBI1	1	-	-	0.000***	0.774
	TDBI2	1.007	0.065	15.534	0.000***	0.789
	TDBI3	0.990	0.065	15.223	0.000***	0.766

***p<0.05 **p<0.01 ***p<0.001**

In terms of measurement relationships, the absolute value of the standardized loading coefficients for each relationship exceeded 0.6 and was significant, indicating good measurement relationships.

Table 4.9 Model AVE and CR Index Results

Factor	AVE	CR
Digital Vision Planning	0.575	0.802
Digital Literacy of Principals	0.602	0.858
Digital Implementation Assurance	0.606	0.86
Effectiveness of Principal	0.606	0.885
Digital Management	0.616	0.889
Teachers' Digital Behavioral Intention	0.603	0.82

As shown in Table 4.8, confirmatory factor analysis (CFA) was conducted for a total of 6 items, with 24 items included in the analysis. As shown in Table 4.9, all AVE values exceed 0.5, and all CR values exceed 0.7, indicating that the data analyzed in this study exhibit good convergent validity.

3. Discriminant Validity

The AVE method was adopted in this study to assess the discriminant validity of the questionnaire. The questionnaire demonstrates good discriminant validity if the correlation coefficient between any two variables is smaller than the square root of the average variance extracted (AVE) of the questionnaire (See Table 4.10).

Table 4.10 Distinguishing Validity: Correlation and AVE Root Value

Factor	DVP	DLP	DIA	EPDL	DM	TDBI
Digital Vision Planning	**0.758**					
Digital Literacy of Principals	0.538	**0.776**				
Digital Implementation Assurance	0.393	0.455	**0.779**			
Effectiveness of Principal	0.464	0.478	0.482	**0.779**		
Digital Management	0.518	0.483	0.535	0.491	**0.785**	
Teachers' Digital Behavioral Intention	0.465	0.541	0.421	0.442	0.494	**0.776**

Note: Diagonal green numbers are AVE square root values

The discriminative validity was analyzed:

For Digital Vision Planning (DVP), the square root of AVE is 0.758, and the maximum absolute correlation coefficient between Greater than factors is 0.538, indicating good discriminant validity.

For Digital Literacy of Principals (DLP), the square root of AVE is 0.776, and the maximum absolute value of the correlation coefficient between Greater than factors is 0.541, indicating good discriminant validity.

For Digital Implementation Assurance (DIA), the square root of AVE is 0.779, and the maximum absolute correlation coefficient among Greater than factors is 0.535, indicating good discriminant validity.

For Effectiveness of Principal Digital Leadership (EPDL), the square root of AVE is 0.779, and the maximum absolute value of the correlation coefficient between Greater than factors is 0.491, indicating good discriminant validity.

For Digital Management (DM), the square root of AVE is 0.785, and the maximum absolute value of the correlation coefficient between Greater than factors is 0.535, indicating good discriminant validity.

For Teachers' Digital Behavioral Intention (TDBI), the square root of AVE is 0.776, and the maximum absolute value of the correlation coefficient among the Greater than factors is 0.541, indicating good discriminant validity.

Correlation Analysis

To explore the degree and direction of linear correlation among the six core variables in this study, a Pearson product-moment correlation analysis was conducted on Digital Vision Planning (DVP), Digital Literacy of Principals (DLP), Digital Implementation Assurance (DIA), Effectiveness of Principal Digital Leadership (EPDL), Digital Management (DM), and Teachers' Digital Behavioral Intention (TDBI). A two-tailed test was used to assess the significance of correlation coefficients, with $p < 0.001$ set as the criterion for an extremely significant correlation. The analysis results are presented in the table below (See Table 4.11).

Table 4.11 Pearson Correlation Analysis

		Digital Vision Planning	Digital Literacy of Principals	Digital Implementation Assurance	Effectiveness of Principal Digital Leadership	Digital Management	Teachers' Digital Behavioral Intention
Digital Vision Planning	Pearson correlation	1					
	SIG. (two-tailed)						
Digital Literacy of Principals	Pearson correlation	0.447***	1				
	SIG. (two-tailed)	0.000					
Digital Implementation Assurance	Pearson correlation	0.328***	0.389***	1			
	SIG. (two-tailed)	0.000	0.000				
Effectiveness of Principal Digital Leadership	Pearson correlation	0.391***	0.418***	0.422***	1		
	SIG. (two-tailed)	0.000	0.000	0.000			

		Digital Vision Planning	Digital Literacy of Principals	Digital Implementation Assurance	Effectiveness of Principal Digital Leadership	Digital Management	Teachers' Digital Behavioral Intention
Digital Management	Pearson correlation	0.438***	0.421***	0.464***	0.436***	1	
	SIG. (two-tailed)	0.000	0.000	0.000	0.000		
Teachers' Digital Behavioral Intention	Pearson correlation	0.377***	0.455***	0.358***	0.379***	0.421***	1
	SIG. (two-tailed)	0.000	0.000	0.000	0.000	0.000	

*** The correlation was significant at the 0.001 level (two-tailed). **The correlation was significant at the 0.01 level (two-tailed). *The correlation was significant at the 0.05 level (two-tailed).

Correlation analysis was used to examine the relationships among Digital Vision Planning, Digital Literacy of Principals, Digital Implementation Assurance, Effectiveness of Principal Digital Leadership, Digital Management, Teachers' Digital Behavioral Intention, and the Pearson correlation coefficient was used to quantify the strength of these relationships. The specific analysis shows that:

The correlation coefficient between Digital Literacy of Principals and Digital Vision Planning is 0.447 ($p < 0.001$), indicating a significant positive correlation.

The correlation coefficient between Digital Implementation Assurance and Digital Vision Planning is 0.328 ($p<0.001$), indicating a significant positive correlation.

The correlation coefficient between Effectiveness of Principal Digital Leadership and Digital Vision Planning is 0.391 ($p=0.001$), indicating a significant positive correlation.

The correlation coefficient between Digital Management and Digital Vision Planning is 0.438 ($p<0.001$), indicating a significant positive correlation.

The correlation coefficient between Teachers' Digital Behavioral Intention and Digital Vision Planning is 0.377 ($p=0.001$), indicating a significant positive correlation.

The correlation coefficient between Digital Implementation Assurance and Digital Literacy of Principals is 0.389 ($p<0.001$), indicating a significant positive correlation.

The correlation coefficient between Effectiveness of Principal Digital Leadership and the Digital Literacy of Principals is 0.418 ($p<0.001$), indicating a significant positive correlation.

The correlation coefficient between Digital Management and Digital Literacy of Principals is 0.421 ($p<0.001$), indicating a significant positive correlation.

The correlation coefficient between Teachers' Digital Behavioral Intention and Digital Literacy of Principals is 0.455 ($p<0.001$), indicating a significant positive correlation.

The correlation coefficient between Effectiveness of Principal Digital Leadership and Digital Implementation Assurance is 0.422 ($p<0.001$), indicating a significant positive correlation.

The correlation coefficient between Digital Management and Digital Implementation Assurance is 0.464 ($p<0.001$), indicating a significant positive correlation.

The correlation coefficient between Teachers' Digital Behavioral Intention and Digital Implementation Assurance is 0.358 ($p<0.001$), indicating a significant positive correlation.

The correlation coefficient between Digital Management and Effectiveness of Principal Digital Leadership is 0.436 ($p<0.001$), indicating a significant positive correlation.

The correlation coefficient between Teachers' Digital Behavioral Intention and Effectiveness of Principal Digital Leadership is 0.379 ($p=0.001$), indicating a significant positive correlation.

The correlation coefficient between Teachers' Digital Behavioral Intention and Digital Management is 0.421 ($p<0.001$), indicating a significant positive correlation.

Structural Equation Models and Hypothesis Testing

1. Model Construction

Based on the results of confirmatory factor analysis (CFA), the theoretical framework of this study was constructed, which included 5 latent variables and 21 observed variables. The 21 measurement residuals in the model were independent, with no covariance detected. The variance of each variable was set to 1. The initial theoretical model is shown in the figure below (See Figure 4.2).

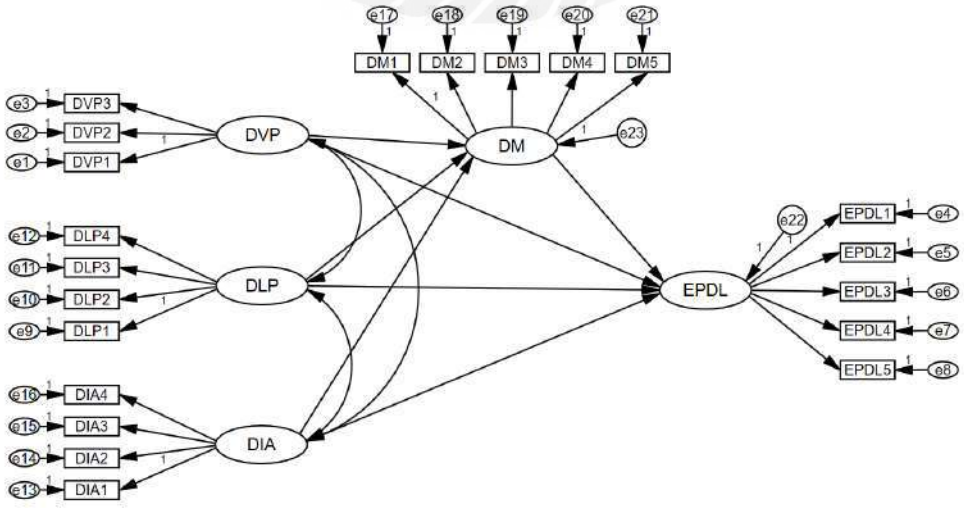

Figure 4.2 Initial Structural Equation Model Diagram

2. Model Fit Analysis

When conducting a hypothesis test for a structural equation model (SEM), it is imperative to assess model fit. To assess the degree of fit between the hypothetical model and the observed data, fit indices must be calculated. SEM fit is primarily evaluated using the chi-square statistic, which reflects the model's goodness of fit; an acceptable fit indicates a high degree of consistency between the model and the data.

In accordance with the propositions put forward by Wen et al. (2004), a comprehensive evaluation of model fit can be achieved by adopting multiple fit metrics, which are categorized into three types: absolute fit indices (e.g., GFI, AGFI); incremental fit indices (e.g., NFI, TLI, CFI); and parsimonious fit indices (e.g., CMIN/DF, PCFI, PNFI). The aforementioned indices collectively provide a comprehensive assessment of the model's overall fit.

Table 4.12 Model Fitting Index

Common Index	χ2	df	χ2/df	RMSEA	RMR	CFI	NFI	IFI	TLI	GFI	AGFI
Judging standard	-	-	<3	<0.08	<0.05	>0.9	>0.8	>0.9	>0.8	>0.8	>0.8
Value	197.118	179	1.101	0.015	0.033	0.996	0.962	0.996	0.996	0.962	0.951

As shown in Table 4.12, $\chi^2/df = 1.101$, which is lower than 3, indicating a good model fit; RMR = 0.033 and RMSEA = 0.015, both of which are less than 0.08, further demonstrating a satisfactory model fit. In addition, GFI = 0.962, NFI = 0.962, IFI = 0.996, TLI = 0.996, and CFI = 0.996, all of which meet the respective standard values. In summary, the model achieves a good overall fit with the observed data.

3. Direct Effect Validation

Since the model constructed in this study is acceptable, the next step was to test the hypotheses. The critical ratio (C.R.) was used to test the research hypotheses in this study. It is generally accepted that when the absolute value of the standardized path coefficient exceeds 1.96, the hypothesis is supported; otherwise, it is not supported.

Table 4.13 Research Hypothesis Testing

Path			Non-Standard Path Coefficient	S.E.	C.R.	P	Standard Path Coefficient
EPDL	<--	DVP	0.179	0.065	2.744	0.006**	0.175
EPDL	<--	DLP	0.188	0.061	3.095	0.002**	0.190
EPDL	<--	DIA	0.243	0.063	3.852	0.000***	0.227
EPDL	<--	DM	0.170	0.056	3.035	0.002**	0.188
DM	<--	DVP	0.329	0.068	4.815	0.000***	0.291
DM	<--	DLP	0.186	0.065	2.869	0.004**	0.170
DM	<--	DIA	0.406	0.065	6.227	0.000***	0.343

***p<0.05 **p<0.01 ***p<0.001**

The results of the direct effect test in Table 4.13 show that the absolute values of C.R. for all paths in the model exceeded 1.96, with all *p*-values less than 0.05, indicating that the direct path relationships among all variables were statistically significant. The characteristics of the specific path coefficients are as follows:

The normalized path coefficient for the Digital Vision Planning-Effectiveness of Principals Digital leadership pair is 0.175 (C.R.=2.744, p<=0.05), indicating that Digital Vision Planning has a significant positive influence on Effectiveness of Principals Digital leadership. The normalized path coefficient of Digital Literacy of Principals pair Effectiveness of Principal Digital leadership is 0.190 (C.R.=3.095, p<=0.05), indicating that Digital Literacy of Principals has a significant positive influence on Effectiveness of Principal Digital leadership. The normalized path coefficient for the Digital Implementation Assurance-Effectiveness of Principal Digital Leadership pair is 0.227 (C.R.=3.852, p<=0.05), indicating that Digital Implementation Assurance has a significant positive influence on Effectiveness of Principal Digital Leadership. The normalized path coefficient for the Digital Management-Effectiveness of Principal Digital Leadership path is 0.188 (C.R.=3.035, p<=0.05), indicating that Digital Management has a significant positive influence on Effectiveness of Principal Digital Leadership. The normalized path coefficient for the Digital Vision Planning-Digital Management pair is 0.291 (C.R.=4.815, p<=0.05), indicating that Digital Vision Planning has a significant positive influence on Digital Management. The normalized path coefficient for the Digital Literacy of Principals-Digital Management path is 0.170 (C.R.=2.869, p<=0.05), indicating that Digital Literacy of Principals has a significant positive influence on Digital Management. The normalized path coefficient for the Digital Implementation Assurance-Digital Management pair is 0.343 (C.R.=6.227, p<=0.05), indicating that Digital Implementation Assurance has a significant positive influence on Digital Management.

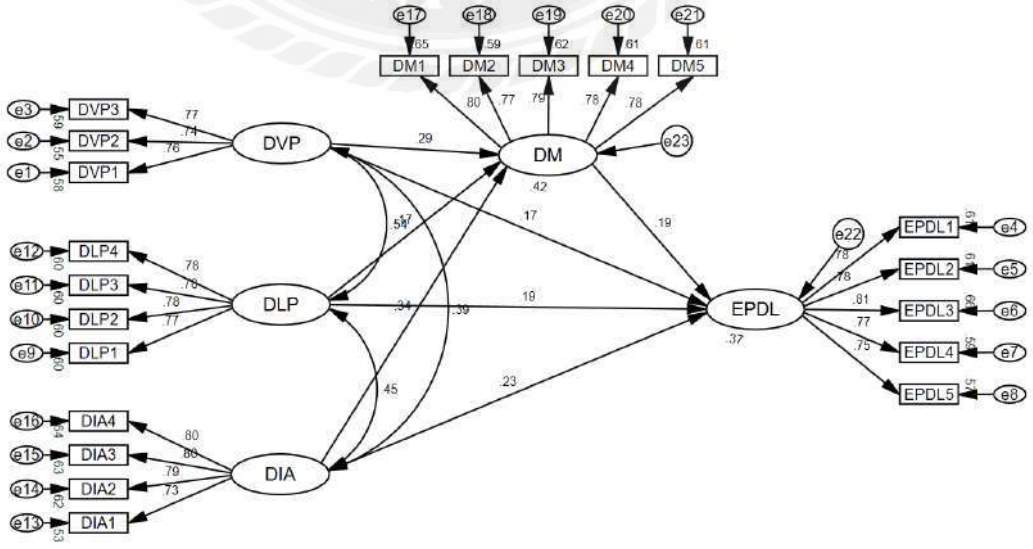

Figure 4.3 Results of Path Relationships in the Structural Equation Model

Mediation Analysis Results

A bootstrapping method was employed to analyze mediation effects in this study using AMOS 23.0. The mediation effect is considered significant if the confidence interval does not contain 0, and the test results are presented as follows (See Table 4.14):

Table 4.14 Mediation Effect Test Results

Path Label	Effect	Estimate	Bias-Corrected 95%（low）	Bias-Corrected 95%（upper）
DVP→DM→EPDL	Total Effect	0.230	0.110	0.356
	Indirect Effect	0.055	0.018	0.111
	Direct Effect	0.175	0.048	0.310
DLP→DM→EPDL	Total Effect	0.222	0.095	0.343
	Indirect Effect	0.032	0.007	0.074
	Direct Effect	0.190	0.112	0.315
DIA→DM→EPDL	Total Effect	0.291	0.181	0.390
	Indirect Effect	0.064	0.022	0.119
	Direct Effect	0.227	0.065	0.336

Based on the results of the Bootstrap mediation effect test (with 5000 repeated samplings), the 95% bias-corrected confidence intervals of all three mediating paths did not contain 0, indicating that the mediation effects were significant (*p* < 0.05) and the path relationships were robust.

Digital Management (DM) exerted a significant partial mediating effect in three paths: Digital Vision Planning (DVP) → Effectiveness of Principal Digital Leadership (EPDL), Digital Literacy of Principals (DLP) → Effectiveness of Principal Digital Leadership (EPDL), and Digital Implementation Assurance (DIA) → Effectiveness of Principal Digital Leadership (EPDL). The upper and lower limits of the 95% confidence intervals for the indirect effects of the three paths all excluded 0 (DVP→DM→EPDL:0.018~0.111;DLP→DM→EPDL:0.007~0.074;DIA→DM→EPDL:0.022~0.119). Meanwhile, all paths had significant direct effects (their confidence intervals did not all contain 0). The above results revealed that Digital Vision Planning (DVP), Digital Literacy of Principals (DLP) and Digital Implementation Assurance (DIA) could not only directly and positively affect Effectiveness of Principal Digital Leadership (EPDL), but also exert an indirect positive impact on Effectiveness of Principal Digital Leadership (EPDL) through the mediating variable of Digital Management (DM), which verified the research hypothesis of this study regarding the mediating role of Digital Management (DM).

Moderating Analysis

To test the moderating role of Teachers' Digital Behavioral Intention (TDBI) in the relationships between Digital Vision Planning (DVP), Digital Literacy of Principals (DLP), Digital Implementation Assurance (DIA), and Digital Management (DM), this study conducted a moderation effect analysis. The specific analysis results are as follows (See Table 4.15):

Moderating Effect of DVP

Table 4.15 Moderation Effect Test Results of DVP

	Digital Management			
	B	**Std Err**	**t**	**p**
Constant	3.213	0.041	77.670	0.000
Digital Vision Planning	0.293	0.043	6.897	0.000
Teachers' Digital Behavioral Intention	0.254	0.041	6.183	0.000
Teachers' Digital Behavioral Intention*Digital Vision Planning	0.254	0.041	6.246	0.000
R2	0.325			
Adjust R2	0.321			
F	73.615, p=0.000			
DW	2.102			

The moderation effect test was conducted using Model 1 in the SPSS macro. The results showed that, in a model with Digital Vision Planning (DVP), Teachers' Digital Behavioral Intention (TDBI), and the interaction term of DVP and TDBI as independent variables, and Digital Management (DM) as the dependent variable, the R^2 was 0.325. The F-value was 73.615 ($p < 0.001$), indicating a good model fit.

Specifically, the regression results for DVP on DM showed a regression coefficient (B) of 0.293 and a t-value of 6.897, both statistically significant ($p< 0.001$), indicating a positive association between DVP and DM. For the regression of TDBI on DM, the B value was 0.254 (t=6.183), which was significant ($p< 0.001$), indicating a positive effect of TDBI on DM. For the interaction term of DVP and TDBI regressed on DM, the B value was 0.254, and the t value was 6.246, indicating a significant result ($p< 0.001$). This indicated that the interaction term between DVP and TDBI had a significant positive effect on DM, supporting the existence of a moderating effect.

Further analysis revealed that the regression coefficient for the DVP×TDBI interaction term (0.254) had the same sign as that for DVP (0.293). This result suggested that TDBI played a positive moderating role in the positive relationship between DVP and DM. In other words, the positive predictive effect of DVP on DM would gradually increase with higher levels of Teachers' Digital Behavioral Intention (TDBI).

Table 4.16 Simple Slope Analysis

Level of Moderating	Regression Coefficient	Standard Error	t	p	LLCI	ULCI
High Level(+1SD)	0.553	0.055	10.034	0.000	0.444	0.661
Average Level	0.293	0.043	6.897	0.000	0.210	0.377
Low Level(-1SD)	0.034	0.063	0.540	0.589	-0.090	0.159

Note: LLCI means the lower limit of the 95% interval for the estimate, and ULCI means the upper limit of the 95% interval for the estimate.

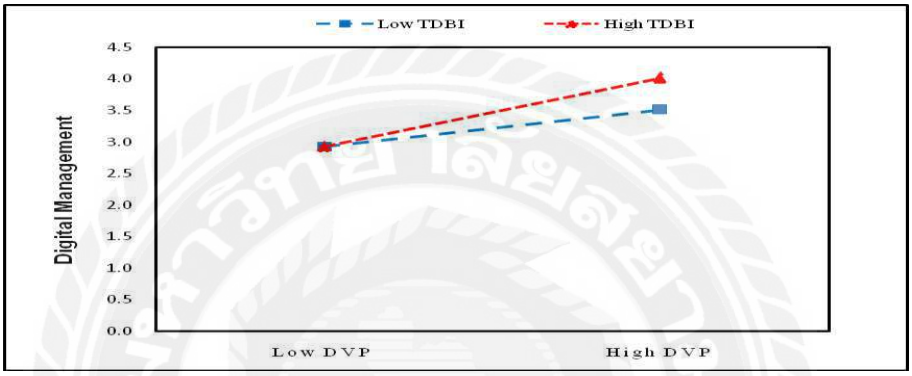

Figure 4.4 Slope Plot 1

Figure 4.4 shows the amplitude difference between X and Y at three levels (high, medium, and low) of the regulating variable Z as a slope plot. The figure above shows the moderating effect of Teachers' Digital Behavioral Intention: when Z is equal to High Level (+1SD), the positive impact of X on Y is significantly greater; when Z is equal to Low Level (-1SD), the positive impact of X on Y is relatively small.

Moderating Effect of DLP

Table 4.17 Moderation Effect Test Results of DLP

	Digital Management			
	B	Std Err	t	p
Constant	3.189	0.043	74.775	0.000
Digital Literacy of Principals	0.254	0.044	5.718	0.000
Teachers' Digital Behavioral Intention	0.265	0.043	6.199	0.000
Teachers' Digital Behavioral Intention*Digital Literacy of Principals	0.262	0.039	6.763	0.000
R2	0.312			
Adjust R2	0.308			

	Digital Management			
	B	**Std Err**	**t**	**p**
F	69.291, p=0.000			
DW	2.074			

The moderation effect test in Table 4.17 was conducted using Model 1 in the SPSS macro. The results showed that, in a model with Digital Literacy of Principals (DLP), Teachers' Digital Behavioral Intention (TDBI), and the interaction term of DLP and TDBI as independent variables, and Digital Management (DM) as the dependent variable, the R^2 was 0.312. The F value was 69.291 (p=0.000), indicating a good model fit.

Specifically, the regression results for DLP on DM showed a regression coefficient (B) of 0.254 and a t-value of 5.718, which passed the significance test ($p< 0.001$), indicating a significant positive effect of DLP on DM. For the regression of TDBI on DM, the B value was 0.265 (t=6.199), which was statistically significant ($p<0.001$), suggesting that TDBI had a significant positive effect on DM. For the interaction term of DLP and TDBI regressed on DM, the B value was 0.262, and the t value was 6.763, indicating a statistically significant result ($p<0.001$). This indicated that the interaction term between DLP and TDBI had a significant positive effect on DM, supporting the existence of a moderating effect.

Further analysis revealed that the regression coefficient for the DLP×TDBI interaction term (0.262) had the same sign as that for DLP (0.254). This result suggested that TDBI played a positive moderating role in the positive relationship between DLP and DM. In other words, the positive predictive effect of DLP on DM would gradually increase with increasing TDBI.

Table 4.18 Simple Slope Analysis

Level of Moderating	**Regression Coefficient**	**Standard Error**	**t**	**p**	**LLCI**	**ULCI**
High Level(+1SD)	0.522	0.055	9.400	0.000	0.413	0.631
Average Level	0.254	0.044	5.718	0.000	0.167	0.341
Low Level(-1SD)	-0.014	0.063	-0.216	0.829	-0.138	0.111

Note: LLCI means the lower limit of the 95% interval for the estimate, and ULCI means the upper limit of the 95% interval for the estimate

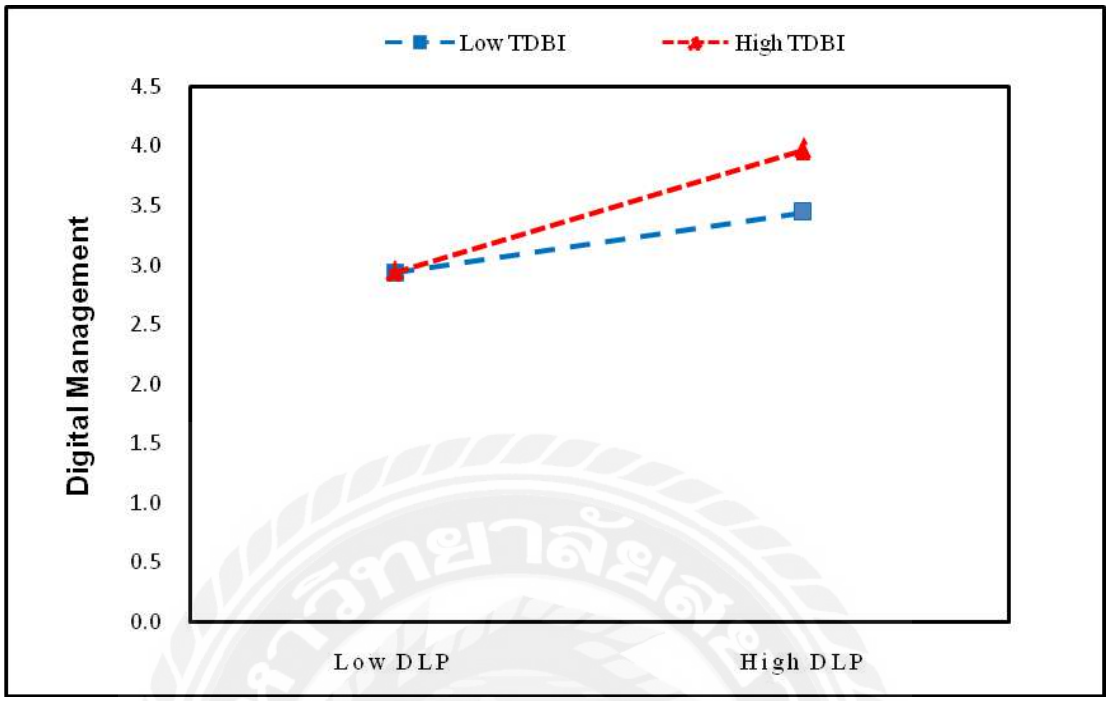

Figure 4.5 Slope Plot 2

Figure 4.5 shows the amplitude difference between X and Y at three levels (high, medium, and low) of the regulating variable Z as a slope plot. The figure above shows the moderating variable, Teachers' Digital Behavioral Intention: when Z is equal to High Level (+1SD), the positive impact of X on Y is significantly greater; when Z is equal to Low Level (-1SD), the negative impact of X on Y is relatively small.

Moderating Effect of DIA

Table 4.19 Moderation Effect Test Results of DIA

	Digital Management			
	B	**Std Err**	**t**	**p**
Constant	3.270	0.042	78.310	0.000
Digital Implementation Assurance	0.359	0.044	8.226	0.000
Teachers' Digital Behavioral Intention	0.268	0.042	6.454	0.000
Teachers' Digital Behavioral Intention*Digital Implementation Assurance	0.111	0.042	2.673	0.008
R2	0.301			
Adjust R2	0.296			

	Digital Management			
	B	**Std Err**	**t**	**p**
F	65.645, p=0.000			
DW	2.098			

The moderation effect test in Table 4.19 was conducted using Model 1 in the SPSS macro. The results showed that, in the model with Digital Implementation Assurance (DIA) as an independent variable, Teachers' Digital Behavioral Intention (TDBI) and the interaction term of DIA and TDBI, and Digital Management (DM) as the dependent variable, the R^2 was 0.301. The F-value was 65.645 ($p < 0.001$), indicating a good model fit.

Specifically, the regression results for DIA on DM showed a regression coefficient (B) of 0.359 and a t-value of 8.226, which met the significance criterion ($p < 0.001$), indicating a significant positive effect of DIA on DM. For the regression of TDBI on DM, the B value was 0.268 ($t = 6.454$), which was statistically significant ($p < 0.001$), indicating a significant positive effect of TDBI on DM. For the interaction term of DIA and TDBI regressed on DM, the B value was 0.111, and the t value was 2.673, indicating a statistically significant result ($p=0.008<0.01$). This indicated that the interaction term between DIA and TDBI had a significant positive effect on DM, supporting the existence of a moderating effect.

Further analysis revealed that the regression coefficient of the DIA×TDBI interaction term (0.111) had the same sign as that of DIA (0.359). This result suggested that TDBI played a positive moderating role in the positive relationship between DIA and DM. In other words, the positive predictive effect of DIA for DM would gradually increase with increasing TDBI levels.

Table 4.20 Simple Slope Analysis

Level of Moderating	Regression Coefficient	Standard Error	t	p	LLCI	ULCI
High Level (+1SD)	0.473	0.057	8.258	0.000	0.360	0.586
Average Level	0.359	0.044	8.226	0.000	0.273	0.445
Low Level (-1SD)	0.246	0.064	3.812	0.000	0.119	0.372

Note: LLCI means the lower limit of the 95% interval for the estimate, and ULCI means the upper limit of the 95% interval for the estimate.

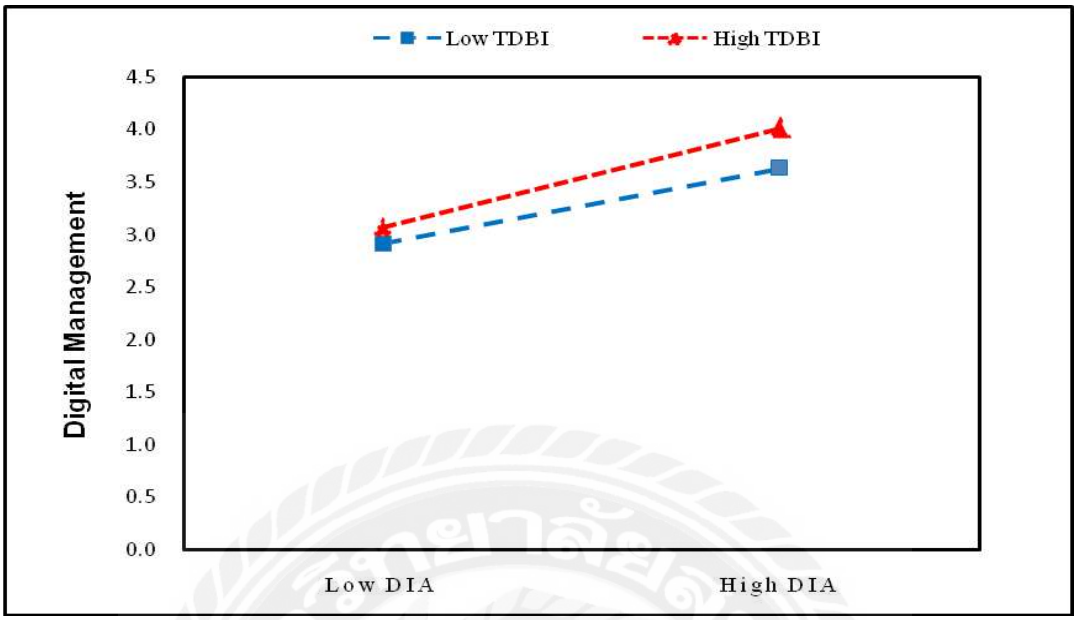

Figure 4.6 Slope Plot 3

Figure 4.6 shows the amplitude difference between X and Y at three levels (high, medium, and low) of the regulating variable Z as a slope plot. The figure above shows the moderating effect of Teachers' Digital Behavioral Intention: when Z is equal to High Level (+1SD), the positive impact of X on Y is significantly greater; when Z is equal to Low Level (-1SD), the positive impact of X on Y is relatively small.

The Results of the Hypothesis Test

Based on the theoretical analysis, this study proposed the following research hypotheses and empirically tested them. The specific test results are as follows (See Table 4.21):

Table 4.21 Results of Hypothesis Test

No.	Hypothesis	Result
H1	There is a significant positive relationship between Digital Vision Planning and Digital Management.	Established
H2	There is a significant positive relationship between Digital Literacy of Principals and Digital Management.	Established
H3	There is a significant positive relationship between Digital Implementation Assurance and Digital Management.	Established
H4a	There is a significant positive relationship between Digital Vision Planning and Effectiveness of Principal Digital Leadership.	Established
H4b	There is a significant positive relationship between Digital Literacy of Principals and Effectiveness of Principal Digital Leadership.	Established

No.	Hypothesis	Result
H4c	There is a significant positive relationship between Digital Implementation Assurance and Effectiveness of Principal Digital Leadership.	Established
H5	There is a significant positive relationship between Digital Management and Effectiveness of Principal Digital Leadership.	Established
H6a	Teachers' Digital Behavioral Intention has a positive moderating effect on the relationship between Digital Vision Planning and Digital Management.	Established
H6b	Teachers' Digital Behavioral Intention has a positive moderating effect on the relationship between Digital Literacy of Principals and Digital Management.	Established
H6c	Teachers' Digital Behavioral Intention has a positive moderating effect on the relationship between Digital Implementation Assurance and Digital Management.	Established
H7	Digital Management has a mediating effect on the relationship between Digital Vision Planning and Effectiveness of Principal Digital Leadership.	Established
H8	Digital Management has a mediating effect on the relationship between Digital Literacy of Principals and Effectiveness of Principal Digital Leadership.	Established
H9	Digital Management has a mediating effect on the relationship between Digital Implementation Assurance and Effectiveness of Principal Digital Leadership.	Established

As shown in Table 4.21, the empirical results of the hypothesis test are generally consistent with the hypotheses regarding the relationship among the core variables of this study, as presented in the conceptual framework in Chapter 2.

There is a significant positive relationship between:

H1: Digital Vision Planning and Digital Management.

H2: Digital Literacy of Principals and Digital Management.

H3: Digital Implementation Assurance and Digital Management.

H4a: Digital Vision Planning and Effectiveness of Principal Digital Leadership.

H4b: Digital Literacy of Principals and Effectiveness of Principal Digital Leadership.

H4c: Digital Implementation Assurance and Effectiveness of Principal Digital Leadership.

H5: Digital Management and Effectiveness of Principal Digital Leadership.

Teachers' Digital Behavioral Intention has a positive moderating effect on the relationship between:

H6a: Digital Vision Planning and Digital Management.

H6b: Digital Literacy of Principals and Digital Management.

H6c: Digital Implementation Assurance and Digital Management.

Digital Management has a mediating effect on the relationship between:

H7: Digital Vision Planning and Effectiveness of Principal Digital Leadership.

H8: Digital Literacy of Principals and Effectiveness of Principal Digital Leadership.

H9: Digital Implementation Assurance and Effectiveness of Principal Digital Leadership.

In Summary:

According to the data analysis of each variable, it can be concluded that all hypothetical relationships are valid, but the strength of their influence varies. **Among the six variables, the most important variable that needs to be strengthened is digital management.** The strengthening of digital management does not require the principal to become a technical expert, but rather to become a "system builder, resource coordinator, and cultural leader" by building a low burden, high support institutional environment, creating a culture of mutual assistance in the use of technology, and activating the initiative of "people" in the organizational system. This process essentially elevates digital management from the "technical operational level" to the "organizational behavioral level".

4.2 Qualitative Data Analysis

Follow-up Interviews

This study conducted follow-up interviews with the same 5 participants of the preliminary study: 2 primary school principals, 2 front-line teachers, and 1 school administrative staff member. By email, 5 participants were asked to provide feedback about their work roles in school. The researcher collected the 5 feedback forms and compiled each dialogue into a separate Word document, sentence by sentence. In the document, the questions and answers were marked. The collected responses were translated from Chinese to English with the help of two academic experts to ensure conceptual fidelity and linguistic accuracy (See Appendix D).

The researcher created a "Follow-up Verification" project using Nvivo.14 software, imported 5 documents to establish a dedicated coding node system—the three-level coding analysis, including open coding, axial coding, and selective coding, to explore and validate the intrinsic connections among the data and the correspondence between high-frequency word codes and various variables (DVP, DLP, DIA, EPDL, DM, and TDBI) in the model. This process further supported the qualitative findings and provided an additional layer of triangulation, consistent with the study's mixed-methods design.

Information of 5 Participants

Principal 1 (P2): Male, 42 years old, master's degree.

Position and Experience:

Currently, he is serving as a principal of the Experimental Primary School in the urban area, with approximately five years of experience. He has a background in interdisciplinary teaching and information management. He led the promotion of the school's "Cloud Classroom" project during the tenure as Vice President of Teaching, and has systematic thinking and practical experience in integrating digital teaching.

Principal 2 (P4): Female, 51 years old, Bachelor's degree.

Position and Experience:

He has served as the principal of a key primary school in the town for over 8 years, gradually growing from a frontline teacher to a management position, and experiencing the entire process of the school from traditional teaching to digital starting, focusing on teacher team building and school-based implementation.

School administrator1 (S1): Female, 37 years old, Master's degree.

Position and Experience:

She is currently serving as the Deputy Director of the School's Academic Affairs Office and concurrently as the Director of the Information Promotion Office, with a tenure of 4 years. She is responsible for managing teaching information projects, organizing teacher training, and coordinating platform operations, which is a key execution node that connects principal decision-making, technical departments, and frontline teaching.

Teacher 1(T2): Male, 42 years old, Bachelor's degree.

Position and Experience:

He has served as a primary school mathematics teacher for 18 years, leader of the grade teaching and research group, and backbone teacher of the school. He has experienced the transition from blackboards to interactive whiteboards and has maintained a cautious yet open attitude toward technical tools. He is skilled in integrating digital resources into traditional teaching.

Teacher 2(T3): Female, 34 years old, Master's degree.

Position and Experience:

She has served as a primary school Chinese teacher for 8 years, and was one of the initiators of the school's "Digital Teaching and Research Community for Young Teachers". She is actively integrating interdisciplinary approaches to teaching and digital evaluation tools, often undertaking innovative tasks in school-level open courses and digital teaching.

Interview Value of 5 Participants

Interview value of P2:

Master's education background and relatively young age enable him to maintain a high sensitivity and acceptance of digital development, providing in-depth insights

into the connection between digital vision planning and implementation assurance from the perspective of school managers.

Interview value of P4:

Rich management experience enables her to have a profound understanding of the mentality of the teacher group, the difficulties in resource allocation, and the problems in the process of policy implementation. Especially from the perspectives of regional balance and intergenerational differences among teachers, they can provide a true reflection of the moderating variables and implementation bottlenecks in the leadership model.

Interview value of S1:

The dual role enables her to understand management intentions while also being familiar with the difficulties and needs of the operational team. It can accurately reveal the specific forms of "digital management" in daily operations, the real obstacles to departmental collaboration, and how support affects the teacher-student experience.

Interview value of T2:

As a senior teacher representative, his views can reflect the adaptability, practical concerns, and key needs of middle-aged teachers in the digital process, which helps to deepen the understanding of the complex considerations of "utility" and "ease of use" in the "teacher digital behavior intention".

Interview value of T3:

As a typical example of highly educated young teachers, she possesses both enthusiasm and reflective ability. She can demonstrate the initiative of applying new technologies and clearly point out the gaps in training, support, and institutional incentives, providing fresh answers to the positive aspects and growth demands of the "teacher behavior intention" in the model.

Content Analysis of the Follow-up Interview

The content analysis covered the three-level coding analysis, including open coding, axial coding, and selective coding, to explore and validate the intrinsic connections among the data and the correspondence between high-frequency word codes and various variables (DVP, DLP, DIA, EPDL, DM and TDBI) in the model.

Step1: Open coding

Read the interview transcript sentence by sentence and paragraph by paragraph for preliminary conceptualization, and attached one or more descriptive labels to each meaningful "sentence unit", using the interviewee's original words or extracts as much as possible (See Table 4.22). In the end, 37 open-ended encodings were found.

Table 4.22 Open Coding of the Interview Text (Excerpt)

Interview Text (A=Answer)		**Open Coding**	**Association with Model Variables**
	P2: Vision and equipment alone are far from enough. The core	Vision and insufficient equipment.	Pointing to Digital Vision Planning (DVP) and Digital

Interview Text (A=Answer)		Open Coding	Association with Model Variables
Principal	is the “management action” in the middle.		Implementation Assurance (DIA).
		Management actions are the core.	Pointing to the core position of Digital Management (DM).
	P2: The use was not included in the assessment of the teaching and research group; there was no arrangement for key teachers to take the lead; and the resource application process is complex.	Lack of assessment and incentives.	Sub dimension of DM: Institutional Management.
		Lack of main leaders.	Sub dimensions of DM: Organization and Personnel Arrangement.
		The resource application process is complex.	Sub dimension of DIA: Process Assurance.
	P2: Having ideas and resources, but lacking management actions, resulting in transmission failure.	Ideas and resource transmission failure.	Summarize the path from DVP, DIA to DM.
		Lack of management actions.	Missing status of DM.
	P4: Teacher willingness is like a ‘regulating valve’; the effects of different grade groups are at two extremes.	The teacher’s willingness serves as a regulatory valve.	Directly pointing to the moderating effect of teacher digital behavioral intention (TDBI).
		Effects vary by group.	The manifestation of the TDBI regulatory effect.
	P4: Continuous and stable regional policies and resource support.	Regional policies and resource support.	New concept: External environmental support.
Teacher	P2: Management is like a bridge; whether the bridge is connected or not has a great impact on us.	Management is a bridge.	DM’s intermediary metaphor.
		The smoothness of bridges.	Management quality of DM.
	T2: Enhance willingness: useful, easy to use, and supported.	Factors that enhance willingness (Utility).	Driving factors of TDBI.
		Factors that enhance willingness (usability).	Driving factors of TDBI.
		Factors that enhance	Driving factors of DBI/related to DIA.

Interview Text (A=Answer)		Open Coding	Association with Model Variables
		willingness (Support).	
	T3: Key mid-level executives can serve as 'super nodes'.	Key Middle Level Executives.	New concept: Middle-level leadership.
School Staff	S1: Without efficient 'digital management', ideas will hit walls everywhere.	Inefficient management leads to obstruction.	The impact of DM on the execution process.
	S1: Assurance is both the foundation and the bottleneck, requiring dynamic service capabilities.	The duality of assurance.	Deep connotation of DIA.
	S1: The closed-loop management and application of data is a crucial aspect.	Data closed-loop management.	DM sub dimension: data-driven decision-making.

Step 2: Axial coding

The researcher further read and analyzed the 37 concepts obtained through open coding earlier, summarized and merged the categories to discover their logical relationships, and classify and aggregate them into "categories". These categories were directly integrated into the model's variables and concepts (See Table 4.23).

Table 4.23 Results of the Axial Coding (Excerpt)

Core Category	Dimension	Open Coding	Relationship with Other Categories
Digital Management (DM) Core Mediating Variable	DM1 system and assessment.	Lack of assessment and incentives.	It results from the combined action of DVP, DLP, and DIA, which directly affects leadership effectiveness; TDBI regulates this effectiveness.
		Factors that enhance willingness (Utility).	
	DM2 organization and personnel.	Lack of main leaders.	
		Key Middle Level Executives.	
	DM3 Process and Coordination.	The resource application process is complex.	
		Inefficient management leads to obstruction.	
	DM4 data closed-loop application.	Data closed-loop management.	
Teachers' Digital	TDBI1 perceived usefulness.	Factors that enhance willingness (Utility).	Adjust the strength of the

Core Category	Dimension	Open Coding	Relationship with Other Categories
Behavior Intention (TDBI) Key Moderator Variable	TDBI2 Perception Usability.	Factors that enhance willingness (usability).	path from DM to leadership effectiveness.
	TDBI3 perceived support.	Factors that enhance willingness (Support).	
	TDBI4 group atmosphere.	Effects vary by group.	
Digital Vision Planning (DVP) and Digital Implementation Assurance (DIA) Core Driving Variables	DVP clarity of vision, strategic alignment.	Vision and Insufficient Equipment.	Deepening connotation and Extended Extension
	DIA1 resource static configuration.	Hardware and software	
	DIA2 Dynamic response of service.	The duality of assurance.	
	DIA3 External resources are stable.	Regional policies and resource support.	
Effectiveness of Principal Digital Leadership (EPDL) Dependent Variable	EPDL1 Improve work efficiency.	Inefficient management leads to obstruction.	Greatly influenced by other variables.
	EPDL2 Enhancement of teaching accuracy.	Inefficient management leads to obstruction.	
	EPDL3 Professional development support.	The duality of assurance.	
	EPDL4 Smooth organizational collaboration	Inefficient management leads to obstruction.	

Through axial coding, these codes were categorized into 6 core categories that were highly compatible with the model: digital vision planning, digital literacy of principals, digital implementation assurance, digital management, teachers' digital behavioral intention, and leadership effectiveness. Among them, 'principal's personal digital literacy' is an implicit yet fundamental variable, evident in the respondents'

narratives and the cornerstone of other explicit leadership behaviors.

Step 3: Selective coding

After the two steps above, it is easy to select a ‘core genus’ that can dominate all categories and systematically connect it with other genera to construct a core category and form a systematic understanding (Wang, 2023). From the above content, it is clear that the “collaborative implementation of principal digital leadership” can be regarded as a core category.

Moreover, it covers all dynamic processes in this model. The digital leadership of primary school principals is not a direct outcome of individual abilities but rather a complex, collaborative process. The combination of digital literacy of principals (DLP) and digital vision planning (DVP), and the pursuit and optimization of digital implementation assurance (DIA), together provides the initial driving force and resource foundation for the school’s digital transformation.

However, these drivers must be transformed into organizational action through a systematic “digital management (DM)” practice. The effectiveness of this transformation process is significantly regulated by Teachers’ Digital Behavioral Intention (TDBI). Ultimately, successful digital leadership is evidenced by significant digital development in schools, with positive changes across multiple dimensions, including teacher professional development and effective digital learning for students.

Summary of Follow-up Interview

Through in-depth follow-up interviews with 5 of the same participants (2 principals, 2 teachers, and 1 administrative staff) and the use of a three-level coding system to analyze interview texts, this study conducted rigorous empirical testing of the variables and their interrelationships in the previously constructed “Digital Leadership Model for Primary School Principals”.

A comprehensive analysis confirms the core variables in the model and has significant implications. The model’s theoretical boundaries and main factors are clarified.

Focus Group Discussion

Focus group discussion is a qualitative research method that organizes a group of people to discuss and explore their perspectives, feelings, and attitudes. Its core is to provide an open and interactive environment in which participants can freely share their viewpoints and experiences, grounded in mutual respect and understanding (Kuckartz & Rädiker, 2019). Through collective discussion, deeper insights can be revealed, which cannot be achieved through a single survey or interview.

The study organized a Ding Talk discussion and invited 7 experts in the fields of education and digital transformation to provide opinions and suggestions. The core goal of this focus group discussion is to deepen the understanding of the connotations and relationships of various variables in the model through experts’ interaction, and lay the foundation for subsequent quantitative evaluation.

Implementation Process of Focus Group Discussion

Step 1: Preparation Before the Discussion

The researcher created a material package containing clear model diagrams and simple explanations of each variable, and sent it to the experts via email 3 days in advance, asking them to "talk with criticism" at the designated time and in the designated Ding Talk group.

Step 2: Hold a Discussion (120 minutes)

Due to cultural sensitivity, the discussion environment, and privacy considerations, the researcher, before the discussion begins, designated an assistant as the recorder (responsible for recording and documenting key points). Then, the researcher delivered an opening speech that explained the rules (e.g., each person's speech should be concise and encourage diverse voices) and then moved directly into the discussion section.

Round 1: Overall Impressions and Highlights (30 minutes)

Core question: Without looking at details, based solely on first impressions, what is the most inspiring aspect of this model for you? What problems did it explain that may have been overlooked in the past?

Purpose: To break the ice, gain positive recognition, and establish confidence in discussion.

Round 2: Targeted Challenges and Deepening (60 minutes)

Core question: Please 'look for problems', what part of the model did you feel was not quite in line with reality, too idealistic, or not explained clearly? Please provide examples based on your field.

Purpose: To collect critical and constructive feedback, which is the core of the validation.

Round 3: Application Concept (30 minutes)

Core question: If you were to use this model tomorrow to improve your work (such as designing a principal training module or developing a school digital evaluation policy), what would you first use it for?

Purpose: To bring theory back to practice, test practicality, and gain specific suggestions.

Finally, the researcher summarized the event, thanked all the experts for their participation, and provided a preview of the feedback.

Step 3: Post Discussion Analysis

Firstly, the researcher organized the discussion content with the assistance of two PhD holders in educational management Ph.D, and made necessary modifications and comparisons, quickly browsed the text, highlight it with different colors, and extracted the 'golden suggestion'. For example, the red represented the consensus confirmation of experts, who highly agreed with this research model in some aspects; Blue represented the deepening suggestions of experts, who put forward some suggestions to deepen the connotation of variables and clarify the pathways of action; Green represented the prospect of applicability, and experts generated some applied and specific suggestions for the models. Finally, the researcher categorized the 'suggestions' and integrated the conclusions, determined whether they belonged to the

categories of ‘consensus confirmation of all the experts’, ‘limitations that need to be explained in the discussion’, or ‘recommendations for future research’.

Representative Questions and Answers (Excerpt)

(Appendix J: Questions and Answers of Focus Group Discussion).

The focus group discussion on “Digital Leadership Model for Primary School Principals” collected in-depth feedback and suggestions based on the questions and answers as follows (See Table 4.24):

Table 4.24 Questions and Answers of Focus Group Discussion

Question	Answer
1. Do you think this model covers all the key elements that affect the digital leadership of principals?	**Principal (Rural School):** For schools with scarce resources, the principal’s ability to ‘piece together resources’ may be more critical than ‘digital literacy’. We often use scattered, outdated equipment, and the ways to combine them to meet basic teaching needs are not reflected in this practical ability model.
2. What do you think would be the biggest obstacle to implementing principal training or school evaluation based on this model?	**The staff of the Local Education Bureau:** The biggest obstacle is regional differences. Developed schools focus on the ‘data loop’, whereas weaker schools may still be reliant on basic equipment support.
3. From your perspective, what are the most valuable insights of this model for regional education policy formulation or school digital development planning?	**The policymaker of the Education Bureau:** It clarifies that digitization is not simply a technological investment, but a systematic leadership project. Policies should encourage schools to integrate digital technologies into school-based development plans and to establish assessment mechanisms, rather than focusing solely on equipment coverage.

Content Analysis of the Experts’ Suggestions

According to the focus group discussion text, all experts’ suggestions were divided into three aspects: consensus confirmation, in-depth suggestions, and application prospects. To scientifically identify consensus and disagreement, and to determine priorities among numerous suggestions, a viewpoint matrix was first constructed, and all original suggestions were included in the matrix analysis (See Table 4.25).

Table 4.25 Viewpoint Matrix of Experts’ Suggestions

Suggestion	Expert	Original Material	Summary
	Principal1	Management actions are like the finishing touch to the dragon painting.	Definitely the core of management
	Education	Success or failure depends	Agree that

Suggestion	Expert	Original Material	Summary
Consensus confirmation	Bureau staff 1	on management processes and systems.	management is more important than hardware.
	Education Training Expert 1	The key leap from management to leadership.	Recognizing the moderator role of intention
	Principal2	The difference between willingness and effectiveness is vast.	Agree on the criticality of intention.
	Education Training Expert 2	Provide a problem diagnosis map	Confirming the explanatory power of the model
	Education Bureau staff 2	It is a system engineering led by the principal	Identify that the Leadership Framework is a system.
In-Deepth suggestions	Principal1	Promoting change requires balancing interests and resolving resistance.	Supplement political balance with wisdom.
	Principal2	The ability to piece together and solve problems under resource scarcity.	Emphasize the practical ability of resource integration.
	Representative of the School Board	The effect should include health and safety bottom lines.	Incorporate student welfare ethics.
	Education Training Expert1	The level of trust deeply influences the teacher's intention.	Pay attention to the foundation of trust relationships.
	Principal2	Individual intention and team atmosphere need to be viewed separately.	Intention of division
	Education Training Expert2	External stakeholders, such as parents, also constitute regulators.	Expand and regulate externalities.
	Education Bureau staff 1	Management needs to expand outward to inter-school resource sharing.	Propose cross-school collaboration.
Application prospects	Principal1	Lightweight self-diagnosis tool guided by key behaviors.	Advocate behavior self-examination checklist.
	Principal2	Building a bottom-up secure communication channel.	Suggest establishing an anonymous feedback channel.
	Principal2	Localization practice cases based on real difficulties.	Call for the construction of a local

Suggestion	Expert	Original Material	Summary
			case library.
	Education Training Expert	Deepen the understanding of variable relationships through role-playing.	Design scenario simulation sand table course
	Education Bureau staff 1	Data-driven personalized development support system.	Imagining a regional development map platform
	Education Bureau staff 2	Evaluation should shift from investment to process and educational effectiveness.	Advocate for the effectiveness of the policy orientation process.

As shown in Table 4.25, 7 experts conducted a detailed discussion on "Digital Leadership Model for Primary School Principals". Overall, the discussion yielded fruitful results: "highly agree with the core framework, actively deepen the theoretical details, and clearly guide the application and transformation", providing a decisive basis for improving and implementing the model.

Summary of Focus Group Discussion

The researcher invited 7 experts to discuss "Digital Leadership Model for Primary School Principals" via a Ding Talk group. The preliminary discussions among experts in the focus group on the appropriateness, feasibility, and practicality of the model provide important references for the design of subsequent experts' evaluation questionnaires items. The core findings are in three aspects:

Firstly, consensus confirmation and cross-role validation of the model's core variables.

Experts unanimously believe that the core chain of "driving factors (DVP, DLP, DIA) →management transformation→ leadership effectiveness" revealed by the model accurately grasps the inherent laws of digital transformation in schools. Especially, the design of "Digital Management (DM)" as a key mediator and "Teachers' Digital Behavioral Intention (TDBI)" as a core moderating variable was highly praised.

Secondly, in-deepth suggestions, key variables and pathways of action were enriched and expanded.

Building on the agreement on the core variables, experts proposed in-depth recommendations to enhance the model's comprehensiveness, informed by their unique practical contexts. For example, it anchored the ethical dimension of student digital well-being for effectiveness of principal digital leadership; it is pointed out that "teachers' digital behavioral intention" is influenced by both team atmosphere and individual trust, and may be regulated by external stakeholders.

Thirdly, high feasibility of application prospects, and specific path for transforming models into practical tools are clearly outlined.

Experts moved beyond theoretical discussions and directly developed the

model's practical implementation. These prospects collectively indicate a clear path into practice: the model's ultimate value must be achieved the effectiveness of digital leadership for primary school principals.

This focus group discussion is not only a successful external validity test but also an effective process of theoretical co-creation. While confirming the model's strong vitality, expert opinions have introduced humanistic care and practical wisdom, thereby laying a solid foundation for subsequent research revisions and model applications.

4.3 Research Results

This study aims to develop a digital leadership model for primary school principals and enhance their digital effectiveness. After posing research questions, setting research objectives, conducting literature review on relevant variables, and using a combination of quantitative and qualitative methods to collect and analyze data, it is clear that among the six variables, the most important variable that needs to be strengthened is digital management. The strengthening of digital management does not require the principal to become a technical expert, but rather to become a "system builder, resource coordinator, and cultural leader" by building a low burden, high support institutional environment, creating a culture of mutual assistance in the use of technology, and activating the initiative of "people" in the organizational system. The relationship diagram of the variables in the study was concluded as shown in Figure 4.7.

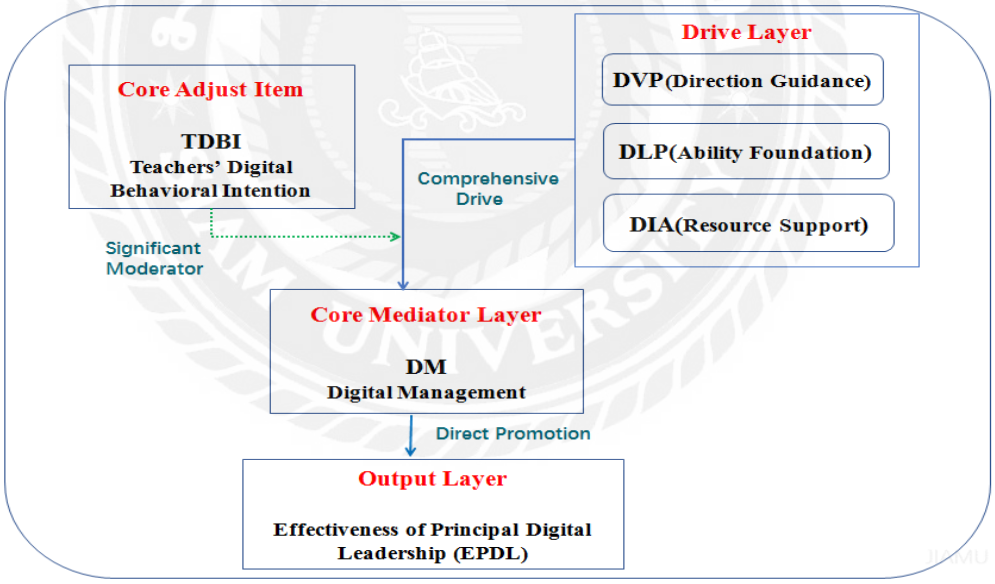

Figure 4.7 Relationship Diagram of the Variables in the Study

In this research, the model refers to a theoretical framework that systematically explains the mechanisms underlying digital leadership among primary school principals in Henan Province. The structured framework identifies the core influencing factors of effectiveness of principal digital leadership which are digital vision planning, digital management, digital literacy of principals, digital implementation assurance and teachers' digital behavioral intention. Among them, according to the quantitative analysis, the most important variable that needs to be strengthened is digital management.

The relationship diagram refers to the comprehensive capability system and practical process in which the principal integrates personal digital literacy, digital vision planning, and digital implementation assurance through a specific context of digital transformation in basic education, with digital management as the core mediator, effectively promoting digital teaching efficiency, digital management optimization, teachers' digital development, and students' digital well-being under the key moderation role of teachers' digital behavioral intention, thereby leading the school to achieve deep digital effectiveness.

This study suggests that the digital leadership of primary school principals is not simply a combination of personal abilities or resources, but rather a dynamic process of transforming input elements such as vision, literacy, and assurance into the digital effectiveness of the school through the organizational behavior mechanism of digital management. Among them, digital management is the most influential mediating variable, which essentially refers to the systematic behavior of principals in building systems, coordinating resources, empowering teachers, and creating culture at the organizational level. The digital behavioral intention of teachers plays a moderating role in this process, affecting conversion efficiency. Above all, the digital leadership model for primary school principals in Henan is presented in Figure 4.8.

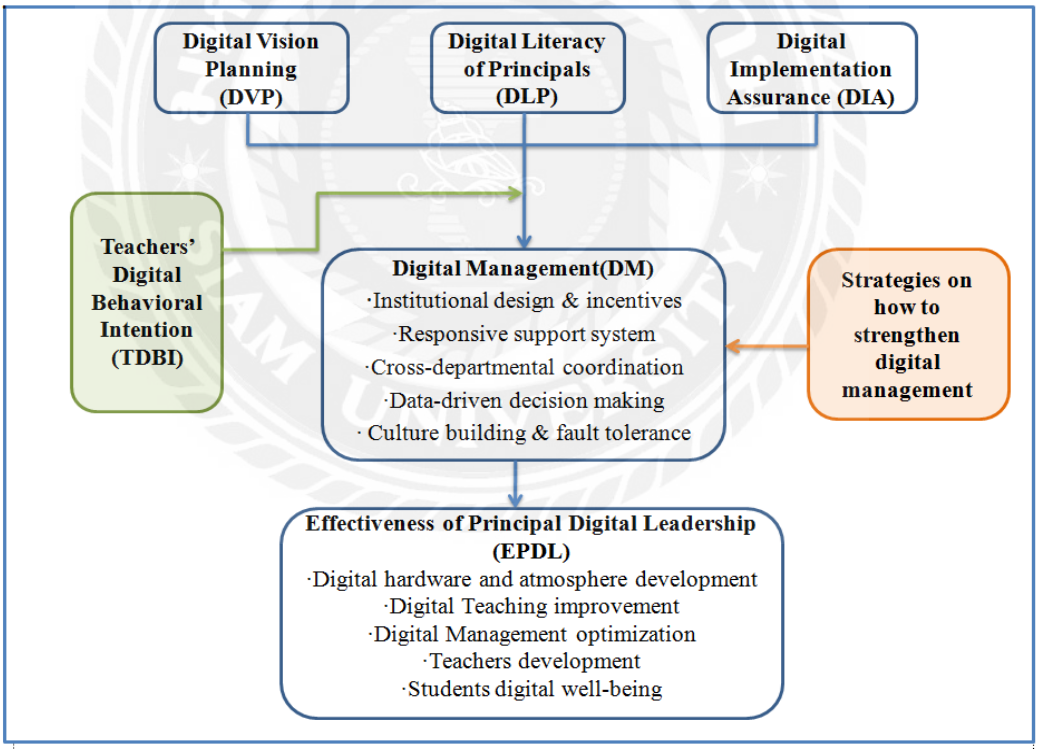

Figure 4.8 Digital Leadership Model for Primary School Principals

1. Process of the Model Development

The researcher interviewed 15 participants and used Nvivo.14 software and Grounded Theory through open coding, axial coding, and selective coding to get the current state of digital leadership among primary school principals and the status of digital development in primary schools in Henan Province in Chapter 1.

Based on the literature review in Chapter 2, the core factors (Digital Vision Planning (DVP), Digital Literacy of Principals (DLP), Digital Implementation Assurance (DIA), Digital Management (DM), Teachers' Digital Behavioral Intention (TDBI)), influenced effectiveness of digital leadership for primary school principals in Henan. The relationships among variables were established based on Educational Change Theory, Leadership Development Theory, Theory of Planned Behavior, and Self-determination Theory to develop the digital leadership model. According to the relationship between the variables in related theories in the literature review, the initial relationship hypotheses were established.

The digital vision planning, digital literacy of principals, and digital implementation assurance do not seem to have direct effects, they must be "transformed" into organizational action through a series of specific management behaviors. Digital management may be the core mediating variable. The same management measure has different effects among different teacher groups, young teachers are willing to try, while older teachers passively coped. This indicates that the strength of the path from management to effectiveness may depend on the collective mentality of teachers. Teachers' Digital Behavioral Intention (TDBI) may be a moderating variable.

After the preliminary framework was formed, data were collected through a combination of quantitative and qualitative methods for model validation. In the quantitative section, data were collected via structured questionnaires to quantify the core influencing factors and their indicators, and descriptive statistics were analyzed using SPSS 26.0. Confirmatory factor analysis and structural equation modeling were performed using AMOS 23.0 to elucidate the structural relationships and pathways among variables. Digital Vision Planning (DVP), Digital Literacy of Principals (DLP), and Digital Implementation Assurance (DIA) are the independent variables; Effectiveness of Principal Digital Leadership (EPDL) is the dependent variable; and Digital Management (DM) is the mediating variable. Teachers' Digital Behavioral Intention (TDBI) is the moderating variable; the relationships among them were supported by hypothesis testing.

In the qualitative phase, a preliminary exploration of research problems and questions was conducted through semi-structured interviews. In the second stage, the study conducted follow-up interviews with 5 participants. The purpose is to examine whether the causal relationship depicted by this final model aligns more closely with the actual situation than initially discussed, and whether a crucial factor in the success of digital effectiveness in schools has been overlooked. Further in-depth opinions were collected through focus group discussions. Based on the above analysis, a digital leadership theoretical model for primary school principals is developed.

2. Product of the Model

Firstly, the most direct product is the dependent variable of the model: "Effectiveness of Principal Digital Leadership", which consists of 5 dimensions: digital hardware and atmosphere development, digital teaching efficiency improvement, digital management optimization, teachers' digital ability development, and student digital well-being. It is the ultimate result of principal digital leadership.

Secondly, the core product is the dynamic process revealed by the model, where "digital management" serves as a core mediator and "teachers' digital behavioral intention" serves as a moderation variable. This mechanism explains how principal digital leadership transforms from "individual ability" to "organizational effectiveness".

Thirdly, in terms of practice, the product of the model also includes a series of practical tools in the guidelines below. These are the knowledge products that can be "produced" after the model is implemented and are truly useful for frontline teachers.

3. Guidelines for Using the Digital Leadership Model of Primary School Principals

The above theoretical model can be applied in practice for primary school principals with the help of the "Guidelines" to evaluate principal's digital leadership and the effectiveness of school's digital development.

Step 1: Diagnose the Current Situation of Principal Digital Leadership

This step is the current status assessment of DLP, DVP and DIA.

1.Principals complete a "Principal Self Evaluation Checklist". It contains the clarity of vision, technological literacy, openness to learning, and management engagement.

2.Principals listen to different voices in the school. It includes teachers' confusion, students' experience, and administrative staff's opinions.

3.Principals draw a "Digital Status Chart". The purpose is to mark the current status of hardware, network, teachers' capabilities, students' literacy, and school administrative staff's support.

Step 2: Plan the Digital Direction

This step is a comprehensive vision planning for the digital activities of the school.

1.Hold a "Digital Vision Planning Meeting". Principals can invite representatives like teachers, students, parents, administrative staff to discuss "The digital vision planning in three years".

2.Transform the digital vision planning into a "commitment".

3.Break down the commitment into a three-year action plan. Filling gaps in the first year, cultivating excellence in the second year, and building the whole environment around school in the third year.

Step 3: Strengthen the Foundation of Digital Implementation Assurance

1.Coordinate resources and implement classified policies. Principals create a "digital asset inventory" that distinguishes three types of assets: core assets, elastic assets, and obsolete assets.

2.Establish "assurance response" standard. It includes fault response, network support, and funding support.

3.Cultivate teachers' technical maintenance ability. Principals select 1-2 young teachers to participate in professional training and become technicians in the school. And establish a "Teacher-Student Technical Volunteer Team", where students help teachers with simple digital problems and young teachers help old teachers.

Step 4: Focus on Digital Management by Primary School Principals

This step emphasizes the mediating role of digital management of principals.

1.Design a reward system for the personnel. For example, rewarding one book with the “Best Micro Course of the Month” to motivate personnel to engage in digital activities.

2.Establish a “responsive” support system. It is better to set up a “technical clinic day” to solve technology problems on the spot.

3.Set up cross departmental collaboration. Principals select a scenario (such as new student information collection), personally coordinate various departments to form a full process workflow.

Step 5: Inspire Teachers in the School

This step focuses on the moderating role of teachers’ digital behavioral intention.

1.Classify teachers’ digital behavioral intention. There are mainly three types for teachers’ digital behavioral intention: active, wait-and-see, and resistant. And, give the different policies to each type.

2.Build a “teacher voice listening mechanism”. It is better to establish anonymous feedback channel, summary it monthly, and hold the discussion item by item.

Step 6: Evaluate the Effectiveness of Principal Digital Leadership

This step is the evaluation of effectiveness of digital teaching efficiency improvement, digital management optimization, teachers’ digital ability development, and students’ digital well-being.

1. Digital changes in teaching. It is clear for principals to focus on teachers’ digital usage frequency, students’ digital participation, subject grades, etc.

2. Changes in digital management. It contains the administrative process time, number of cross departmental projects and so on.

3. Changes of teachers in the school. It is about the changes in the proportion of active teachers and a decrease in the proportion of resistant teachers.

4. Changes of students. It is about the rate of nearsighted, risk of Internet addiction, and feedback from parents.

Based on the above six steps of guidelines, the guidelines diagram is presented in Figure 4.9. It can guide primary school principals to evaluate and improve the effectiveness of principal digital leadership.

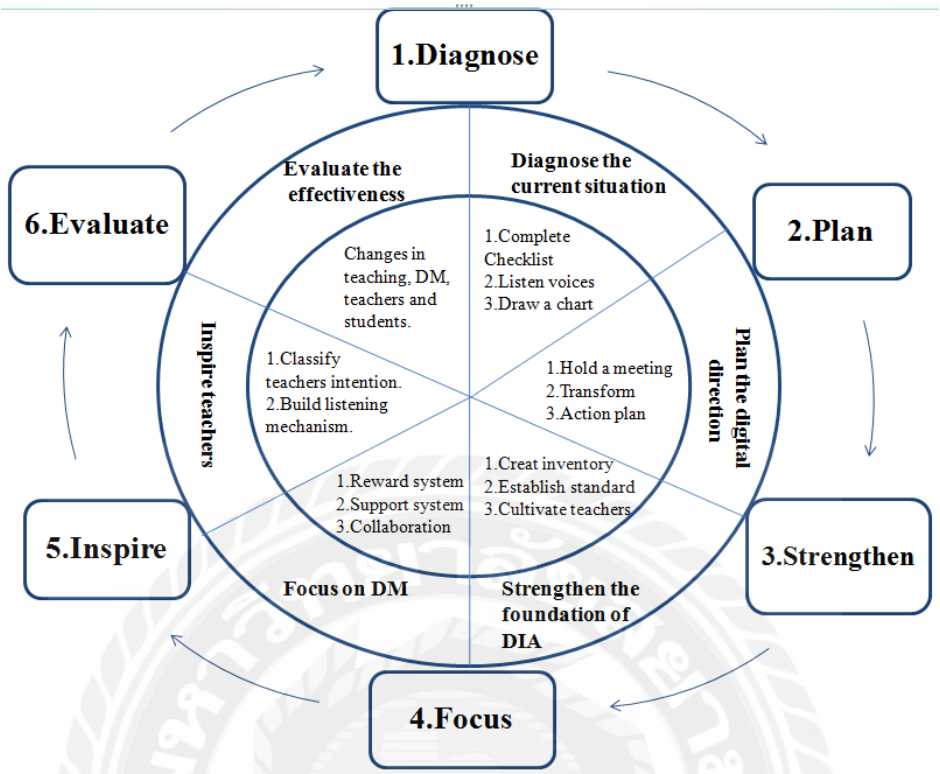

Figure 4.9 Guidelines Diagram of the Model Operation

Final Instructions to Users of the Practical Model:

These six steps can be used repeatedly. It can start from any step, for example:

1.Poor hardware and weak support→Starting from Step 3 (Strengthening the Foundation).

2.Teacher resistance→Starting from Step 5 (Inspire Teachers).

3.Good foundation but chaotic digital management→Starting from Step 4 (Digital Management).

4.4 Validation of the Research Model

To systematically evaluate the theoretical rigor and practical value of the research model of this study, 8 Ph.D experts (See Table 4.26) majoring in education and management were invited to complete a structured evaluation questionnaire using a five-point Likert scale (1-5 Scores): 1 score=complete disagreement; 2 scores=not very agree; 3 scores=average; 4 scores=agree; 5 scores=complete agreement.

Table 4.26 Basic Information of Experts for Evaluating the Research Model

No.	Name	Organization	Position	Graduation Institution	Education Level	Years of Experience
1	Zhang Lei	Central China Normal University	Associate Professor of the College of Education, Central China Normal University	University of Macau	PhD in Education	16

No.	Name	Organization	Position	Graduation Institution	Education Level	Years of Experience
2	Bai Linqian	Central China Normal University	Associate Professor of the College of Literature, Central China Normal University	Southwest University	PhD in Education	15
3	Wang Hui	Pingdingshan University	Vice President of the College of Literature, Pingdingshan University	Shanghai Jiaotong University	PhD in Education	22
4	Chang Minqiang	Pingdingshan University	Professor of the College of Journalism, Pingdingshan University	Wuhan University	PhD in Management	25
5	Chen Li	Henan Normal University	Professor of the College of Education, Henan Normal University	Northeast Normal University	PhD in Management	21
6	Zhang Xiaodong	Henan Normal University	Associate Professor of the College of Education, Henan Normal University	Henan University	PhD in Education	17
7	Zhao Fang	Xinyang Normal University	Professor of the College of Art, Xinyang Normal University	Beijing Normal University	PhD in Education	23
8	Liu Chang	Xinyang Normal University	Associate Professor of College of Art, Xinyang Normal University	Henan University	PhD in Education	15

The evaluation items contained three dimensions: “Propriety, Feasibility, and Utility”, each item comprising five specific indicators (See Table 4.27). The structured evaluation questionnaires were sent via email, and the experts independently rated each indicator. The collected data were subsequently analyzed by calculating mean scores (M) and standard deviations (SD). This approach is consistent with established practices in content validity studies (Lynn, 1986).

Table 4.27 Evaluation Questionnaire of the Model

Category	Item	Scale				
		1	2	3	4	5
Propriety	**P1:** The model clearly identifies and defines the core variables that affect the digital leadership of primary school principals.					
	P2: The causal relationships between variables in the model are reasonably set, which conforms to the basic logic of school organization and operation.					

Category	Item	Scale				
		1	2	3	4	5
	P3: The overall framework of the model comprehensively covers the main processes of digital leadership without any obvious omissions.					
	P4: The emphasis of the model on "TDBI" as a moderating variable is an accurate grasp of the "human factor" in the digital transformation of schools.					
	P5: This model is related to classic leadership theories, such as transformational leadership, and builds on this foundation.					
Feasibility	**F1:** The various variables in the model can be effectively measured through specific and observable behaviors or indicators.					
	F2: Develop a scale based on this model to evaluate principals' digital leadership, with high operational feasibility.					
	F3: The model has basic explanatory power and applicability for the digital leadership status of principals in different regions and types of schools.					
	F4: The pathway of action revealed by the model provides a clear logical basis for designing targeted intervention measures.					
	F5: In practical applications, the complexity of collecting data and making judgments based on this model is within an acceptable range.					
Utility	**U1:** The model can provide a valuable framework for primary school principals to self-diagnose and plan their personal digital leadership development.					
	U2: The model can provide theoretical guidance to regional education departments in designing and evaluating digital leadership development projects and related policies for principals.					
	U3: The model has a clear, illuminating effect on the design of relevant courses and training content for teacher training institutions.					
	U4: The research framework developed by the model provides a solid foundation for subsequent empirical research, including the mechanisms of impact.					
	U5: This study has positive theoretical significance and practical value for promoting the digital transformation of basic education.					

The researcher collected experts' evaluation questionnaires and calculated the mean value and standard deviation of each item. Mean (M) value represents the average level of agreement among experts on the question item, cross all items, the mean values ranged between 4.4 and 4.8 (out of 5), indicating a strong positive assessment of the conceptual model's propriety, feasibility, and utility; Standard deviation (SD) represents the degree of dispersion (consistency) of expert opinions. The smaller the SD value, the more consistent the experts' opinions (See Table 4.28).

Table 4.28 Results of Experts' Evaluation

Item	Experts 1-8	M	SD	Result
P1	5, 5, 5, 4, 5, 4, 5, 4	4.63	0.52	Highly agree on the propriety.
P2	5, 4, 5, 4, 4, 5, 4, 4	4.38	0.52	
P3	4, 5, 4, 5, 4, 4, 4, 4	4.25	0.46	
P4	5, 5, 5, 5, 5, 4, 5, 5	4.88	0.35	
P5	4, 4 , 4, 4, 5, 4, 4, 4	4.13	0.35	
p		4.38	0.41	
F1	5, 4, 4, 3, 4, 4, 4, 4	4.00	0.53	Clearly define the measurement method.
F2	4, 4, 4, 3, 4, 3, 4, 4	3.75	0.46	
F3	4, 3, 4, 4, 3, 4, 4, 3	3.63	0.52	Consider situational differences.
F4	4, 5, 4, 4, 5, 4, 4, 4	4.25	0.46	
F5	4, 4, 4, 3, 4, 4, 4, 4	3.88	0.35	
F		3.93	0.55	Basic agreement, slight challenge.
U1	5, 5, 4, 5, 5, 4, 5, 4	4.63	0.52	Highly agree on the significant value.
U2	5, 5, 5, 4, 5, 5, 5, 5	4.88	0.35	
U3	4, 5, 4, 5, 4, 4, 5, 5	4.50	0.53	
U4	5, 5, 5, 4, 5, 4, 5, 4	4.63	0.52	
U5	5, 5, 5, 4, 5, 5, 4, 5	4.75	0.46	
U		4.55	0.47	

Based on the data in Table 4.28, the comprehensive scores for the three dimensions (Propriety, Feasibility and Utility) are substantially higher than the theoretical median (3 points). This indicates that the model has been highly developed for its theoretical appropriateness and practical value.

The feasibility score is relatively low, particularly for "cross-situational applicability (F3)." This indicates that the model still requires further research on its universality and on the development of measurement tools. The standard deviation (SD) of all items is generally small (<1.0), indicating a high degree of consensus within the expert group, and the validation results are robust and reliable.

In Summary:

The results demonstrates that all three dimensions scored substantially above the theoretical median, confirming the model's sound theoretical foundation and practical applicability. The high level of consensus among experts, as evidenced by the consistently small standard deviations, further validated the robustness and credibility of the model.

CHAPTER 5

DISCUSSION, CONCLUSION, AND RECOMMENDATION

5.1 Discussion

This study aimed to develop and validate a model that systematically explains the mechanisms underlying digital leadership of primary school principals in Henan Province. By assessing the current state of digital leadership of primary school principals in Henan Province using interviews, the research identified strategies on how to strengthen digital management and in the end to enhance the effectiveness of this leadership. The study employed a mixed-methods approach combining qualitative interviews and focus group discussion, and quantitative questionnaire survey. The theoretical saturation and external validity were verified through follow-up interviews, focus group discussions, and expert evaluations.

Research Question 1

What are current status of digital leadership of primary school principals and digital conditions in primary schools in Henan?

To assess the current status of digital leadership of primary school principals and the status of digital development in primary schools in Henan Province, the researcher conducted a small-scale, semi-structured interview with participants in the digital training program during the preliminary phase. The three groups of participants (each comprising 5 participants) were primary school principals, school administrative staff, and front-line teachers (See Table 1.3). They were interviewed to explore their varied experiences and perceptions regarding principal digital leadership and the digital condition of their schools.

Data analysis showed that the digital leadership of principals is insufficient, and the digital development level of primary schools in Henan Province is generally lagging. The current situation of digital leadership of primary school principals in Henan is not very promising, primarily influenced by factors including regional economy, policy support, technological infrastructure, training opportunities, and the teachers' digital behavioral intention of the school. Primary school principals' digital situations are described as: Weak in a clear vision and strategic planning and a lack of personal literacy. High enthusiasm coupled with a lack of necessary technical skills and digital literacy, inadequate understanding of data analysis, and a lack of a clear vision and strategic planning for digital development and management. Loose management mechanisms and a lack of assurance systems. There is greater emphasis on hardware investment than on integrating technology into education, resulting in insufficient awareness and capability. Lack of implementation and promotion. There is a lack of coordination among departments (academic affairs, home, and school) in ensuring effective digital implementation.

The key findings of digital conditions in primary schools are: "Outstanding results on the surface and poor circumstances below". In other words, only a few regional schools, such as those in the Digital Comprehensive Reform Pilot Zone,

demonstrate high aspirations and exceptional outcomes in digital development. However, many districts and schools remain in a more passive state. Due to limitations in funding, equipment, networks, and other factors, the integration of online and offline teaching is not commonly implemented (Yuan, 2023). Furthermore, young teachers are highly enthusiastic but often lack systematic training. Some veteran teachers resist adopting new technologies. The school organizes one or two annual information technology training sessions for all staff, but the content is overly theoretical and does not align with practical teaching contexts. Students are proficient in using technology but have limited awareness of information filtering and network security; some families lack smart devices. Thus, the digital transformation of primary schools is complex.

Research Question 2

What core factors influence the effectiveness of digital leadership of primary school principals in Henan?

To examine the core influencing factors of the effectiveness of principal digital leadership in Henan, the literature review of some scholars on the "constituent elements of digital leadership of principals", with the core elements in the definitions of principal digital leadership (Table 2.4), the related influencing factors of principal digital leadership (Table 2.8), the core elements of effectiveness of principal digital leadership (Table 2.10) were integrated in this study. It is evident that the influencing factors of effectiveness for principal digital leadership can be divided into three aspects: School members, the processes of school organization, and the processes of teaching and learning. All of these can be divided into external influencing factors (Digital resources, school background, teaching and learning, teachers' technology integration, digital behavioral intention) and internal influencing factors (principal's major and leadership experience, productivity and professional practice, digital vision, IT coordination ability, ICT professional development ability).

According to the semi-structured interviews in Chapter 1, in the research on the influencing factors of digital leadership of principals, there is too much uncertainty in external factors such as regional economy, policy and technology support. The research mainly focuses on the digital leadership of principals themselves and the behavioral intention of the school teachers (Yang et al., 2019). And, most primary school principals in Henan are weak in, or lack, a clear vision and strategic planning, personal literacy, implementation, promotion, assurance systems, and management mechanisms. Combined with the above results from literature reviews, 10 influencing factors of effectiveness of principal digital leadership (Table 2.11) were identified. As shown in Table 2.11, some elements are repeated or included. After deleting the repetitive ones and recombining the included ones, and referring to the expression of wording of "Informationization Leadership Standards for Primary and Secondary School Principals (Trial)" issued by the Teacher Work Department of the Ministry of Education, Last, it restructured and reserved 5 core influencing factors. They are digital vision planning, digital management, digital literacy of principals, digital implementation assurance, and teachers' digital behavioral intention.

Research Question 3

What is the digital leadership model for primary school principals in Henan?

In this research, the "digital leadership model" refers to a theoretical model that systematically explains the mechanisms underlying digital leadership among primary school principals in Henan Province. The structured framework that identifies the core influencing factors of the effectiveness for principal digital leadership are digital vision planning, digital management, digital literacy of principals, digital implementation assurance and teachers' digital behavioral intention.

The digital leadership model refers to the comprehensive capability system and practical process in which the principal integrates personal digital literacy, digital vision planning, and digital implementation assurance through a specific context of digital transformation in basic education, with digital management as the core mediator, digital hardware and atmosphere development, effectively promoting digital teaching efficiency, digital management optimization, teachers' digital development, and students' digital well-being under the key moderation role of teachers' digital behavioral intention, thereby leading the school to achieve deep digital effectiveness.

The relationships and effects among the variables are clear.

Direct Effects: Digital Leadership (DVP, DLP, DIA) and Digital Management (DM) have direct effects on Effectiveness of Principal Digital Leadership (EPDL).

Digital Vision Planning (DVP), Digital Literacy of Principals (DLP), and Digital Implementation Assurance (DIA) have direct effects on Digital Management (DM).

Mediating Effects: Digital Management (DM) mediates the relationships between the independent variables: Digital Vision Planning (DVP), Digital Literacy of Principals (DLP), and Digital Implementation Assurance (DIA), and the dependent variable: Effectiveness of Principal Digital Leadership (EPDL).

Moderating Effect: Teachers' Digital Behavioral Intention (TDBI) moderates the relationships between the independent variables: Digital Vision Planning (DVP), Digital Literacy of Principals (DLP), and Digital Implementation Assurance (DIA) and the dependent variable: Effectiveness of Principal Digital Leadership (EPDL).

The core proposition of the model is that principal digital leadership is not a direct output of personal traits. However, a collaborative implementation process is centered on "digital management" and is moderated by "teachers' digital behavioral intention".

Research Question 4

To validate the digital leadership model, a research tool (Digital Leadership Survey Questionnaire for Primary School Principals) was developed and revised. First, after the questionnaires were collected, simple random sampling was used to select the sample in SPSS 26.0. Exploratory factor analysis was conducted on the questionnaire using the principal axis factor method and maximum variance method, further to test the "structural validity" of the questionnaire. This study used AMOS 23.0 to select the remaining sample data for confirmatory factor analysis to assess the goodness-of-fit between the structural model derived from exploratory factor analysis and the observed data.

Then, Structural Equation Modeling (SEM) was used to validate the reliability, validity, and fitness of the revised model. This study conducted follow-up interviews with 5 participants: 2 primary school principals, 2 front-line teachers, and 1 school administrative staff member. The purpose was to examine whether the causal relationship depicted by this final model aligned more closely with the actual situation than initially discussed, and whether a crucial factor in the success of digital effectiveness in schools has been overlooked.

Moreover, this study used a focus group discussion to gather insights, advice, and recommendations from specialists. The study invited 7 experts in the field of education and digital transformation who had not participated in this research before to provide opinions and suggestions to the model.

In the end, to systematically evaluate the theoretical rigor and practical value of the research model in this study, 8 PhD. experts majoring in education and management were invited to complete a structured evaluation questionnaire to evaluate the model's propriety, feasibility, and utility by using a five-point Likert scale, (1-5 Scores): 1 score means complete disagreement; 2 scores means not very agree; 3 scores means average; 4 scores means agree; 5 scores means complete agreement. The evaluation results demonstrates that all three dimensions scored substantially above the theoretical median, confirming the model's sound theoretical foundation and practical applicability. The high level of consensus among experts, as evidenced by the consistently small standard deviations, further validated the robustness and credibility of the model.

5.2 Conclusion

Based on the analysis results, the following conclusions are drawn.

1. A theoretical model of digital leadership synergy that has been empirically tested and has strong explanatory power is established.

The "Digital Leadership Model for Primary School Principals (See Figure 5.1)" ultimately established in this study includes six core variables, forming a clear "**drive** (digital vision planning (DVP), digital literacy of principals (DLP), and digital implementation assurance (DIA))-**mediator** (digital management (DM)) -**adjust** (teachers' digital behavioral intentions (TDBI)) -**output** (Effectiveness of Principal Digital Leadership (EPDL))" chain of action. The core proposition of the model is that principal digital leadership is not a direct output of personal traits. However, a collaborative implementation process is centered on "digital management (DM)" and is adjusted by "teachers' digital behavioral intentions (TDBI)".

The model indicates that:

Digital Vision Planning (DVP): its function is direction guidance, and it needs to be translated into specific action plans.

Digital Literacy of Principals (DLP): it is the core abilities of the principals, including multidimensional connotations such as technological cognition, strategic thinking, resource integration, and political wisdom.

Digital Implementation Assurance (DIA): it is the resource support, it includes not only static devices, but also dynamic service response capabilities and stability of external resources.

Digital Management (DM): This is the central system of the model. It transforms the concepts, capabilities, and resources of the drive layer into organizational actions through a series of specific management behaviors, serving as a necessary bridge connecting “ideas” and “effects”.

Teachers’ Digital Behavioral Intention (TDBI): it significantly affects the efficiency of the transformation from “digital management” to “leadership effectiveness”. Its strength is influenced by external factors such as perceived usefulness, ease of use, support, and team atmosphere.

Effectiveness of Principal Digital Leadership (EPDL): Ultimately reflected in digital teaching efficiency, digital management optimization, teachers’ digital ability development, and student digital well-being, this is the ultimate value pursued by digital leadership.

The core product is the dynamic process revealed by the model, where “digital management (DM)” serves as a core mediator. This mechanism explains how principal digital leadership transforms from “individual ability” to “organizational effectiveness”. Then, in terms of practice, the product of the model also includes a series of practical tools, such as principal self evaluation checklists, teacher feedback channels, etc. in the “Guidelines for Using the Digital Leadership Model of Primary School Principals”. These are the knowledge products that can be “produced” after the model is implemented and are truly useful for frontline teachers.

Based on the analysis above, the model of this study is presented in Figure 5.1.

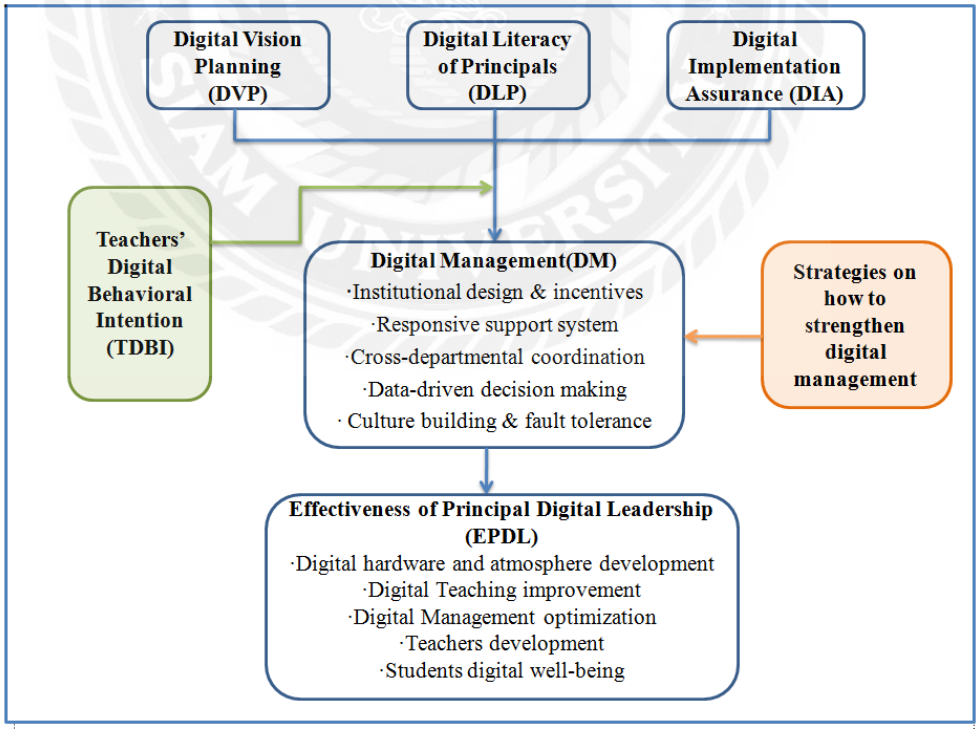

Figure 5.1 Theoretical Model of this Study

2.The core mechanism of the model has been revealed, which constitutes the core theoretical contribution of this study.

(1) Mediating Influence (Mediator role of digital management)

This study challenges the traditional view of leadership as a direct function of personal traits and, for the first time, clarifies and validates "digital management" as an indispensable mediating influence in the field of digital leadership. It explains why the reality of having "ideas and resources" may be "ineffective" lies in the absence of systematic management systems that translate strategy and resources into sustainable organizational practices.

(2) Moderator Influence (Moderator role of teachers' digital behavioral intention)

The model creatively placed "teachers' digital behavioral intention" as the core moderating variable. This emphasizes that digital transformation is a "bilateral adaptation" change, and that the leadership effectiveness of principals largely depends on the collective psychological and behavioral readiness of the executing subjects (teachers). The collective intention of teachers is influenced by factors such as perceived usefulness, ease of use, and group atmosphere, it can amplify or weaken the ultimate effect of any management measure. The same policy can have vastly different implementation outcomes among teachers with high levels of identification and strong resistance. This forces the exercise of leadership to involve a profound insight and proactive intervention into the psychological and behavioral patterns of the executing subject. This offers new theoretical insights into the organizational change in schools.

(3) Strategies on how to strengthen digital management

Based on the empirical findings of this study, strengthening digital management (DM), the most influential mediating variable, requires a shift from technology administration to organization leadership. Specifically, principals should focus on four interrelated actions: A.designing light but motivating institutional incentives; B. establishing responsive technical support systems (e.g., "tech clinic" hours); C. fostering a fault-tolerant and collaborative digital culture through anonymous feedback and peer sharing; and D.leading small-scale, data-driven teaching experiments to demonstrate the value of evidence-based decision making. These strategies, grounded in organizational behavior theory (e.g., SDT, TPB) and validated by the qualitative and quantitative evidence of this research, collectively strengthen DM as the core mechanism that translates vision, literacy, and resources into tangible digital leadership outcomes.

3. The research successfully explained the core contradiction initially discovered and gained high recognition from practitioners.

The model provides a systematic explanatory framework for the common dilemma of "outstanding performance on the surface and poor situation beneath the surface" discovered in the early stages of research in Chapter 1.

The "surface score" primarily derives from hardware investment and project-driven activities in "Digital Implementation Assurance (DIA)" and "Digital Management (DM)" undertaken in response to external inspections. The "deep

problems" are rooted in the ambiguity of Digital Vision Planning (DVP), insufficient strategic and learning leadership in Digital Literacy of Principals (DLP), and systemic deficiencies in Digital Management (DM). Meanwhile, the ineffective Teachers' Digital Behavioral Intention (TDBI) intervention further undermines the effectiveness of management measures.

In qualitative verification, participants from different roles and education and management experts reproduced the formation process of this contradiction in their own language and cases within the model framework, demonstrating the model's strong explanatory power in practice.

5.3 Recommendation

Against the backdrop of "Digital China" and the digital transformation of education, this study makes significant theoretical contributions and practical implications for basic education in Henan Province.

1. Theoretical Contributions

Deepening and contextualizing the existing leadership theories.

Compared with transformational leadership theory, which focuses on leaders inspiring subordinates to surpass themselves through charisma, the model developed in this study situates classic leadership theories (such as transformational leadership) within the specific context of China's digital transformation of basic education, thereby developing a more operational and explanatory theory. It clarifies the specific path for the transformation of leadership from individual abilities to organizational effectiveness in the context of technological integration in education.

Developing an integrated and collaborative digital leadership model.

Compared to previous research on leadership technology models that focused more on ability lists, this model integrates individual, organizational, and situational variables for the first time, in the form of a dynamic "drive-mediator-adjust-output" action chain, clarifying the causal and moderator relationships between them, and providing a testable theoretical framework for subsequent empirical research.

Proposing key theoretical insights.

Besides the above all, in particular, the discussion of the mediating role of "digital management" and the key moderating role of "teachers' behavioral intention" offers a new perspective on the micro-mechanism of school digital reform.

2. Practical Implications

Firstly, the research developed the six steps action guidelines for primary school principals.

The theoretical model is applied in practice for principals with the help of the "Guidelines" to evaluate principal's digital leadership and the effectiveness of the school's digital development and in the end, the practical model is created.

Step 1: Diagnose the Current Situation of Principal Digital Leadership

This step is the current status assessment of DLP, DVP and DIA.

1.Principals complete a “Principal Self Evaluation Checklist”. It contains the clarity of vision, technological literacy, openness to learning, and management engagement.

2.Principals listen to different voices in the school. It includes teachers’ confusion, students’ experience, and administrative staff’s opinions.

3.Principals draw a “Digital Status Chart”. Mark the current status of hardware, network, teachers’ capabilities, students’ literacy, and school administrative staff’s support.

Step 2: Plan the Digital Direction

The step is a comprehensive vision planning for digital activities of the school.

1. Hold a “Digital Vision Planning Meeting”. Principals can invite representatives like teachers, students, parents, administrative staff to discuss “The digital vision planning in three years”.

2. Transform the digital vision planning into a “commitment”.

3. Break down the commitment into a three-year action plan. Filling gaps in the first year, cultivating excellence in the second year, and building the whole environment around school in the third year.

Step 3: Strengthen the Foundation of Digital Implementation Assurance

1. Coordinate resources and implement classified policies. Principals create a “digital asset inventory” that distinguishes three types of assets: core assets, elastic assets, and obsolete assets.

2. Establish “assurance response” standard. It includes fault response, network support, and funding support.

3. Cultivate teachers’ technical maintenance ability. Principals select 1-2 young teachers to participate in professional training and become technicians in the school. And establish a “Teacher-Student Technical Volunteer Team”, where students help teachers with simple digital problems and young teachers help old teachers.

Step 4: Focus on Digital Management by Primary School Principals

This step emphasizes the mediating role of digital management of principals.

1. Design a reward system for the personnel. For example, rewarding one book with the “Best Micro Course of the Month” to motivate personnel to engage in digital activities.

2. Establish a “responsive” support system. It is better to set up a “technical clinic day” to solve technology problems on the spot.

3. Set up cross departmental collaboration. Principals select a scenario (such as new student information collection), personally coordinate various departments to form a full process workflow.

Step 5: Inspire Teachers in the School

This step focuses on the moderating role of teachers’ digital behavioral intention.

1. Classify teachers' digital behavioral intention. There are mainly three types for teachers' digital behavioral intention: active, wait-and-see, and resistant. And, give the different policies to each type.

2. Build a "teacher voice listening mechanism". It is better to establish anonymous feedback channel, summary it monthly, and hold the discussion item.

Step 6: Evaluate the Effectiveness of Principal Digital Leadership

This step is the evaluation of effectiveness of digital teaching efficiency improvement, digital management optimization, teachers' digital ability development, and students' digital well-being.

1. Digital changes in teaching. It is clear for principals to focus on teachers' digital usage frequency, students' digital participation, subject grades, etc.

2. Changes in digital management. It contains the administrative process time, number of cross departmental projects and so on.

3. Changes of teachers in the school. It is about the changes in the proportion of active teachers and a decrease in the proportion of resistant teachers.

4. Changes of students. It is about the rate of nearsighted, risk of Internet addiction, and feedback from parents.

According to the guidelines for principals, the operation diagram is shown in Figure 5.2:

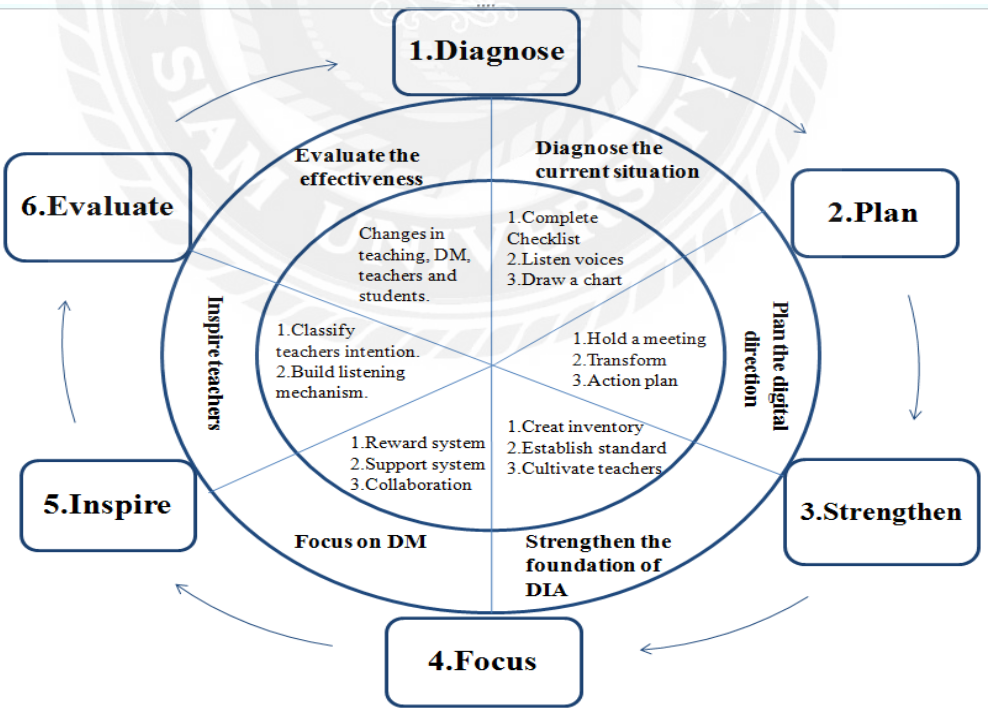

Figure 5.2 Guidelines Diagram of the Model Operation

Secondly, the research gives suggestions for regional education administrative departments and education training institutions.

It offers education policy and evaluation orientation.

In resource allocation and school evaluation, the emphasis should shift from "hardware investment" to "management process" and "application effect". Regional policies should strive to provide stable, sustained resource support, and support principals in carrying out sustainable digital vision planning.

It offers innovative training and support system.

The training content in education training institutions should shift from technology application to "digital leadership" and "digital management". Develop a regional digital teaching, research, and resource-sharing platform to promote the flow and sharing of high-quality experiences and resources, break the bottleneck of single-school resources, and amplify the positive effect of excellent digital management practices.

3. Research Limitations

The first is the regional characteristics of the sample.

Although the sample size was sufficient and the structure was reasonable, the sample primarily came from Henan Province. The nationwide applicability of the research conclusions, particularly in regions with significant economic and social development disparities, warrants further verification.

The second is the measurement depth of the core variables.

Although this study has good reliability and validity in measuring complex concepts such as "digital management (DM)", its richer sub-dimensions (such as innovation risk management) need to be further refined and explored in future research.

The last is the lack of longitudinal data.

This study reveals correlations and causal pathways among variables based on cross-sectional data; however, the development of digital leadership is a dynamic process, and its long-term effects and evolutionary trajectory remain to be elucidated through longitudinal tracking research.

4. Future Research Prospects

Firstly, the cross-situational validation and adaptation of the research model in the future.

Future research can test this model across different regions and school types (e.g., rural small-scale schools and international schools) and examine the necessary adjustments to enhance the theory's universality and ecological validity.

Secondly, deepen the research on key variables.

More detailed case studies or experimental research can be conducted on the intermediary process of “digital management”, especially in emerging dimensions such as “data-driven decision -making”. At the same time, it is possible to explore in depth the formation and change mechanism of “teachers’ digital behavioral intention” and design effective intervention strategies.

Thirdly, expand the external system perspective of the model.

Integrate external system variables such as parental digital literacy, corporate and social support, and higher-level digital governance policies more comprehensively into the analysis framework, and construct a more macro-level leadership model for digital education transformation.

Conclusion of the Study

This study developed and validated the model that elucidates the intrinsic mechanism of digital leadership of primary school principals in Henan Province through a rigorous mixed-methods approach. This model not only offers a new analytical framework for the academic community to understand leadership in the digital transformation of education, but also provides a clear “action map” for educational practitioners, particularly principals. It indicates that excellent digital leadership is essentially the art of finding concise levers in complex systems. It is hoped that the results of this research will help advance the digitalization of basic education, moving from “superficial excitement” to “deep integration”.

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APPENDIX

APPENDIX A

Preliminary Studies: Semi-structured Interview Questions A Development of Digital Leadership Model for Primary School Principals in Henan

To Interview Respondent

Thank you for your participation in this study. As a doctoral student, I am now seeking to interview with you. Please be assured that all information obtained from this study will be used solely for academic purposes. Your personal information will be kept strictly confidential. Once again, I express my sincere gratitude for your involvement.

Ms. Du Xueping, Ph.D. Student
Siam University

Semi-structured interview questions for principals:

1. Do you know about the digital leadership of principal?
2. What plans do you have for the digital development in your school?
3. How do you promote the implementation of digital leadership?
4. What preventive measures has the school taken to deal with digital risks?
5. What are the main digital achievements and highlights in your school?

Semi-Structured interview questions for school administrative staff:

1. Do you know about the digital leadership of principal?
2. Do you know about digital transformation of education?
3. What difficulties do you face in your work in the digital era?
4. What do you think of the principal's digital intentions?
5. What do you think of the principal's digital abilities?

Semi-Structured interview questions for teachers:

1. Do you know about the digital leadership of principal?
2. Do you know about digital transformation of education?
3. Have you received any digital training or digital policies?
4. In what way do you hope to improve your digital ability?
5. Do you think digital methods have truly improved teaching effectiveness?

APPENDIX B

Interview Outline of Principles Administrative Staff and Teachers

Personal statements of 5 principals:

Principal A, P1(from a non experimental county primary school):

Last year, the school was rated as an ‘Information Technology Standard School’, which sounds good, but in reality, it just added a few smart screens and a computer classroom. During the epidemic, online teaching exposed many problems--unstable network and unfamiliar teacher operation. Now everything has returned to the old path. The most headache inducing part is training: inviting an expert to give a lecture, the teacher felt it was fresh at the time and couldn’t even use it when they went back. Old teachers find it troublesome, while young teachers lack guidance and cannot change their habits with just one or two training sessions.

The use of the device is not ideal. There are many functions of the smart screen, but most teachers only use it to display PPTs. The functions of whiteboard interaction, classroom recording, and online answering are basically idle. Except for information technology classes, computer classrooms are rarely used for other subjects. Over time, people prefer to use chalkboards and chalk in their own classes.

Training is my biggest headache. We invite experts to conduct one or two full staff training sessions every year. Last year, we hired teachers from the Energy saving Education Center to teach about the application of smart classrooms. The on-site demonstration was very effective, and the teachers felt it was fresh at the time. Many people took photos and videos. But the training ended immediately without any follow-up. As soon as the expert left, the teacher returned to the office and faced real equipment, real classrooms, and real students. How to log in to the system? How to create a student account? Where can I find courseware resources? These questions have not been answered by anyone. I have found that the biggest problem with training is not the insufficient frequency, but the disconnect between the content and actual teaching, and the lack of after-sales service after the training.

I think what is most needed is not more equipment, nor more one-time training, but a sustainable 'support system'. For example, our school has a young teacher who understands technology and graduated from the Information Technology major. Many teachers privately seek his help. But his class workload has not decreased, and helping is purely voluntary. He is also very tired himself. If the school can establish a "digital teaching support post" to reduce his classes and let him specialize in training, answering questions, and maintenance, it may be more effective than hiring ten experts. In addition, I also want to include digital usage in the assessment of teaching and research groups at the school level, but there is a lot of resistance.

Principal B, P2 (from the Digital Comprehensive Reform Pilot Zone School):

Our district is a provincial-level digital education pilot, with leading hardware and platforms. We have also explored ‘digital classrooms’ and data-driven evaluation.

But even here, digitalization is mainly driven by projects, and once the project is completed, continuous investment cannot keep up. Moreover, different departments have different understandings of ‘digitalization’: the Academic Affairs Office wants grade data, the Moral Education Office wants a home school interactive platform, and the Technical Department only focuses on equipment, lacking overall planning. The principal is in the middle, more like a ‘coordinator’ than a ‘leader’.

Our biggest problem at present is the unsustainability brought about by 'project-based operation'. I am now more like a 'coordinator' than a 'leader'. The ideal state is that I can lead everyone to develop an overall plan for the digital development of the school, and then all departments can work together to promote it under this plan. But the reality is that policies change every year, emphasizing smart classrooms this year, education evaluation reform next year, and possibly changing priorities the year after. As soon as the school plan was made, the wind direction in the district changed, and we had to adjust accordingly. In this environment, it is difficult to form long-term strategic determination. I am also reflecting on whether my digital literacy is not enough and my understanding of this field is not deep enough, so I dare not make decisions or persist. On the other hand, I do lack professional guidance and reference, and I don't know how other schools do it, so I can only explore on my own.

Principal C, P3 (from a rural town primary school):

Our most pressing issues are money and equipment. The number of tablets provided by the superior is not enough, and one tablet is needed for daily use; The network bandwidth is small, and live classes often lag. Young teachers have ideas, but schools are unable to support them in developing curricula. Digitization is more like a necessary check for us, rather than a tool to truly enhance teaching. We also want to change, but the regional economic gap is here, and it is difficult to rely solely on the efforts of schools.

In recent years, our school has recruited several young teachers who graduated from a normal university and are very interested in digital teaching. There is a teacher named Xiao Zhang who teaches mathematics. He made a video of micro class and put it on the official account of WeChat. Students can watch it when they come home from school. There is also a teacher named Xiao Li who teaches English and has tried to do interactive quizzes on a tablet. The students have a high level of enthusiasm. However, the school's conditions are too limited, and they want to develop courses without equipment; I want to participate in the training, but there are no available spots (priority will be given to schools in urban areas for training quotas in the district); I want to do research on a topic, but I don't have any guiding experts. I watched them slowly go from enthusiasm to despair, and I felt very uncomfortable.

For schools like ours, digitization is often a necessary check to deal with. Every year, the Education Bureau conducts an evaluation of information technology work and requires the completion of reports, such as the coverage rate of smart screens, the number of teacher training sessions, and the utilization rate of student computer rooms. When we fill in, we try to write it in a visually appealing way, but we are aware that these numbers have little to do with the actual quality of teaching. I know this is not right, but we can't even guarantee basic equipment and networks. How can we have the energy to pursue deep integration and classroom innovation? During the

district meeting, listening to the principals of urban schools share their experiences, such as "big data precision teaching" and "blended learning online and offline", I feel very distant. It's not that I don't want to learn, it's that I can't learn. The gap between us and them cannot be filled by just one or two training sessions.

Principal D, P4 (from a traditional famous school in the city):

The school has a long history and many old teachers. They have a resistance to new technologies and believe that blackboard writing is the real ability. Although training is organized every year, the content is single and disconnected from actual teaching. During the epidemic, we were forced to conduct online teaching for all staff, but progress was faster at that time; Now that offline has been restored, many functions are idle again. I think the fundamental problem lies in the lack of true integration of digitalization with curriculum and evaluation, which has become an ‘add-on’ rather than a ‘mandatory’ option.

We conduct training every year, but the results are very poor. On the one hand, the content is single, with "PPT Advanced Techniques" and "Introduction to Xiwo Whiteboard" every year. Old teachers may forget it after listening to it once, while young teachers feel that they have already learned it. On the other hand, there is a disconnect between the training format and actual teaching. Experts talk about ideal application scenarios, but in our school, there are only one device for a class of 50-60 people, and students have no opportunity to interact. After the training, the teacher returned to the classroom in their most convenient way.

If I could design from scratch, I would embed digitalization into the three most core aspects. The first is curriculum design, where each subject should have clear digital literacy training objectives, not scattered embellishments, but systematic planning. The second is teaching evaluation. There should be specialized technical application dimensions for listening and evaluating lessons, and it is not enough to just look at whether the teacher's blackboard is good or whether the students' discipline is good. The third is teacher development. Schools should establish a tiered digital competency certification system, linking from entry-level to proficient, and appropriately linking it with professional title evaluation and appointment. Of course, these are all ideals. The reality is that schools are not independent kingdoms, curriculum outlines are compiled by departments, examination systems are unified, and evaluation standards have been formed over many years. It is difficult to leverage this system solely with the power of one school.

Principal E, P5 (from a City Primary School):

Our school has a high hardware starting point, but the software and manpower cannot keep up. The teaching staff is young and enthusiastic, but lacks systematic training and often explores on their own, resulting in uneven effectiveness. As the principal, I realize the need for a clear digital vision, but district policies change every year and priorities are often adjusted, making school planning difficult to sustain. Each department also operates independently, and academic affairs, moral education, and technology centers rarely sit together to discuss overall plans.

After taking office, I spent three months working with my teachers to develop a three-year action plan for the development of smart education in schools. It clearly

defines our school's digital vision - not to become the school with the best equipment, but to make technology serve the personalized growth of every child. We also listed the key tasks for the first year, such as building a school-based digital resource library and training a team of backbone teachers. At that time, everyone was very motivated and felt that they finally had a clear direction. But the problem is that the policies in the district are changing every year. In the first year, the district emphasized the "smart classroom", and our planning was in line with this direction. In the second year, the district changed its director in charge and shifted its focus to "education evaluation reform", requiring schools to focus on data-driven academic evaluation. Although this aspect is included in our plan, it is not the main focus and can only be temporarily adjusted by reallocating manpower and funds. By repeatedly adjusting in this way, the school's long-term plan becomes an "annual work plan", and the three-year action plan is virtually non-existent.

Personal statements of 5 teachers

Teacher A, T1 (young teacher, teaching for 3 years):

I often use PPT and online homework platforms, but school training only teaches basic operations, such as how to use PPT, which is not very helpful for our actual teaching. I hope to learn how to use data to analyze students' weaknesses or design blended learning activities, but no one is teaching me. The equipment also frequently malfunctions, and even after receiving feedback, no one repairs it in a timely manner, gradually losing enthusiasm.

The biggest challenge for me is that the equipment often malfunctions and repairs are slow. Our classroom's smart screen has broken twice this year. The first time was due to touch failure, and the second time was due to system freezing. Every time I report a repair, the people at the information center say 'I know', but they wait for a week. During that time, only laptops could be used for projection during class, which was very inconvenient. There are also network issues. Our school's wireless network coverage is incomplete, and some classrooms have poor signal, which often leads to failure to load online resources. I have provided feedback many times, but the issue has not been resolved.

When I first started working, I spent one or two hours every night making courseware, searching for resources, and even researching various educational apps on weekends. Now, if possible, don't do it. It's not laziness, it's feeling like no one is watching, helping, or encouraging even after doing it. The equipment is broken and no one repairs it, the problem feedback is ignored, and the innovation attempts are not followed up.

Teacher B, T2 (Senior Teacher, 25 years of teaching experience):

I am used to blackboard chalk, which is simple and direct. The smart screens developed by the school are complex to operate, time-consuming to create courseware, and may not necessarily yield better results. I also participated in the training, but I spoke too quickly and couldn't remember. I think technology is just an aid and cannot replace teachers in teaching. It's a bit of a case of putting the cart before the horse now.

I attended the training, but to be honest, I can't remember. The expert spoke very quickly, talking about this feature and that feature at times. I skipped over before I could even react. A lot of training materials have been sent out, and when I go back and open them up, I can see the dense operation steps. Just looking at two lines makes me feel overwhelmed. I also asked a young teacher to teach me, and I learned it at that time. I don't have to forget it again in a few days. Later on, I stopped tinkering and felt that these technologies were not designed for someone like me who was about to retire.

I think the biggest problem is putting the cart before the horse. Nowadays, in many open classes, teachers spend a lot of time making courseware and cutting videos, and the classroom is like a performance show. But what exactly did the students learn? Has classroom efficiency really improved? I'm not sure. Technology should serve teaching, not the other way around. Sometimes when I see young teachers using technology for the sake of using it, even though they can explain the concept clearly in a few sentences, they insist on playing an interactive game. I think it's a waste of time.

Many teachers of our age have the idea of 'not seeking merit, but striving for no mistakes'. Good digital teaching does not necessarily earn extra points; If done poorly, there will be no deduction of points. So there's no need to spend too much energy. I understand that schools need to innovate and that young teachers have enthusiasm, but please don't force us old teachers either. We have our own teaching methods, which have been effective over the years.

Teacher C, T3 (Excellent Teacher, Subject Teaching and Research Leader):

We attempted to use digital tools for collective lesson preparation and learning situation analysis, but the data platform was not unified. The academic affairs office required grade data, while the technical department provided login data, which did not match the two. Schools lack people who understand both education and technology to guide, resulting in many tools that cannot be used and become mere decorations.

What our school lacks the most are people who understand both education and technology. Those who understand technology, such as teachers in information centers, know how to install systems, fix computers, and configure networks, but they are completely clueless about teaching and do not know how to allocate 40 minutes in a class or what students are interested in. Those who understand teaching, such as our teaching and research team leader, know the course objectives and teaching methods, but have a shallow understanding of technical tools and do not know what software can achieve what functions. These two groups of people sit together for meetings and often have inconsistent topics. The technical department said 'this platform has twenty functions', while the teaching and research group said' we only need that one function, but it's not easy to use'. This type of communication is costly and difficult to cultivate a bilingual talent.

For me, successful digital teaching is not about how many high-tech devices are used or how cool courseware is made, but about technology truly solving the pain points in teaching. For example, in English speaking training, in the past we couldn't practice, students dared not speak, and teachers couldn't hear us; Now using intelligent voice evaluation, students can practice by facing their phones, the system

automatically scores, and teachers can see each student's pronunciation problem report. This is the successful application. On the other hand, if technology cannot solve pain points and only increases the burden, then no matter how advanced it is, it is meaningless.

Teacher D, T4 (Information Science Teacher):

I often help old teachers with equipment issues because I have some technical knowledge, but this extra work does not count towards class hours and is purely supported by passion. The school training content repeats every year and there are no advanced courses. The things in the digital resource library are also very old and do not match the textbooks, making it very inconvenient to use.

The biggest problem is the lack of layering and advancement. The content and form of the annual training are almost the same. The experts tell it once and everyone listens to it once. What novice teachers need is "hands-on teaching", such as how to log in to the platform, how to create classes, and how to distribute homework; What advanced teachers need is' why ', such as why this design is more effective and how to integrate technology and disciplines; What backbone teachers need is "how to create", such as how to develop their own digital resources and how to guide others. But our school is not hierarchical, and everyone listens to the same lecture, resulting in beginners not understanding, advanced students feeling shallow, and backbone students wasting time.

The digital resource library is basically a decoration. Many of the courseware, lesson plans, and micro lessons in the resource library were uploaded several years ago, and their content does not match the current textbooks. For example, the textbooks compiled by the Chinese department have been updated twice, but the resource library still contains the old version of the People's Education Press textbooks.

Teacher E, T5 (teacher, focusing on home school communication):

During the epidemic, using Ding Talk to hold parent teacher conferences was efficient, but now they have returned to offline meetings, and many parents cannot come due to work. In fact, digitalization has great potential in home school co education, but schools do not have a unified platform. Classes use We Chat, schools use Ding Talk, and notifications are often overlooked. Lack of coordination among departments has increased our workload.

The ideal digital home school co education should not be a one-way notification push, but a two-way communication and collaboration. For example, schools can regularly push family education guidance micro courses to parents; Parents can also provide feedback on their children's academic performance at home; The system can generate a child's growth profile, which can be jointly recorded and evaluated by parents and teachers. But now, our school doesn't even have a unified platform, and each department operates independently, always prioritizing teaching in resource allocation. The Moral Education Department wants to innovate, but lacks budget and technical support. Our homeroom teacher is caught in the middle, wanting to use digitalization to reduce work burden, but also facing the dilemma of system chaos and insufficient support.

What is most needed is top-level design and cross departmental coordination at the school level. It's not about the Academic Affairs Office creating one set, the Moral Education Office creating one set, and the Technology Center creating another set, but about everyone sitting together and planning a unified digital platform that serves student development. This platform should meet the needs of all parties and reduce the burden on teachers and parents. Of course, this is difficult and requires strong promotion from the principal.

Personal statements of 5 administrative staff members

Staff member A, S1(Academic Affairs Office Officer):

We are responsible for scheduling classes and teaching statistics. Currently, we need to use a digital platform to input grades and analyze exams, but the system often lags and the data cannot be exported. The technical department says the equipment is old, while the finance department says there is no budget for updating it. Teachers complain a lot, and we are caught in the middle, which is very inefficient.

I am mainly responsible for course scheduling, grade input, and teaching statistics. Our school uses a set of educational management system, which theoretically can schedule courses online, input grades online, and automatically generate reports. But the reality is that the system often lags, and it's impossible to log in during peak hours. After each mid-term and final exam, the teachers urge for grade analysis, but the system easily crashes. We can only manually input data using Excel first, and then import it when the system is no longer stuck. Walking on two legs is inefficient and prone to errors.

The most fundamental solution is to incorporate information technology operation and maintenance into the regular budget of the school, rather than relying on project funds for guerrilla warfare. Purchasing a system costs hundreds of thousands, but the system requires annual maintenance, upgrades, and training, and these ongoing investments are more important than one-time purchases. In addition, the technical department should also take responsibility for the operation and maintenance of business systems, rather than just focusing on network and hardware. The Academic Affairs Office is a user, not a technical expert. If there are problems, the technical department should diagnose and coordinate with suppliers to solve them. This situation must be broken now.

Staff member B, S2 (Information Administrator):

I am in charge of maintaining the school’s network and equipment, but I am the only one. Once there is a problem with the equipment, it cannot be accessed. When purchasing, we pursue ‘advanced’, but many functions are not used by teachers. We are also responsible for training, but the academic affairs office does not have specific requirements, so training becomes a formality.

The biggest problem is the lack of long-term planning. If the device is broken, buy the device. If the system crashes, replace the system. The school has never seriously considered: what kind of digital campus should we build in the next three or five years? What kind of technical architecture is needed? What kind of talent team is needed? Due to the lack of planning, procurement is random and projects are isolated. Today is this supplier, tomorrow is that platform. The teacher learned a bunch of

software, but with a new leadership, they started over from scratch. This kind of turmoil has consumed too much of people's enthusiasm.

Staff member C, S3 (Head of Moral Education Department):

We want to use a digital platform for student behavior recording and home school interaction, but the tools provided by the technical department are not user-friendly, and the homeroom teacher is also unwilling to make additional entries. The school lacks top-level design, and data from various departments is not interconnected. The data required for moral education and academic affairs are not provided, making it difficult to form a cohesive force.

The principal needs to personally push for it. This is not a technical or budget issue, it is an organizational collaboration problem. If the principal does not come forward to coordinate, various departments will never actively cooperate. The Academic Affairs Office has KPIs for the Academic Affairs Office, and the Moral Education Office has KPIs for the Moral Education Office, each managing their own share, without the motivation to cooperate with others. Only when the principal elevates digitalization to the strategic level of the school, clarifies responsibilities, breaks down barriers, and coordinates resources, can it truly be pushed forward.

Staff member D, S4 (Home School Cooperation Specialist):

Digitization could have better connected parents, but the school platform has limited functionality and can only send notifications. Parents want to use online methods, but the technical department says there is no server support. Different departments have different understandings of ‘home school co-education’, and resource allocation always prioritizes teaching, making it difficult for us to promote innovation.

The Academic Affairs Office believes that the top priority of the school is teaching, and all resources should prioritize ensuring teaching; The Department of Moral Education believes that home school co education is a part of moral education work and should be led by them; The technical department knows nothing about home school cooperation and is not interested in it. Every time we apply for resources, we need to explain repeatedly and coordinate with multiple parties.

We need a functional and integrated home school interactive platform. No need for advanced features, meeting the four core needs of notification publishing, online meetings, resource sharing, and parental feedback is enough. We don't pursue 'wisdom', 'innovation', or 'cutting-edge', we just want something stable, easy to use, free, or low-cost. With this foundation, we can talk about innovation. Now there is no infrastructure, and all ideas are castles in the air.

Staff member E, S5 (logistics support personnel):

We purchased the equipment according to the list, but the teacher reported that it is not easy to use; The maintenance budget is insufficient every year, and there are more and more old equipment. I bought a batch of live streaming equipment during the epidemic, but it is now idle in the warehouse. Schools lack long-term planning and often buy for the sake of buying, regardless of how they are used or repaired later on.

Most of our inventory is idle in the warehouse. In the early stage of the 2020 epidemic, the higher authorities urgently allocated funds to require schools to purchase live streaming equipment to ensure "suspension of classes without suspension of learning". Our school has also purchased a large number of cameras, microphones, fill lights, and portable laptops. But these things are emergency procurement, without sufficient justification, and the quality varies greatly. After the epidemic stabilized, many teachers reported that the equipment was not easy to use, the operation was complicated, and they were unwilling to use it. Most of the equipment is now piled up in the warehouse, covered in dust.

Lack of long-term planning, buying for the sake of buying. Many purchases are not made to solve practical problems, but to spend budgets, to cope with inspections, and to 'have what others have'. Before purchasing, there was insufficient research on user needs, and after purchasing, there was no tracking of usage effects. Even if it broke down, there was no funding for repairs. This "heavy procurement, light management, and no evaluation" model has caused huge waste of resources. I think schools should answer three questions before purchasing every year: Do teachers really need this thing? Will anyone use it after buying it? Is there money to repair it if it's broken? If these three questions cannot be answered, the procurement should be postponed.

APPENDIX C

Follow-up Interview Questions of Principals, Teachers and School Staff Member

To Interview Respondents,

Thank you for agreeing to participate in this follow-up interview. This discussion aims to gather your insights on the proposed model developed from this study. Specifically, we seek your expert evaluation regarding the model's effectiveness. Your feedback will be invaluable in refining the model and ensuring it offers practical solutions that align with real-world practices within basic education. We appreciate your time and expertise in contributing to the success of this research.

Ms. Du Xueping, Ph.D.
Siam University

Follow-up interview questions for principals:

1. Does the model align with your observation of your school's digital process?
2. Do the ideas and resources of principal need to be implemented through a series of specific management actions?
3. Have you ever experienced the effectiveness of management measures is reduced or increased due to different attitudes of teachers?
4. Do you feel there is a crucial factor that has not been fully reflected in this model?

Follow-up interview questions for school administrative staff:

1. As a key position connecting policy, technology, and teaching, do you think the coordination directly determine good digital ideas?
2. What does 'digital implementation assurance' in the model specifically refer to in your work?
3. Have you observed that willingness of teacher community to new technologies significantly affects a digital management policy?
4. Is there any link or role whose importance has been underestimated by the model?

Follow-up interview questions for teachers:

1. Are the digital management measures a bridge connecting the design of the school with your classroom practice?
2. What factors do you think can most effect your willingness to try new technologies?
3. What positive changes do you think a successful principal's digital leadership should ultimately make teachers feel in their work?
4. Are there any other key figures or invisible conditions that are absolutely indispensable?

APPENDIX D

Follow-up Interview Outline of Principals, Teachers and School Staff Member

Follow-up dialogue with principals:

Question 1:

Q: Principal Wang, based on your years of management experience, does the basic model framework of 'driving factors → management actions → final effects' align with your observation of the school's digitalization process?

P2: Very fitting. I deeply understand that vision and equipment (driving factors) are far from enough. The core is the 'management action' in the middle. For example, our school proposed the vision of a 'smart campus' three years ago and also built maker classrooms, but initially no one used them. The problem lies in the management not keeping up - the use was not included in the assessment of the teaching and research group, there was no arrangement for key teachers to take the lead, and the resource application process was too complicated. It wasn't until last year when we are formulated the 'Digital Teaching Application Management Measures' that the situation improved. So, this model places' management 'in the central transmission position, which is the finishing touch and fully captures the key.

P4: Completely in line, and I have a deeper understanding. For our rural schools, the 'driving factors' themselves are insufficient - insufficient equipment, poor network, and lack of funding, which are inherent gaps between us and urban schools. But even under such conditions, I have observed that whether management can keep up or not, the effect is completely different. It is also a computer room with only 30 old computers. Some principals lock it up for fear of damage, while others schedule classes, arrange teacher training, and encourage students to use it. Over the years, students' information literacy has greatly improved. So your chain is correct: resources are the foundation, but management determines whether resources can be turned into effects. Our rural schools already have limited resources. If we don't manage and make good use of them, we'll really have nothing left.

Question 2:

Q: In the model, we placed 'digital management' at the core hub. In your opinion, do the ideas and resources of the principal need to be implemented through a series of specific management actions in order to be truly realized?

P2: It is absolutely necessary. Let me give you a negative example: we once invested in introducing a great classroom interaction platform with the intention of increasing classroom participation. But it was just a simple notification without supporting management actions - there was no organized hierarchical training, no technical Q&A personnel arranged, and no adjustment of the listening and evaluation standards to encourage use. The result is that, except for a few young teachers who tried it out, most of them didn't know what to do with it or how to use it well. The money was spent, but the effect was almost non-existent. This is a typical case of

'having ideas and resources, but lacking management action', leading to transmission failure.

P4: I have asked myself this question many times. My answer is: Insufficient resources require more management. Our school doesn't have enough tablets for a single class, so I asked the teaching office to create a 'tablet reservation sharing form'. Which teacher needs to use a tablet for which class, please register one week in advance. In this way, although there are few devices, every class can be used on the cutting edge, and no one will waste a trip. Due to network congestion, we will adjust the schedule of live classes to avoid peak internet usage throughout the town. Isn't this management? No money was spent, but the problem was solved. I would like to emphasize one point in particular: management does not mean spending money, management is about putting effort into it. Many principals always think, 'I'll wait until I have the money and complete the equipment before going digital,' but they end up waiting for five or ten years without doing anything. I won't wait, I'll just dig into the details and find ways within the existing conditions. It's a step forward if I can push forward.

Question 3:

Q: We found that teachers' willingness is like a 'regulating valve'. For example, implementing an online lesson preparation platform can have vastly different effects in departments with high teacher acceptance and strong resistance. Have you ever experienced a situation where the effectiveness of management measures is reduced or increased due to different attitudes of teachers?

P2: Too much experience! We are in the same school, but the situation is completely different for different grade groups. Last year, when the 'Electronic Home School Contact Book' was implemented, the third grade homeroom teachers were young and accustomed to communicating through WeChat. They quickly got started and even developed new features, which received good feedback from parents. But there are many senior teachers in the fifth grade group, who feel that it has increased their burden and have strong resistance. Although they have also followed the requirements, it has become a formality and parents are not satisfied. The same schools, policies, and training ultimately result in two extremes. This has made me deeply realize that any digital management measures must take into account the variable of 'teacher willingness' when designing, and cannot be a one size fits all approach.

P4: This variable is more important and difficult to handle for our rural schools than for urban areas. There are many old teachers in our school, many of whom are private teachers who have been converted to full-time positions, and their computer foundation is very weak. There are few young teachers, and most of them are from out of town. They will leave after two or three years and cannot stay. So the digital ability of the teaching staff has never improved, and their willingness has also been weak. But what I want to say is that intention can be 'activated'. Our school has a 50 years old Chinese teacher who has always been against using computers. Last year when her son went to college, he bought a new computer and brought the outdated one to school. Our information teacher helped her install several teaching software and taught her how to make courseware step by step. She found that this thing could

indeed help with teaching, so she voluntarily signed up to participate in the county's information technology teaching competition and won the third prize. This incident made me understand that the willingness of teachers is not innate, but supported. I completely agree with placing it in the 'regulating variable' position in your model, but I would like to add that the principal can manually tighten this regulating valve

Question 4:

Q: Finally, looking at this model and based on all of your work experience, do you feel that there is a crucial factor or condition that has not been fully reflected in this model? Any subtle perception is fine.

P2: Well... the core components of the model are already very complete. If I had to say something, I think it might be 'sustained and stable regional policies and resource support'. We often operate in a 'project-based' manner now, where a pilot project comes with funding and support, and everyone is full of enthusiasm; The project is over, it may be discontinued. The personal vision and management of the principal are greatly influenced by the sustainability and direction of the 'east wind' mentioned above. It may not be entirely an internal variable of the school, but it strongly affects the 'digital implementation and guarantee' on the left side of your model, and even affects the long-term intention of teachers. This may be considered as an important external condition.

P4: I think the 'digital implementation and guarantee' mentioned in your model may mainly refer to equipment, networks, and platforms for urban schools. But for our rural schools, there is a more advanced guarantee - the guarantee of basic educational conditions. We don't want to go digital, we really don't have electricity, internet, or equipment. Last year, there was a classroom in our school where the voltage was unstable and the smart screen went black as soon as it was turned on. We asked an electrician to check and found out that the entire circuit was aging and needed to be rewired. The school cannot afford this money, and there is no budget in the town. We have to wait for almost half a year. What I want to say is that it is unrealistic to talk about 'deep integration' and 'mode innovation' when a school is still worried about 'lack of electricity'. If this model is to be extended to weaker areas in the future, it may need to add a concept of 'basic security threshold' - some conditions cannot be solved by principals through management, and require the government and society to provide a backup.

Follow-up dialogue with teachers

Question 1:

Q: From your perspective of frontline teaching, are the digital management measures of the school a bridge connecting the top-level design of the school with your classroom practice?

T2: That's right, it's a bridge, and whether it's accessible or not has a huge impact on us. For example, the top-level design of the school says it wants' data-driven teaching ', but if the management measures only require us to fill out a bunch of complex forms every week (the bridge is not fixed), it will be a burden on us. But if the management measures are to provide us with simple data analysis tools, arrange fixed teaching and research time to review data together, and have experts guide us on

how to adjust teaching based on data (the bridge has been repaired), then this top-level design can truly enter my classroom. So, managing the design quality of this' bridge 'directly determines whether we benefit or suffer.

T3: I agree that it is a bridge, but I would like to add a perspective: sometimes this bridge is a 'one-way street'. The management measures of schools are mostly conveyed downwards - tasks assigned by the academic affairs office, notices issued by the information center, and requirements proposed by the principal's office. However, the voice, confusion, and needs of teachers are rarely transmitted upwards through this bridge. For example, our teaching and research group found that the report dimensions of a certain data platform did not match our actual teaching focus. We wanted to provide feedback to the technical department, but found that there was no feedback channel. No one replied to the email, and even though it was mentioned in the meeting, there was no follow-up. Over time, we no longer provide feedback and rely on our own efforts. So I think that true 'digital management' should not be a one-way command issuance, but a two-way dialogue mechanism. I haven't seen this very clearly in your model yet.

Question 2:

Q: The model emphasizes the influence of 'teacher behavioral intention'. What factors do you think can most enhance or undermine you and your colleagues' willingness to try new technologies?

T2: The most important aspect of increasing willingness is that it is' useful ', which can really help me solve pain points in teaching or management, rather than relying solely on technology for its own sake; The second is' easy to use ', not too complicated, and the learning cost should not be too high; The third is' having support ', someone can solve problems in a timely manner, and there are role models to learn from. The opposite of discouraging willingness is: first, it increases unnecessary workload; second, the training cannot keep up, and it is too painful to explore on one's own; third, no one sees it even after using it, and there is no positive feedback, feeling like the effort is in vain.

T3: I have observed an interesting phenomenon: training is not the most crucial, peer influence is the most important. Our group has a 54 years old teacher who never participates in school training and feels it's a waste of time. But last year, the young teacher in his neighboring class used a tablet to play a math interactive game. He stood behind and watched a class, and found that the student participation was particularly high. He took the initiative to consult the young teacher when he returned, and now the two of them often work together to study how to use technology to break through teaching difficulties. This incident made me realize that the behavior intention of teachers is not 'taught', but 'infected'. No matter how much the principal mobilizes, it is not as convincing as a living successful case around them. So I think that while emphasizing 'training' and 'motivation', the model should also pay attention to the role of 'peer demonstration' and 'practical community'.

Question 3:

Q: What positive changes do you think a successful principal's digital leadership should ultimately make teachers feel in their work?

T2: I think the most tangible changes should be three points: firstly, 'work is more efficient', for example, some repetitive labor is replaced by technology, communication between home and school is more convenient, and time is saved for teaching innovation. The second is' more precise teaching ', which can better understand students through data and provide more basis for teaching decisions. The third is' growth is more supported ', which can provide more diverse and personalized professional development opportunities through digital platforms and resources, forming a positive learning community. If digitization brings these feelings, then we consider leadership to be successful.

T3: I will look at three things. Firstly, is the teacher willing to actively share their experience in technology application during teaching and research activities. If it is only shared after being arranged or named, it means that everyone still regards it as a task; If you are eager to share and showcase, it means that everyone really thinks this matter is valuable. Secondly, is the use of technology in open classes' natural '. In many open classes, technology is presented for the sake of demonstration, and teaching content is two separate skins. When technology becomes as natural as chalk on a blackboard, without the need to specifically state 'what innovative methods I used', that is the true fusion. Thirdly, whether young teachers are willing to stay. Our school has young teachers who leave every year. Before leaving, I asked them why, and many of them said 'you can't learn anything here'. Digitization is not only a tool, but also a signal of whether a school is' moving up '. If a school has a good digital atmosphere, young people will feel that there is room for growth here. So, the digital leadership of the principal ultimately lies in whether they can retain and develop people.

Question 4:

Q: Setting aside the model, based on your most personal experience, in order to truly transform and improve the digitalization of schools, besides the willingness of principals, managers, and teachers, are there any other 'key figures' or' invisible conditions' that are absolutely indispensable?

T2: I think they are 'key middle-level executors', such as the director of the information center, the leader of the teaching and research group, or one or two technically proficient and helpful' teachers'. The principal grasps the direction, but it is often these people who truly translate policies into concrete steps that teachers can understand and operate, and provide support around them every day. If they are capable, they can play a lubricating and accelerating role between management and teachers; If they are ineffective or passive, even the best policies at our level will be distorted. They are a bit like 'super nodes', and this role seems to be more prominent in the model.

T3: I think the role of parents is underestimated. Your model mentions both teacher behavior intention and digital implementation guarantee, but parents actually influence both at the same time. From a security perspective, many digital projects (such as electronic class signs and home school interactive apps) require parents to pay or cooperate, and if parents do not support them, the projects cannot be pushed forward at all. From the perspective of teacher intention, teachers' frustration often comes from parents - teachers work hard to create micro lessons and send

notifications, but parents do not look back and even complain that 'playing on the computer hurts their eyes'. This negative feedback is very detrimental to motivation. On the contrary, if parents actively participate and provide feedback, teachers will feel that what they have done is seen and recognized. So I think parents should not be the 'invisible people' behind the model. Of course, this does not mean turning parents into a core variable, but at least we should specifically discuss in the discussion how principals can strive for parents' understanding and support, and how to transform parents from 'resistance' to 'assistance'.

Follow-up dialogue with staff member (an academic affairs officer)

Question 1:

Q: As a key position connecting policy, technology, and teaching, do you think that the coordination and reasonable processes of various departments (i.e., the level of 'digital management') directly determine whether good digital ideas are 'unobstructed' or 'blocked and paralyzed'?

S1: Yes, my daily job is to deal with 'obstruction'. For example, if a school wants to organize an 'Online Teaching Open Week', it requires the Academic Affairs Office to schedule classes, the Technical Department to ensure live streaming, the Moral Education Office to organize parents, and various teaching and research groups to prepare content. If the management and coordination are not good, it will become: the academic affairs office sets a time, and the technical department says that the server needs to be maintained that day; After the time is fixed, another teaching and research team leader said that the key teachers are on a business trip. In the end, either rush into battle or let it go. So, without efficient 'digital management' for cross departmental collaboration and process streamlining, even the best ideas will encounter obstacles everywhere when they are implemented, and people who handle things will feel particularly tired.

Question 2:

Q: What does' digital implementation and assurance 'in the model specifically refer to in your work? Do you think budget approval speed, equipment maintenance response, or platform stability are the foundation, or can they also become a bottleneck?

S1: For me, it is both the most fundamental 'logistics' and the most common' bottleneck '. Specifically, it refers to whether the budget can be approved in a timely manner, whether the purchased equipment model meets the teacher's real needs, whether the network can be fixed within half an hour after a disconnection, and how many seals need to be stamped for a software account application... It is indeed the foundation, but once problems arise, it is the most direct bottleneck. For example, if a teacher is attending an important public class and the smart blackboard suddenly crashes, and the warranty cannot keep up, the repair will have to wait for two days. This will undermine the teacher's trust in all digital devices in the future. So, security is not a static resource, but a dynamic and responsive service capability that directly affects everyone's user experience and confidence.

Question 3:

Q: You need to interact with a large number of teachers in your work. Have you observed that the overall willingness of the teacher community towards new technologies significantly affects the difficulty and ultimate effectiveness of implementing a digital management policy?

S1: The impact is enormous, which directly determines my work mode. If teachers have a high willingness, my job is to be a 'service provider' and a 'supporter'. Everyone will actively ask questions and raise needs, and the policy implementation will be smooth, and the effects will also be easy to show. If teachers generally resist, my job becomes a 'supervisor' and 'debt collector', requiring constant notification, data collection, and frequent complaints. In this situation, there are many obstacles to policy implementation, and even if it is barely completed, the data quality is poor, and the effect is impossible to talk about.

Question 4:

Q: From your unique perspective as a security center, does this model fully depict the overall digital operation of the school? Is there any link or role whose importance has been underestimated by the model?

S1: The core logic of the model from strategy to execution is very complete. If there is any link that is easily underestimated, I think it is' closed-loop management and application of data '. Nowadays, many management systems only focus on 'collecting data' (such as course enrollment rates and platform login rates), but once collected, the closed loop of how to analyze, provide feedback to teachers, and optimize teaching and management is often broken. This leads to a large amount of 'data waste gas' generated by digitization, which is not only useless but also a burden. The ability of this' data closed loop 'may be both an advanced manifestation of' digital management 'and a key link in ultimately producing' results', perhaps worth emphasizing separately.

APPENDIX E: Questionnaire

A Development of Digital Leadership Model for Primary School Principals in Henan

To Questionnaire Respondent

Thank you for your participation. This questionnaire consists of three parts: demographic information, factors influencing the Effectiveness of a Digital Leadership Model for Primary School Principals in Henan Province and further suggestions or opinions. The information from this research will be used only for academic purposes, and all your personal information will be strictly confidential. Thank you again for your participation.

Please answer objectively to ensure the research results are objective and accurate.

Ms. DuXueping, PhD.
Siam University

Part 1: Demographics Information

Remark: The first part of the questionnaire concerns your personal situation. Please check "√" before the options that match.

1.Gender □Male □Female

2. Age □More than 50 years old □35-50 years old □Less than 35 years old

3.Highest educational level □Doctor Degree □Master Degree □Bachelor Degree

4. Your school located in □city □county/town □village

5. The years you have been a principal

□More than 15 years □8-15 years □Less than 8 years

6. Since you are a principal, how many times have you attended the relevant principals' information technology training or digital training?

□More than 10 times □4-10 times □Less than 4 times

7. Since you are the principal, how many times you have organized information technology or digital teaching training for school staff, especially for teachers.

□More than 10 times □4-10 times □Less than 4 times

Part 2:

Current state of digital leadership among primary school principals in the digital era. (Please choose the corresponding degree of conformity based on the actual situation.

Please indicate your level of agreement with the following statements.

There are five levels: 1. Strongly Disagree; 2. Disagree; 3. Neutral; 4. Agree; 5. Strongly agree

1. Digital Vision Planning (DVP)

No.	Items	1	2	3	4	5
DVP1	1. I am able to depict the digital vision of school education and establish digital development goals.					
DVP2	2. I have organized the preparation of the school's digital development plan and specific action plan.					
DVP3	3. I am able to propose innovative measures for digital construction based on the situation of the school, and promote educational reform.					

2. Digital Literacy of Principals (DLP)

No.	Items	1	2	3	4	5
DLP1	1. I have a digital awareness and pay attention to and understand the related digital education policies issued by the country.					
DLP2	2. I am willing to accept emerging digital information technologies and actively utilize the Internet for self-directed learning.					
DLP3	3. I have a basic grasp of digital technology knowledge and possess the ability to identify and use information.					
DLP4	4. I am familiar with intellectual property, data, and information security issues related to the application of digital technology.					

3. Digital Implementation and Assurance (DIA)

No.	Items	1	2	3	4	5
DIA1	1. I am able to use reasonable methods to evaluate and assure the digital quality and digital teaching ability of teachers.					
DIA2	2. I can assess and assurance students' digital quality and digital learning ability.					
DIA3	3. I am able to evaluate and assure the school's digital hardware and software construction status of facilities.					
DIA4	4. I can evaluate the implementation and effectiveness of various digital policies or systems in schools, and provide improvement suggestions.					

4. Effectiveness of Principal Digital Leadership (EPDL)

No.	Items	1	2	3	4	5
EPDL1	1. Support from higher education departments regarding funding, resources, technology, etc., provides indispensable conditions for developing school digital construction.					
EPDL2	2. The school's hardware (computers, multimedia teaching) and software can meet teachers' and students' teaching and learning needs.					
EPDL3	3. The school's digital planning and institutional construction are reasonable, and the digital atmosphere is intense.					
EPDL4	4. Teachers' work enthusiasm continues to improve, and teaching levels and effectiveness can be improved effectively. Teachers will provide suggestions or feedback on the schools' digital construction.					

EPDL5	5. Students are highly accepting of reforms, especially digital information reforms. Their overall learning performance has improved, and their digital quality and innovative learning ability have been effectively enhanced.					

5. Digital Management (DM)

No.	Items	1	2	3	4	5
DM1	1. I am constantly improving the digital infrastructure construction of the school (such as network equipment, terminal equipment, future classrooms, etc.).					
DM2	2. I establish or improve a digital management team for the school, clarifying the division of labor and responsibilities among team members.					
DM3	3. I can take measures to encourage teachers to use digital devices for teaching, organize teacher training, promote the use of online educational resources, and innovate teaching models.					
DM4	4. I encourage students to actively participate in information and Digital Quality Knowledge Competition and Digital Innovation Ability Competition.					
DM5	5. I can use digital technology platforms to effectively communicate and interact with teachers, parents, students, and others.					

6. Teachers' Digital Behavioral Intention (TDBI)

No.	Items	1	2	3	4	5
TDNI1	1. Teachers have a high acceptance of reforms, especially digital information reforms.					
TDBI2	2. Teachers can actively participate in various digital training organized both inside and outside the school, and the level of digital teaching can meet the requirements of daily teaching.					
TDBI3	3. Teachers will provide their own suggestions or feedback on the digital construction and effectiveness of schools.					

Part 3:

For this questionnaire, if you have any further suggestions or comments, please provide them in the space below.

_____

_____

_____

You have completed this questionnaire.

Thank you for your support.

APPENDIX F: Index of Item Objective Congruence

A Development of Digital Leadership Model
for Primary School Principals in Henan
河南省小学校长数字领导力模型开发
Du Xueping
杜雪萍
PhD in Educational Administration Innovation
教育管理创新专业博士

Research Questions

What are the current status of digital leadership of primary school principals and digital condition in primary schools in Henan?

What core factors influence the effectiveness of digital leadership of primary school principals in Henan?

What is the digital leadership model of primary school principals in Henan?

How can the digital leadership model of primary school principals in Henan be validated?

Research Objectives

To study the current status of digital leadership of primary school principals and digital condition in primary schools in Henan.

To identify and analyze the core factors influence the effectiveness of digital leadership of primary school principals in Henan.

To develop a digital leadership model of primary school principals in Henan.

To validate the digital leadership model of primary school principals in Henan.

Instruction

This IOC form seeks the experts' opinions on all questions embedded in this questionnaire and whether they are congruent with research objectives and definitions of terms. The criteria used for IOC are explained below.

+1 = Congruent 0= Questionable -1= Incongruent

说明：此 IOC 表格旨在征求专家对本问卷中所有问题的意见，这些项目是否符合研究目标和术语定义。IOC 使用的标准解释如下。

+1 = 一致 0 = 可疑 −1 = 不一致

Table Quantitative Item-Objective Congruence (IOC)

Digital Vision Planning (DVP) It emphasizes that principals can clearly outline the vision for developing digital construction in schools, formulate digital development goals and plans that align with the school's situation, and propose digital innovation measures. The planning involves multiple aspects, including the school's digital construction environment, teacher information technology training plans, and subject information technology integration.	**Expert Opinion**			**Remark**
	1	**0**	**-1**	
DVP1. I am able to depict the digital vision of school education and establish digital development goals. 我能够描绘学校教育的数字化愿景，并制定数字化发展目标。				
DVP2. I have organized the preparation of the school's digital development plan and specific action plan. 我组织编制了学校的数字化发展计划和具体行动计划。				
DVP3. I am able to propose innovative measures for digital construction based on the situation of the school, and promote educational reform. 我能根据学校情况提出数字化建设创新措施，促进教育改革。				
Digital Literacy of Principals (DLP) Digital literacy is a comprehensive ability that principals should possess in the digital transformation of education. It includes digital awareness, attitude towards information technology, basic understanding of digital knowledge, and digital ethical security.	**Expert Opinion**			**Remark**
	1	**0**	**-1**	
DLP1. I have a digital awareness and pay attention to and understand the related digital education policies issued by the country. 我有数字意识，关注和理解国家发布的相关数字教育政策。				
DLP2. I am willing to accept emerging digital information technologies and actively utilize the Internet for self-directed learning. 我愿意接受新兴数字信息技术，积极利用互联网自主学习。				
DLP3. I have a basic grasp of digital technology knowledge and possess the ability to identify and use information. 我对数字技术知识有基本掌握，具备识别和使用信息的能力。				

DLP4. I am familiar with intellectual property, data, and information security issues related to the application of digital technology. 我熟悉与数字技术应用相关知识产权、数据和信息安全问题。				
Digital Implementation Assurance (DIA) Digital implementation assurance capability, like planning and management, includes various aspects such as school system construction, infrastructure construction, teacher teaching, and student learning. This study divides principals' digital implementation assurance ability into evaluating teachers' digital teaching level, students' digital learning ability, school digital environment construction, and digital-related system construction.	**Expert Opinion**			**Remark**
	1	**0**	**-1**	
DIA1. I am able to use reasonable methods to evaluate and assurance the digital quality and digital teaching ability of teachers. 我能用合理方法评估和保证教师数字素质和数字教学能力。				
DIA2. I am able to assess and assurance students' digital quality and digital learning ability. 我能够评估和保证学生的数字素质和数字学习能力。				
DIA3. I am able to evaluate and assurance school's digital hardware and software construction status of facilities. 我能够评估和保证学校的数字硬件和软件设施建设状况。				
DIA4. I can evaluate the implementation and effectiveness of various digital policies or systems in schools, and provide improvement suggestions. 我可以评估学校各种数字政策或系统的实施情况和有效性，并提供改进建议。				
Effectiveness of Principal Digital Leadership (EPDL) It refers to the positive impacts and changes that a principal has on school members (mainly teachers), school organizational processes, and ultimately on teaching and learning through implementing a series of digital vision planning, construction, management, and support behaviors.	**Expert Opinion**			**Remark**
	1	**0**	**-1**	
EPDL1. Support from higher education departments regarding funding, resources, technology, etc., provides indispensable conditions for developing school digital construction. 高一级教育部门在资金、资源、技术等方面的支持，为发展学校数字化建设提供了不可或缺的条件。				

EPDL2. The school's hardware (computers, multimedia teaching) and software can meet teachers' and students' teaching and learning needs. 学校硬件（计算机、多媒体教学）和软件可以满足教师和学生的教、学需求。				
EPDL3. The school's digital planning and institutional construction are reasonable, and the digital atmosphere is intense. 学校数字化规划和制度建设合理，数字化氛围浓厚。				
EPDL4. Teachers' work enthusiasm continues to improve, and teaching levels and effectiveness can be improved effectively. Teachers will provide suggestions or feedback on schools' digital construction. 教师工作积极性不断提高，教学水平和效果能够得到有效提高。教师将就学校的数字化建设提供建议或反馈。				
EPDL5. Students are highly accepting of reforms, especially digital information reforms. Their overall learning performance has improved, and their digital quality and innovative learning ability have been effectively enhanced. 学生们高度接受改革，尤其是数字信息改革。他们的整体学习成绩有所提高，数字素质和创新学习能力得到了有效提升。				
Digital Management (DM) Promoting digital transformation in schools cannot be separated from the effective management of principals. This study determines the principals' digital management ability as the management ability of the school's digital construction environment, digital management team, teachers' digital teaching, students' digital learning, and communication and coordination ability with families, schools, and society.	**Expert Opinion**			**Remark**
	1	**0**	**-1**	
DM1.I am constantly improving the digital infrastructure construction of the school (such as network equipment, terminal equipment, future classrooms, etc.). 我在不断完善学校的数字化基础设施建设（如网络设备、终端设备、智慧教室等）。				
DM2.I establish or improve a digital management team for the school, clarifying the division of labor and responsibilities among team members. 我为学校建立或完善了一个数字管理团队，明确了团队成员之间的分工和责任。				
DM3.I can take measures to encourage teachers to use digital devices for teaching, organize teacher training,				

promote the use of online educational resources, and innovate teaching models. 我可以采取措施鼓励教师使用数字设备进行教学，组织教师培训，推广在线教育资源的使用，创新教学模式。				
DM4.I encourage students to actively participate in information and Digital Quality Knowledge Competition and Digital Innovation Ability Competition. 我鼓励学生积极参与信息与数字素质知识竞赛和数字创新能力竞赛。				
DM5. I am able to use digital technology platforms to effectively communicate and interact with teachers, parents, students, and others. 我能够使用数字技术平台与教师、家长、学生和其他人进行有效的沟通和互动。				
Teachers' Digital Behavioral Intention (TDBI) In this study, it include their acceptance of educational digital transformation, their active participation in various information technology and teaching training organized both inside and outside the school, their level of digital teaching in everyday teaching situations, and whether they will provide their suggestions or feedback on school's digital construction.	**Expert Opinion**			**Remark**
	1	**0**	**-1**	
TDBI1. Teachers have a high acceptance of reforms, especially digital information reforms. 教师对改革，特别是数字信息改革有很高的接受度。				
TDBI2. Teachers can actively participate in various digital training organized both inside and outside the school, and the level of digital teaching can meet the requirements of daily teaching. 教师可以积极参与校内外组织的各种数字化培训，数字化教学水平能够满足日常教学的要求。				
TDBI3. Teachers will provide their own suggestions or feedback on the digital construction and effectiveness of schools. 教师将对学校数字化建设和有效性提出自己的建议或反馈。				

Semi-structured Interview Questions for Experts

Qualitative Questions for Principals	**IOC Score**			**Remark 得分**
	1	**0**	**-1**	**Remark**
1.Do you know about the digital leadership of principal? 你了解校长数字领导力吗？				
2.What plans do you have for the digital development in your school? 你对学校的数字化发展有什么计划？				
3. How do you promote the implementation of digital leadership? 你如何推动数字化领导力的实施？				
4. What preventive measures has the school taken to deal with digital risks? 学校采取了哪些预防措施来应对数字风险？				
5.What are the main digital achievements and highlights in your school? 你们学校的主要数字成就和亮点是什么？				
Qualitative Questions for School Administrative Staff	**IOC Score**			**Remark 得分**
	1	**0**	**-1**	**Remark**
1. Do you know about the digital leadership of principal? 你了解校长数字领导力吗？				
2. Do you know about digital transformation of education? 你了解教育数字化转型吗？				
3. What difficulties do you face in your work in the digital era? 在数字时代，你的工作面临哪些困难？				
4. What do you think of the principal's digital intentions? 你如何看待校长的数字化意图？				
5. What do you think of the principal's digital abilities? 你觉得校长的数字化能力如何？				
Qualitative Questions for Teachers	**IOC Score**			**Remark 得分**
	1	**0**	**-1**	**Remark**
1. Do you know about the digital leadership of principal? 你了解校长数字领导力吗？				
2. Do you know about digital transformation of education? 你了解教育数字化转型吗？				
3.Have you received any digital training or digital policies? 你是否接受过任何数字培训或收到数字政策？				
4. In what way do you hope to improve your digital ability? 你希望以何种方式提高你的数字能力?				
5.Do you think digital methods have truly improved teaching effectiveness? 你认为数字化方式真的提高了教学效果吗？				

Expert's name:

Review date: 13/ 12/ 2025

Thank you very much for your valuable comments.

APPENDIX G: English-Chinese Questionnaire

感谢您的参与。本问卷由三部分组成：第一部分是人口统计学信息，第二部分是河南省小学校长数字领导力模型开发所需的核心变量,第三部分是您对问卷的意见和建议。本研究所得信息仅用于学术研究，您的所有个人信息将严格保密。再次感谢您的参与。如果您需要进一步的信息或需要我们的帮助，请联系我们。我将采用 5 点李克特量表：1=非常不同意 2=不同意 3=中立 4=同意 5=非常同意进行打分。

第一部分:人口统计学信息

1. 性别 ☐男 ☐女

2. 年龄 ☐50 岁以上 ☐35-50 岁 ☐35 岁以下

3. 最高学历 ☐博士研究生 ☐硕士研究生 ☐本科

4. 学校区位 ☐城市 ☐乡镇 ☐村庄

5. 成为校长的时间 ☐超过 15 年 ☐8-15 年 ☐8 年以下

6. 成为校长以来,参加过多少次校长级信息化或数字化培训?

☐超过 10 次 ☐4-10 次 ☐不足 4 次

7. 成为校长以来,你为学校员工,尤其是教师组织过多少次信息化或数字化培训?

☐超过 10 次 ☐4-10 次 ☐不足 4 次

第二部分：河南省小学校长数字领导力模型开发核心变量

数字愿景规划		1	2	3	4	5
DVP1	我能够描绘学校教育的数字化愿景，并制定数字化发展目标。					
DVP2	我组织编制了学校的数字化发展计划和具体行动计划。					
DVP3	我能根据学校情况提出数字化建设创新措施，促进教育改革。					
校长数字化素养		1	2	3	4	5
DLP1	我有数字意识，关注和理解国家发布的相关数字教育政策。					
DLP2	我愿意接受新兴数字信息技术，积极利用互联网自主学习。					
DLP3	我对数字技术知识有基本掌握，具备识别和使用信息的能力。					
DLP4	我熟悉与数字技术应用相关知识产权、数据和信息安全问题。					
数字实施与保障		1	2	3	4	5
DIA1	我能用合理方法评估和保证教师数字素质和数字教学能力。					
DIA2	我能够评估和保证学生的数字素质和数字学习能力。					
DIA3	我能够评估和保证学校的数字硬件和软件设施建设状况。					
DIA4	我可以评估学校各种数字政策或系统的实施情况和有效性，并提供改进建议。					

校长数字领导力成效		1	2	3	4	5
EPDL1	高一级教育部门在资金、资源、技术等方面的支持，为发展学校数字化建设提供了不可或缺的条件。					
EPDL2	学校硬件（计算机、多媒体教学）和软件可以满足教师和学生的教、学需求。					
EPDL3	学校数字化规划和制度建设合理，数字化氛围浓厚。					
EPDL4	教师工作积极性不断提高，教学水平和效果能够得到有效提高。教师将就学校的数字化建设提供建议或反馈。					
EPDL5	学生们高度接受改革，尤其是数字信息改革。他们的整体学习成绩有所提高，数字素质和创新学习能力得到了有效提升。					
数字化管理		1	2	3	4	5
DM1	我在不断完善学校的数字化基础设施建设（如网络设备、终端设备、智慧教室等）。					
DM2	我为学校建立或完善了一个数字管理团队，明确了团队成员之间的分工和责任。					
DM3	我可以采取措施鼓励教师使用数字设备进行教学，组织教师培训，推广在线教育资源的使用，创新教学模式。					
DM4	我鼓励学生积极参与信息与数字素质知识竞赛和数字创新能力竞赛。					
DM5	我能够使用数字技术平台与教师、家长、学生和其他人进行有效的沟通和互动。	1	2	3	4	5
教师数字化行为意识						
TDBI1	教师对改革，特别是数字信息改革有很高的接受度。					
TDBI2	教师可以积极参与校内外组织的各种数字化培训，数字化教学水平能够满足日常教学的要求。					
TDBI3	教师将对学校数字化建设和有效性提出自己的建议或反馈。					

Professor Jennifer Miller,
Wuhan University

SU 0210.04 / 049

Graduate School of Education
Siam University
38 Phet Kasem Rd., Bang Wa,
Phasi Charoen, Bangkok 10160

12th February 2026

Dear Professor Jennifer Miller,
Wuhan University

Subject: Invitation to be an expert to verify the translation of the research questionnaires.

Since Ms. Du Xueping, student ID 6419000028, a doctoral student in the English Program, Graduate School of Education, Siam University. She is currently conducting research entitled *"A Development of a Digital Leadership Model for Primary School Principals in Henan"*, with Associate Professor Dr. Boonmee Nenyod (the advisor) and Dr. Leehsing Lu (the co-advisor), the Graduate School of Education would like to invite you to be an expert to verify the translation of the research questionnaires.

The research questionnaires are an essential tool for researchers to find answers. Ms. Du Xueping conducted this research in English, the instrument was designed in English. However, it must be applied to Chinese respondents. Your role as an expert in verifying the translation of the research questionnaire from English into Chinese is of utmost importance for the success of this research. Then, Ms. Du Xueping will contact and coordinate all details by herself.

We really appreciate your help.

Yours sincerely,

Asst. Prof. R. Adm.Supathra Urwongse, Ph.D
Acting Dean of Graduate School of Education

Professor ZhangYan,
Beijing Foreign Studies University

SU 0210.04 / 049

Graduate School of Education
Siam University
38 Phet Kasem Rd., Bang Wa,
Phasi Charoen, Bangkok 10160

12th February 2026

Dear Professor Zhang Yan,
Beijing Foreign Studies University

Subject: Invitation to be an expert to verify the translation of the research questionnaires.

Since Ms. Du Xueping, student ID 6419000028, a doctoral student in the English Program, Graduate School of Education, Siam University. She is currently conducting research entitled *"A Development of a Digital Leadership Model for Primary School Principals in Henan"*, with Associate Professor Dr. Boonmee Nenyod (the advisor) and Dr. Leehsing Lu (the co-advisor), the Graduate School of Education would like to invite you to be an expert to verify the translation of the research questionnaires.

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Yours sincerely,

Asst. Prof. R. Adm.Supathra Urwongse, Ph.D
Acting Dean of Graduate School of Education

APPENDIX H: Item-Objective Congruence Examination

Result of the Index of Item-Objective Congruence Examination

Result of the Index of Item-Objective Congruence (OC) Rating

Influencing Factors No.	Item No.	Rating from experts					$\sum R$	OC $\frac{\sum R}{N}$	Result
		Dr. Zhang Weiping	Dr. Zhang Mingjun	Dr. Zhou Donghui	Dr. Zhang Lei	Dr. Tan Minda			
I Digital Vision Planning (DVP)	1	1	1	1	1	1	5	1.0	Pass
	2	1	1	0	1	1	4	0.8	Pass
	3	1	1	1	1	0	4	0.8	Pass
II Digital Literacy of Principals (DLP)	1	1	1	1	1	1	5	1.0	Pass
	2	1	1	1	1	1	5	1.0	Pass
	3	1	1	0	1	1	4	0.8	Pass
	4	1	1	1	1	1	5	1.0	Pass
III Digital Implementatio -n Assurance (DIA)	1	1	1	1	0	1	4	0.8	Pass
	2	1	1	1	1	0	4	0.8	Pass
	3	1	1	1	1	1	5	1.0	Pass
	4	1	1	1	1	1	5	1.0	Pass
IV Effectiveness of Principal Digital Leadership (EPDL)	1	1	1	1	1	0	4	0.8	Pass
	2	1	1	1	1	1	5	1.0	Pass
	3	1	-1	1	1	1	3	0.6	Pass
	4	1	1	1	1	1	5	1.0	Pass
	5	1	0	1	1	1	4	0.8	Pass
V Digital Management (DM)	1	1	1	1	1	1	5	1.0	Pass
	2	1	1	1	1	1	5	1.0	Pass
	3	1	0	1	1	1	4	0.8	Pass
	4	1	1	1	1	1	5	1.0	Pass
	5	1	1	0	1	1	4	0.8	Pass
VI Teachers' Digital Behavioral Intention (TDBI)	1	1	1	1	1	1	5	1.0	Pass
	2	1	1	1	1	1	5	1.0	Pass
	3	1	1	-1	1	1	3	0.6	Pass
VII Qualitative Questions for Principals	1	1	1	1	1	1	5	1.0	Pass
	2	1	1	1	1	0	4	0.8	Pass
	3	1	1	1	1	1	5	1.0	Pass
	4	1	1	1	1	1	5	1.0	Pass
	5	1	1	1	0	1	4	0.8	Pass
VIII Qualitative Questions	1	1	1	1	1	1	5	1.0	Pass
	2	1	1	1	1	0	4	0.8	Pass
	3	1	1	1	1	1	5	1.0	Pass

for Administrative Staff	4	1	1	1	1	1	5	1.0	Pass
	5	1	1	1	1	1	5	1.0	Pass
IX Qualitative Questions for Teachers	1	1	1	1	1	0	4	0.8	Pass
	2	1	1	1	1	1	5	1.0	Pass
	3	1	1	1	1	1	5	1.0	Pass
	4	1	1	-1	1	1	3	0.6	Pass
	5	1	1	1	1	1	5	1.0	Pass

List of Experts for IOC of Research Instrument

No.	Full Name	Organization	Position	Graduation Institution	Education Level	Years of Experience
1	Zhang Weiping	Tsinghua University	Professor / Doctoral supervisor	China University of Political Science and Law	Ph.D in Education	30
2	Zhang Mingjun	Shanghai Jiao Tong University	Professor / Doctoral supervisor	Renmin University of China	Ph.D. in Philosophy	28
3	Zhou Donghui	Guizhou Normal University	Professor / Doctoral supervisor	Tianjin Normal University	Ph.D. in Education	17
4	Zhang Lei	Central China Normal University	Associate Professor	University of Macau	Ph.D. in Education	11
5	Tan Minda	Shandong Normal University	Associate Professor	Pennsylvania State University	Ph.D. in Philosophy	10

Expert's Name:

Review Date: 13 / 12 / 2015

SU 0210.14 /188.3

Graduate School of Education
Siam University
38 Phet Kasem Rd., Bang Wa,
Phasi Charoen, Bangkok 10160

6 October 2025

Dear Professor Dr. Zhang Weiping,
Tsinghua University

Subject: Invitation to be an expert to examine research tools

Since Ms. Du Xueping, student ID. 6419000028, a doctoral student in English program, Graduate School of Education works on dissertation *"A development of a digital leadership model for primary school principals in Henan"* with Assoc. Prof. Dr. Boonmee Nenyod (the advisor) and Assistant Professor Dr. Lechsing Lu (the co-advisor), the Graduate School of Education would like to invite you to be an expert to examine the research tools.

Questionnaire regarding current circumstances is a significant tool of the research which is needed to be considered and examined including suggestion for research tools. Ms.Du Xueping will contact and coordinate all details by herself.

We really appreciate your help.

Yours sincerely,

Professor Emeritus Dr. Chanita Rukspollmuang
Dean of Graduate School of Education

SU 0210.14 / 136.3

Graduate School of Education
Siam University
38 Phet Kasem Rd., Bang Wa,
Phasi Charoen, Bangkok 10160

6 October 2025

Dear Professor Dr. Zhang Mingjun,
Shanghai Jiao Tong University

Subject: Invitation to be an expert to examine research tools

Since Ms. Du Xueping, student ID. 6419000028, a doctoral student in English program, Graduate School of Education works on dissertation *"A development of a digital leadership model for primary school principals in Henan"* with Assoc. Prof. Dr. Boonmee Nenyod (the advisor) and Assistant Professor Dr. Leehsing Lu (the co-advisor), the Graduate School of Education would like to invite you to be an expert to examine the research tools.

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Professor Emeritus Dr. Chanita Rukspollmuang
Dean of Graduate School of Education

SU 0210.14 / 135.3

Graduate School of Education
Siam University
38 Phet Kasem Rd., Bang Wa,
Phasi Charoen, Bangkok 10160

6 October 2025

Dear Professor Dr. Zhou Donghui,
Guizhou Normal University

Subject: Invitation to be an expert to examine research tools

Since Ms. Du Xueping, student ID. 6419000028, a doctoral student in English program, Graduate School of Education works on dissertation *"A development of a digital leadership model for primary school principals in Henan"* with Assoc. Prof. Dr. Boonmee Nenyod (the advisor) and Assistant Professor Dr. Leehsing Lu (the co-advisor), the Graduate School of Education would like to invite you to be an expert to examine the research tools.

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Professor Emeritus Dr. Chanita Rukspollmuang
Dean of Graduate School of Education

SU 0210.14 / 135.3

Graduate School of Education
Siam University
38 Phet Kasem Rd., Bang Wa,
Phasi Charoen, Bangkok 10160

6 October 2025

Dear Assoc. Prof. Dr. Zhang Lei,
Central China Normal University

Subject: Invitation to be an expert to examine research tools

Since Ms. Du Xueping, student ID. 6419000028, a doctoral student in English program, Graduate School of Education works on dissertation *"A development of a digital leadership model for primary school principals in Henan"* with Assoc. Prof. Dr. Boonmee Nenyod (the advisor) and Assistant Professor Dr. Leehsing Lu (the co-advisor), the Graduate School of Education would like to invite you to be an expert to examine the research tools.

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Professor Emeritus Dr. Chanita Rukspollmuang
Dean of Graduate School of Education

SU 0210.14 / 135.3

Graduate School of Education
Siam University
38 Phet Kasem Rd., Bang Wa,
Phasi Charoen, Bangkok 10160

6 October 2025

Dear Assoc. Prof. Dr. Tan Minda,
Shandong Normal University

Subject: Invitation to be an expert to examine research tools

Since Ms. Du Xueping, student ID. 6419000028, a doctoral student in English program, Graduate School of Education works on dissertation *"A development of a digital leadership model for primary school principals in Henan"* with Assoc. Prof. Dr. Boonmee Nenyod (the advisor) and Assistant Professor Dr. Leehsing Lu (the co-advisor), the Graduate School of Education would like to invite you to be an expert to examine the research tools.

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We really appreciate your help.

Yours sincerely,

Professor Emeritus Dr. Chanita Rukspollmuang
Dean of Graduate School of Education

APPENDIX I: The Request for Cooperation in Data Collection

Education and Training Center of Henan University

SU 0210.04 / 041

Graduate School of Education
Siam University
38 Phet Kasem Rd., Bang Wa,
Phasi Charoen, Bangkok 10160

4 February 2026

Dear Director of Education and Training Center of Henan University

Subject: Request for Cooperation in Data Collection

This is to certify that Ms. Du Xueping, student ID 6419000028, a doctoral student in the English Program, Graduate School of Education, Siam University. She is currently conducting research entitled *"A Development of a Digital Leadership Model for Primary School Principals in Henan"*, with Associate Professor Dr. Boonmee Nenyod and Dr. Leehsing Lu. Her contact information is as follows: email phd_ed1 @siam.edu.

In this regard, the student researcher has to collect data from the school principal, teachers, and staffs using the questionnaires. The students will subsequently coordinate with you and provide more details on this matter

Accordingly, I would like to kindly request for your permission to allow this student researcher to collect data for academic purposes. Your cooperation will be highly appreciated.

Yours sincerely,

(Professor Emeritus Dr. Chanita Rukspollmuang)
Dean of Graduate School of Education

Education and Training Center of Henan Normal University

SU 0210.04 / 041.01

Graduate School of Education
Siam University
38 Phet Kasem Rd., Bang Wa,
Phasi Charoen, Bangkok 10160

4 February 2026

Dear Director of Education and Training Center of Henan Normal University

Subject: Request for Cooperation in Data Collection

This is to certify that Ms. Du Xueping, student ID 6419000028, a doctoral student in the English Program, Graduate School of Education, Siam University. She is currently conducting research entitled *"A Development of a Digital Leadership Model for Primary School Principals in Henan"*, with Associate Professor Dr. Boonmee Nenyod and Dr. Leehsing Lu. Her contact information is as follows: email phd_ed1 @siam.edu.

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Yours sincerely,

(Professor Emeritus Dr. Chanita Rukspollmuang)
Dean of Graduate School of Education

Education and Training Center of Xinyang Normal University

SU 0210.04 / 041.02

Graduate School of Education
Siam University
38 Phet Kasem Rd., Bang Wa,
Phasi Charoen, Bangkok 10160

4 February 2026

Dear Director of Education and Training Center of Xinyang Normal University

Subject: Request for Cooperation in Data Collection

This is to certify that Ms. Du Xueping, student ID 6419000028, a doctoral student in the English Program, Graduate School of Education, Siam University. She is currently conducting research entitled *"A Development of a Digital Leadership Model for Primary School Principals in Henan"*, with Associate Professor Dr. Boonmee Nenyod and Dr. Leehsing Lu. Her contact information is as follows: email phd_ed1 @siam.edu.

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Yours sincerely,

(Professor Emeritus Dr. Chanita Rukspollmuang)
Dean of Graduate School of Education

Education and Training Center of Zhengzhou Normal College

SU 0210.04 / 041.03

Graduate School of Education
Siam University
38 Phet Kasem Rd., Bang Wa,
Phasi Charoen, Bangkok 10160

4 February 2026

Dear Director of Education and Training Center of Zhengzhou Normal College

Subject: Request for Cooperation in Data Collection

This is to certify that Ms. Du Xueping, student ID 6419000028, a doctoral student in the English Program, Graduate School of Education, Siam University. She is currently conducting research entitled *"A Development of a Digital Leadership Model for Primary School Principals in Henan"*, with Associate Professor Dr. Boonmee Nenyod and Dr. Leehsing Lu. Her contact information is as follows: email phd_ed1 @siam.edu.

In this regard, the student researcher has to collect data from the school principal, teachers, and staffs using the questionnaires. The students will subsequently coordinate with you and provide more details on this matter

Accordingly, I would like to kindly request for your permission to allow this student researcher to collect data for academic purposes. Your cooperation will be highly appreciated.

Yours sincerely,

(Professor Emeritus Dr. Chanita Rukspollmuang)
Dean of Graduate School of Education

Education and Training Center of Luoyang Normal College

SU 0210.04 / 041.04

Graduate School of Education
Siam University
38 Phet Kasem Rd., Bang Wa,
Phasi Charoen, Bangkok 10160

4 February 2026

Dear Director of Education and Training Center of Luoyang Normal College

Subject: Request for Cooperation in Data Collection

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Dean of Graduate School of Education

Education and Training Center of Nanyang Normal College

SU 0210.04 / 041.05

Graduate School of Education
Siam University
38 Phet Kasem Rd., Bang Wa,
Phasi Charoen, Bangkok 10160

4 February 2026

Dear Director of Education and Training Center of Nanyang Normal College

Subject: Request for Cooperation in Data Collection

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Dean of Graduate School of Education

APPENDIX J: Focus Group Discussion

Consent Letter

Title of the Research: A Development of Digital Leadership Model for Primary School Principals in Henan.

The host of the discussion: Du Xueping

Institution: Graduate School of Educational Administration, Siam University, Thailand

Contact Information: 847314102@qq.com

Participation and Procedures (Modified to Chinese Research Context):

The study organized a Ding Talk discussion and invited 7 experts in the fields of education and digital transformation to provide opinions and suggestions. The core goal is to deepen the understanding of the connotations and relationships of various variables in the model through experts' interaction, and lay the foundation for subsequent quantitative evaluation. It comprises three steps: Preparation, the discussion, and post-meeting analysis. According to the focus group discussion text, all experts' suggestions are divided into three areas: consensus confirmation, in-depth suggestions, and application prospects.

Due to cultural sensitivity, the discussion environment, and privacy considerations, the host, before the discussion begins, designates an assistant as the recorder (responsible for recording and documenting key points). All responses were treated with strict confidentiality, and no personally identifiable information was used in the analysis or reporting process.

Participant's Name: _____

Participant's Signature: _____

Date: _____

If you have any questions or concerns, please contact DuXueping

Thank you for your valuable contribution to this research.

Sincerely,

Siam University

Questions and Answers of Focus Group Discussion

Part I: Does the model accurately reflect reality?

Question 1: Do the six core variables (DVP, DLP, DIA, DM, TDBI, EPDL) in the model fully reflect the key elements of principal digital leadership? Are there any omissions or redundancies?

P1： The structure of the model captures the main thread from 'idea' to 'effect', but the political wisdom of the principal may have been underestimated. When promoting sensitive digital changes, such as evaluation reform, the ability of principals to balance the interests of all parties and resolve resistance is crucial, which goes beyond the scope of 'personal literacy'.

P2： For schools with scarce resources, the principal's' ability to piece together resources' may be more critical than 'digital literacy'. What we can often use are scattered and outdated equipment, and how to combine them to meet basic teaching needs is not reflected in this practical ability model.

B6： From a regional perspective, the model lacks the dimension of 'cross school collaboration'. Especially in the context of group education, whether the principal can lead the school to find positioning and share resources in regional digital development is an important leadership performance.

E4: The causal chain of the model is clear, but the 'teacher behavioral intention' may not only regulate some content, but also be directly influenced by the personal charm and trust relationship of the principal. Suggest considering the level of trust between the principal and teachers.

S3： As parents, we are most concerned about whether digitalization truly enhances our children's learning outcomes. The 'leadership effectiveness' in the model should more clearly include the dimension of' student digital well-being '(such as vision protection and prevention of internet addiction), which is the responsibility that principals must undertake.

Question 2: Is it reasonable for the model to set 'teacher behavioral intention' as a moderating variable and emphasize its moderating effect on management effectiveness? Are there any other groups' wishes that need to be taken into consideration?

E5： Very reasonable! Teachers are the executors of reform, and their intentions directly determine the depth of technological application. But parents' digital literacy and supportive attitude cannot be ignored, especially when promoting home school collaboration platforms. Suggest adding 'external stakeholder support' to the moderating variables.

P1： The moderating effect of teacher intention is indeed significant, but the model can further distinguish between individual intention and team atmosphere. Sometimes individual teacher resistance can trigger a group effect, while a positive teaching and research group culture can offset individual negative attitudes.

Question 3: The model considers' Principal's Personal Digital Literacy '(DLP) as a core driving variable. In your opinion, besides technical operation ability, what other 'digital

age core competencies' do principals need to possess the most?

E4： I particularly want to emphasize 'learning leadership'. The technological iteration is too fast, and today's most advanced platform may be eliminated in three years. The most important thing for a principal is not how many tools they learn themselves, but whether they can create an organizational atmosphere of continuous learning and daring trial and error for all staff. We observed during the training that some principals are technically proficient, but the digital atmosphere in the school is dull; Some principals may have average skills, but they are good at identifying key talents, building platforms, and encouraging innovation, which can actually go further. So DLP should include the ability to build a learning organization.

B7： From the perspective of regional governance, I would like to add 'data literacy' and 'ethical leadership'. Nowadays, many schools have accumulated a large amount of teaching and behavioral data, but whether principals will use them, dare to use them, and use them correctly is a big problem. There was a school in our district that used data to 'profile' students, but parents complained about privacy infringement. If the principal lacks awareness of data ethics, it is easy to make mistakes. So DLP not only needs to understand technology and teaching, but also the boundaries and ethics of data governance.

P2： I added 'change management ability'. The essence of digitization is organizational change, which will inevitably affect the existing interest structure - old teachers feel challenged, academic affairs feel deprived of power, and technical departments feel neglected. If the principal only has technical vision and lacks organizational wisdom, it is easy to hinder progress. I have seen a principal who had advanced technical concepts, but forcibly pushed a new platform, but the teachers collectively resisted and it ultimately came to nothing. So the core of DLP is to transform technical logic into organizational logic capability.

S3： As parents, our biggest concern is' temperature and culture '. We hope that the principal, while pursuing numbers, always remembers that behind the screen are lively children. We have encountered some schools that, in order to showcase their 'smart campus', require students to stare at tablets every day and complete their homework online, which affects their eyesight and social skills. So the digital literacy of principals should include a 'child centered mindset' - all technological decisions should ask one question: Is this really good for children.

Question 4: The model includes' Digital Vision Planning '(DVP),' Principal Personal Digital Literacy '(DLP), and' Digital Implementation and Assurance '(DIA) as three parallel driving variables. But in practical work, there may be contradictions between these three factors - for example, the principal has high literacy, but the school's guarantee conditions are extremely poor; Or the guarantee is good, hopefully the scenery is blurry. What do you think is the relationship between these three? Which is more important, or which is a prerequisite?

P2： For our rural schools, security is a prerequisite. Without stable electricity, usable networks, and sufficient equipment, even if the principal has vision and literacy, there is nothing they can do. I have seen some young principals with great ideas go to rural schools, full of enthusiasm for innovation, but their spirit is gradually worn down by

reality. So I have always advocated that when evaluating a principal's digital leadership, we should first look at their 'family background' and not simply attribute the differences in effectiveness caused by resource gaps to the principal's abilities. Of course, this does not mean that it is enough to guarantee it - under the same conditions, whether the principal has ideas or can manage it, the effect is still different.

B6： From the perspective of regional resource allocation, I believe that these three are in a progressive relationship. Firstly, there must be basic guarantees - this is the responsibility of the government, and schools cannot struggle with the question of whether they have it or not. Then, the principal should have literacy - able to make good use of these resources and judge which technologies are suitable for the school. Finally, there is the vision - to form a distinctive and long-term development direction based on the first two. When we are doing digital planning in our district, we follow this logic: first, we need to identify the hardware gaps of each school and provide a backup guarantee; Then organize hierarchical training to enhance the literacy of principals and teachers; Finally, encourage each school to develop a three-year plan and form its own characteristics. This model puts the three in parallel, which is theoretically complete, but in practical operation, it is necessary to consider their order and importance.

E4： I want to emphasize the 'bridge' role of literacy. No matter how good the guarantee is, if the principal doesn't know how to use it or doesn't want to use it, it's still a waste; No matter how beautiful the vision is, the principal's inability to implement it is just empty talk. I have trained many principals, some from schools with good security, but principals have no sense of technology and the school's digitalization is stagnant; Some come from schools with average security, but the principal is particularly good at learning and integration, and has made outstanding achievements under limited conditions. So literacy is the key to revitalizing and ensuring the implementation of the vision. This model places literacy as a driving variable and is very accurate.

S3： As parents, we don't really care which of these three is more important. We only care about the outcome - whether the child has benefited. But if I have to choose, I hope the principal has a vision first, and then takes action. Our school once had a new principal, and the first thing he did upon taking office was to hold three symposiums, asking teachers, parents, and the community: 'What do you hope our school will become in three years?'? ”Then, based on these voices, a very simple and warm plan was formulated. In those three years, the school underwent significant changes. Although the hardware was not the best, we parents felt very confident. So the vision is not a slogan hanging on the wall, but the attitude of the principal who is willing to listen and respond.

Part II: Can the variables of the model be observed and measured?

Question 1: If we were to use this model to evaluate a principal's digital leadership, which variable do you think is the most difficult to objectively measure? How to improve?

P1： Digital management (DM) is visible and tangible to us, but digital vision planning (DVP) can easily become a wall slogan. Suggest examining whether the principal has broken down their digital vision into specific annual action plans and regularly reviewing progress at teacher meetings.

E4： The measurement of Teacher Behavior Intention (TDBI) should avoid formalism. Anonymous questionnaires may be distorted, and a more authentic approach is to observe the spontaneity and innovation of teachers using digital tools in non mandatory situations, such as whether they actively share new applications in teaching and research groups.

B6: In the regional assessment, the hardware part of 'Digital Implementation Assurance' (DIA) is easy to check, but the 'response efficiency of assurance' is difficult to quantify. Suggest adding process indicators such as' average time to repair faults' and 'approval cycle for teacher resource applications'.

E5： For 'Principal's Personal Digital Literacy' (DLP), traditional knowledge testing has little significance. We are currently conducting a 'Digital Leadership Scenario Simulation Workshop' to evaluate the strategic thinking and data application abilities of principals by observing their performance in simulated decision-making cases.

S3： Sensory evidence of the principal's digital leadership can be collected through semi-structured parent interviews and open day observations. But clearer guidelines are needed to map fragmented feedback from parents to various variables in the model.

Question 2: What do you think is the biggest implementation obstacle for conducting principal training or school digital performance evaluation based on this model?

E5： The biggest obstacle is regional differences. Developed schools focus on 'data closed-loop', while weaker schools may still be stuck in basic equipment support. Suggest designing differentiated evaluation indicators and providing tiered training resources.

B6： Time cost is an implicit obstacle. Principals and teachers are already burdened with a large number of administrative tasks, and new digital management activities need to be integrated with existing workflows, otherwise it will be difficult to implement. It is recommended to emphasize 'lightweight tools' and' process integration 'in the application of the model.

Question 3: How to distinguish between 'surface management behavior' and 'real management effectiveness' when evaluating a principal's digital leadership?

E5： We have interviewed frontline teachers, and they are very sensitive. Whether the principal really values the meeting and whether the system is really implemented, they can tell at a glance. For example, in the 'data meeting', if the principal just goes through the motions and reads the report, the teachers will not prepare seriously next time. But if the principal really analyzes the data, asks the reasons, discusses countermeasures, and even remembers the progress of a student discussed in the last meeting with the teachers, they know that the principal is serious. Therefore, the evaluation cannot only look at whether there is a meeting, but also ask the teachers: Is the principal's meeting helpful to your teaching?

B6： This question touches upon the core difficulty of evaluation. Our current approach is to introduce a feedback mechanism - not only listening to the principal's report, but also to the evaluation of teachers and parents. For example, to evaluate 'digital management', we will interview the teaching and research team leader: 'What digital initiatives has the principal promoted this year?'? Are these measures helpful for the teachers in your group? ’At the same time, we will look at some 'trace data', such as

the principal's activity on the school-based training platform, and the proportion of digital related issues he initiates in administrative meetings. Cross validation with multi-source data is necessary to penetrate the form.

E4： I suggest adding 'key event interviews' to the evaluation. Ask the principal: 'Please share a specific case where you discovered teaching problems through data and pushed for improvement.'. ’Then he asked, 'What were you thinking at that time?'? What resistance did you encounter? How was it resolved? ’Through this case, it can be determined whether he is really using data? Has he transformed the data into action? Did he drive the team to improve together? A real case is more convincing than a hundred 'how many meetings have been held' data.

P2： Let me add a rural perspective. In our resource scarce school, 'real management effectiveness' is often reflected in' small but sustained changes'. For example, our school does not have a big data platform, but I insist on having the teaching department use Excel to calculate the completion rate of each class's homework every month, and then post it on the wall of the teacher's office. At first, the teachers didn't mind, but after posting for three months, a teacher took the initiative to come to me and said, 'Principal, our class's homework completion rate is lower than the neighboring class, and I want to change the method.'. ’This is efficiency - not form, it truly touches people. So when evaluating, we should pay attention to the transition from passive to active.

Question 4: Where do you think the biggest resistance may come from in promoting and applying research results? How to break through?

B7： I think the biggest obstacle is structural barriers. The current organizational structure of schools is designed around the core of 'teaching' - the Academic Affairs Office manages teaching, the Moral Education Office manages students, the General Affairs Office manages logistics, and the Technical Center manages equipment. What digitalization needs to do is precisely to 'connect', to allow data to flow between departments, and to enable management to collaborate in the process. But the existing structure is fragmented, and any principal who wants to promote cross departmental collaboration will encounter huge organizational inertia and interest barriers. The key to breakthrough lies in top-level design - the Education Bureau needs to introduce policies that clarify the responsibilities of each department in digitalization, making collaboration a necessary option.

P1： I agree that structural barriers come first, and I would also like to add that the cognitive limitations of principals themselves are often shaped by structures. We have been working in a 'one person, one share' system for a long time, and have become accustomed to 'as long as nothing happens' and' as long as we don't cross the line '. Suddenly asking us to break boundaries and drive change, many people don't know where to start and dare not take risks. So breakthroughs need to be made on two levels: first, loosening the constraints on principals, encouraging innovation and allowing trial and error in policies; The second is to 'empower' the principal by providing training and sharing case studies, allowing them to see how others have done it and how it can be achieved.

P2： In practical work, we have learned that the biggest obstacle for frontline teachers is the lack of a sense of meaning. Many digital initiatives have been pushed down, but they do not feel that they are helpful for teaching. They only feel that they are adding new tasks and troubles. If the principal cannot explain the significance of digitization clearly and cannot show them that it can really solve the pain points of work, they will use 'passive cooperation' to resist. So the key to breakthrough is for the principal to 'look down' - truly understand the confusion of teachers and respond to their needs digitally.

E5： I have observed an implicit resistance called 'ability panic'. Many principals are not unwilling to do it, they really don't know how to do it. They haven't learned how to analyze data, don't know how to design incentive systems, and don't know how to coordinate cross departmental conflicts. Our current training mostly focuses on concepts and techniques, with little emphasis on 'management'. So in the future, we need to develop more 'practical digital management' courses, using cases, sand tables, and workshops to allow principals to practice in simulations and accumulate confidence through practice. As the ability increases, the resistance decreases.

Part III: How can the model be transformed into a practical tool?

Question 1: Experts, please imagine: If a set of tools to support the development of principals is developed based on this research, what do you think should be prioritized for development? What is the specific form?

P1： Prioritize the development of a 'digital leadership self-assessment checklist'. The list should be brief, with each item corresponding to a key behavior of the model, such as "Did I host a data-driven teaching analysis meeting this month?" to allow the principal to quickly reflect and adjust.

P2： We need a 'digital typical case library for rural schools', not just high-end displays, but simple cases that solve real problems with limited resources. The model needs to be accompanied by such a story to have vitality.

B6： Suggest transforming the model into an online platform for regional 'Principal Digital Leadership Development Map'. After logging in, the principal can see their position in the entire district and intelligently push micro courses and peer experiences in weak areas.

S3： The tool should include an 'anonymous feedback channel for teachers', which regularly summarizes teachers' perceptions and confusion about digital management measures to the principal. Enable the principal to not only lead from top to bottom, but also listen from bottom to top.

E5： We can develop a 'digital leadership drama sandbox' training course. Divide the principal into small groups and play different roles to apply model theory and deepen understanding in the simulated conflict of digital transformation in schools.

Question 2: From your professional perspective, what are the most valuable insights for regional education policy formulation or school digital development planning from this study?

B7： It clarifies that digitization is not simply a technological investment, but a systematic leadership project. Policies should encourage schools to integrate

digitization into their school-based development plans and establish assessment mechanisms guided by 'management processes' and' application effects', rather than just focusing on equipment coverage.

E4： The model suggests that technology service providers should not only sell products, but also help schools build a collaborative system of 'management technology human'. For example, the platform should provide data dashboards to support principal decision-making and embed teacher collaboration functions to promote digital behavioral intention conversion.

Question 3: If a new principal wants to use this model to plan his digital development, where do you suggest he start?

P1： My suggestion is not to rush into planning for now, but to do a 'deep diagnosis' first. Spend a month walking into the classroom, chatting with teachers and students, and understanding their real pain points and needs. Our school once spent hundreds of thousands of yuan to buy a platform, only to find that what teachers need most is not a new platform, but a network that doesn't get stuck and equipment that doesn't break down. This lesson taught me that diagnosis is more important than prescribing medication. So I suggest the new principal take the first step: bring a laptop, walk into the classroom, and ask three questions - 'What are you most annoyed with now?'? ’What do you want most? ’What do you think technology can help you with? ’

B6： From the perspective of regional support, I suggest that the first step for the new principal is to 'identify the door' - to understand the policy resources, expert resources, and peer resources within the region. Our district has special funds for digitalization, training programs, and exhibition activities every year, and many new principals are unaware of them and miss them for nothing. So my suggestion is: in the first month of taking office, proactively visit the relevant departments of the district education bureau and ask, 'What do we have in our district?'? What can I apply for? Who can help me? ’Having a clear understanding of these external resources before making campus plans would be more practical.

E5： I suggest the new principal choose a 'small incision'. Don't try to solve all problems at once, but choose the most painful, smallest, and most effective point, such as' first use technology to solve the communication problem between home and school. '. Use this' small incision 'to accumulate experience, build confidence, cultivate backbone, and gradually expand. This model tells us that 'digital management' is the core, and the first step in management is to find a 'leverage point' that can leverage the overall situation.

S3： As a parent representative, I particularly hope that the first step for the new principal is to 'have a chat with parents'. Hold a parent discussion and honestly ask: 'What is your biggest concern about children using electronic devices?'? What do you hope schools can do in terms of digitalization? ’We parents actually have many good suggestions and reasonable concerns. If the principal could listen to the voices of parents at the beginning of his tenure and promote any home school interaction projects later on, it would be much smoother. Trust starts with listening.

Question 4: If this model is to be truly implemented, what external support conditions are needed besides the principal's own efforts?

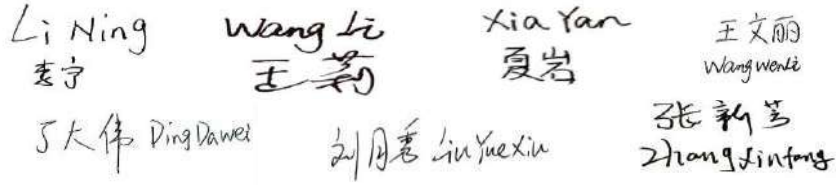
B7： I think the most important thing is policy support. Nowadays, many places still evaluate schools based on their hardware compliance rate and the number of information technology projects, without emphasizing the management process and application effectiveness. The principals are very smart, they do whatever they take in exams. If the evaluation criteria are not changed, even if this model looks good, it will be difficult to truly implement. So I suggest that at the regional level, we should take the lead in piloting the integration of 'digital management efficiency' into the school supervision and evaluation system, and even into the performance assessment of principals. When the evaluation changes, the behavior changes.

E4： I am providing additional training support. What principals need is not just one or two lectures, but continuous, follow-up, and accompanying professional development. We are trying the 'mentorship system' - assigning an experienced 'digital mentor' to each newly appointed principal, who will provide regular guidance, diagnose problems, design plans, and review and improve together. This' learning by doing 'approach is more effective than any classroom training. So establishing a digital leadership development support system for principals is more important than developing a bunch of tools.

P2： For our rural schools, what we need most is resource allocation. It's not an average score, it's just 'filling gaps'. The gap between us and urban schools is too big. If the policy only treats everyone equally, we will never catch up. I hope to establish a digital special fund for rural schools at the regional level, specifically to address basic issues such as network, equipment, and operation and maintenance. Only by addressing these shortcomings can we be qualified to talk about 'leadership'. Otherwise, even the best model is useless to us.

S3： I think there is still a need for social atmosphere support. Many parents have misunderstandings about digitalization, thinking that it is' letting their children play with their phones' and 'hurting their eyes'. If parents do not support it, it will be difficult for teachers to promote any home school interactive projects. Therefore, schools should take the initiative to provide parents with digital literacy training, so that parents can understand the significance of digitalization for their children's future and learn how to guide their children to use electronic devices healthily. With the understanding and support of parents, the digital leadership of principals can truly be exerted.

B6: I want to emphasize the importance of funding support. Digitization is not a one-time investment, but a continuous and dynamic one. Equipment needs to be updated, software needs to be upgraded, personnel need to be trained, and operation and maintenance need to be guaranteed, all of which require money. Nowadays, many schools' digital funding is' project-based ', with money available for projects this year and no money left after the project ends next year. This funding model makes it difficult for principals to make long-term plans. Therefore, establishing a stable digital regular budget is the' hard support 'for model implementation.



APPENDIX K: Experts' Evaluation of the Research Results

To systematically evaluate the theoretical rigor and practical value of the research results in this study, 8 PhD. experts majoring in Education and Management were invited to complete a structured evaluation questionnaire via email by using a five-point Likert scale (1-5 Scores, 1 score=complete agreement; 2 scores=not very agree; 3 scores=average; 4 scores=agree; 5 scores=complete agreement) to validate the "Propriety, Feasibility, and Utility" of the research results in this study.

Expert Evaluation Questionnaire of the Model

Category	Item	1	2	3	4	5
Propriety	**P1:** The model clearly identifies and defines the core variables that affect the digital leadership of primary school principals.					
	P2: The causal relationships between variables in the model are reasonably set, which conforms to the basic logic of school organization and operation.					
	P3: The overall framework of the model comprehensively covers the main processes of digital leadership without any obvious omissions.					
	P4: The emphasis of the model on "TDBI" as a moderating variable is an accurate grasp of the "human factor" in the digital transformation of schools.					
	P5: This model is related to classic leadership theories, such as transformational leadership, and builds on this foundation.					
Feasibility	**F1:** The various variables in the model can be effectively measured through specific and observable behaviors or indicators.					
	F2: Develop a scale based on this model to evaluate principals' digital leadership, with high operational feasibility.					
	F3: The model has basic explanatory power and applicability for the digital leadership status of principals in different regions and types of schools.					
	F4: The pathway of action revealed by the model provides a clear logical basis for designing targeted intervention measures.					
	F5: In practical applications, the complexity of collecting data and making judgments based on this model is within an acceptable range.					
Utility	**U1:** The model can provide a valuable framework for primary school principals to self-diagnose and plan their personal digital leadership development.					
	U2: The model can provide theoretical guidance to regional education departments in designing and evaluating digital leadership development projects and related policies for principals.					
	U3: The model has a clear, illuminating effect on the design of relevant courses and training content for teacher training institutions.					

	U4: The research framework developed by the model provides a solid foundation for subsequent empirical research, including the mechanisms of impact. **U5:** This study has positive theoretical significance and practical value for promoting the digital transformation of basic education.

Results of Experts' Evaluation Scores

Item	Experts 1-8	M	SD	Results
P1	5, 5, 5, 4, 5, 4, 5, 4	4.63	0.52	
P2	5, 4, 5, 4, 4, 5, 4, 4	4.38	0.52	
P3	4, 5, 4, 5, 4, 4, 4, 4	4.25	0.46	Highly agree with the item of propriety.
P4	5, 5, 5, 5, 5, 4, 5, 5	4.88	0.35	
P5	4, 4 , 4, 4, 5, 4, 4, 4	4.13	0.35	
p		4.38	0.41	
F1	5, 4, 4, 3, 4, 4, 4, 4	4.00	0.53	Clearly define the measurement method.
F2	4, 4, 4, 3, 4, 3, 4, 4	3.75	0.46	
F3	4, 3, 4, 4, 3, 4, 4, 3	3.63	0.52	Consider situational differences.
F4	4, 5, 4, 4, 5, 4, 4, 4	4.25	0.46	
F5	4, 4, 4, 3, 4, 4, 4, 4	3.88	0.35	
F		3.93	0.55	Basic agreement, slight challenge.
U1	5, 5, 4, 5, 5, 4, 5, 4	4.63	0.52	
U2	5, 5, 5, 4, 5, 5, 5, 5	4.88	0.35	
U3	4, 5, 4, 5, 4, 4, 5, 5	4.50	0.53	Highly agree with significant value
U4	5, 5, 5, 4, 5, 4, 5, 4	4.63	0.52	
U5	5, 5, 5, 4, 5, 5, 4, 5	4.75	0.46	
U		4.55	0.47	

Invitations to be an Expert to Evaluate the Result

SU 0210.04 / 051

Graduate School of Education
Siam University
38 Phet Kasem Rd., Bang Wa,
Phasi Charoen, Bangkok 10160

12th February 2026

Dear Dr. Zhang Lei,
Central China Normal University

Subject: Invitation to be an expert to evaluate the results.

Since Ms. Du Xueping, student ID 6419000028, a doctoral student in the English Program, Graduate School of Education, Siam University. She is currently conducting research entitled *"A Development of a Digital Leadership Model for Primary School Principals in Henan"*, with Associate Professor Dr. Boonmee Nenyod (the advisor) and Dr. Leehsing Lu (the co-advisor), the Graduate School of Education would like to invite you to be an expert to evaluate the results. Ms. Du Xueping will contact and coordinate all details herself.

We really appreciate your help.

Yours sincerely,

Asst. Prof. R. Adm.Supathra Urwongse, Ph.D
Acting Dean of Graduate School of Education

SU 0210.04 / 051.01

Graduate School of Education
Siam University
38 Phet Kasem Rd., Bang Wa,
Phasi Charoen, Bangkok 10160

12th February 2026

Dear Dr. Bai Linqian,
Central China Normal University

Subject: Invitation to be an expert to evaluate the results.

Since Ms. Du Xueping, student ID 6419000028, a doctoral student in the English Program, Graduate School of Education, Siam University. She is currently conducting research entitled *"A Development of a Digital Leadership Model for Primary School Principals in Henan"*, with Associate Professor Dr. Boonmee Nenyod (the advisor) and Dr. Leehsing Lu (the co-advisor), the Graduate School of Education would like to invite you to be an expert to evaluate the results. Ms. Du Xueping will contact and coordinate all details herself.

We really appreciate your help.

Yours sincerely,

Asst. Prof. R. Adm.Supathra Urwongse, Ph.D
Acting Dean of Graduate School of Education

SU 0210.04 / 051.02

Graduate School of Education
Siam University
38 Phet Kasem Rd., Bang Wa,
Phasi Charoen, Bangkok 10160

12th February 2026

Dear Dr. Wang Hui,
Pingdingshan University

Subject: Invitation to be an expert to evaluate the results.

Since Ms. Du Xueping, student ID 6419000028, a doctoral student in the English Program, Graduate School of Education, Siam University. She is currently conducting research entitled *"A Development of a Digital Leadership Model for Primary School Principals in Henan"*, with Associate Professor Dr. Boonmee Nenyod (the advisor) and Dr. Leehsing Lu (the co-advisor), the Graduate School of Education would like to invite you to be an expert to evaluate the results. Ms. Du Xueping will contact and coordinate all details herself.

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Acting Dean of Graduate School of Education

SU 0210.04 / 051.03

Graduate School of Education
Siam University
38 Phet Kasem Rd., Bang Wa,
Phasi Charoen, Bangkok 10160

12th February 2026

Dear Dr. Chang Minqiang,
Pingdingshan University

Subject: Invitation to be an expert to evaluate the results.

Since Ms. Du Xueping, student ID 6419000028, a doctoral student in the English Program, Graduate School of Education, Siam University. She is currently conducting research entitled *"A Development of a Digital Leadership Model for Primary School Principals in Henan"*, with Associate Professor Dr. Boonmee Nenyod (the advisor) and Dr. Leehsing Lu (the co-advisor), the Graduate School of Education would like to invite you to be an expert to evaluate the results. Ms. Du Xueping will contact and coordinate all details herself.

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Acting Dean of Graduate School of Education

SU 0210.04 / 051.04

Graduate School of Education
Siam University
38 Phet Kasem Rd., Bang Wa,
Phasi Charoen, Bangkok 10160

12th February 2026

Dear Dr. Chen Li,
Henan Normal University

Subject: Invitation to be an expert to evaluate the results.

Since Ms. Du Xueping, student ID 6419000028, a doctoral student in the English Program, Graduate School of Education, Siam University. She is currently conducting research entitled *"A Development of a Digital Leadership Model for Primary School Principals in Henan"*, with Associate Professor Dr. Boonmee Nenyod (the advisor) and Dr. Leehsing Lu (the co-advisor), the Graduate School of Education would like to invite you to be an expert to evaluate the results. Ms. Du Xueping will contact and coordinate all details herself.

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Asst. Prof. R. Adm.Supathra Urwongse, Ph.D
Acting Dean of Graduate School of Education

SU 0210.04 / 051.05

Graduate School of Education
Siam University
38 Phet Kasem Rd., Bang Wa,
Phasi Charoen, Bangkok 10160

12th February 2026

Dear Dr. Zhang Xiaodong,
Henan Normal University

Subject: Invitation to be an expert to evaluate the results.

Since Ms. Du Xueping, student ID 6419000028, a doctoral student in the English Program, Graduate School of Education, Siam University. She is currently conducting research entitled *"A Development of a Digital Leadership Model for Primary School Principals in Henan"*, with Associate Professor Dr. Boonmee Nenyod (the advisor) and Dr. Leehsing Lu (the co-advisor), the Graduate School of Education would like to invite you to be an expert to evaluate the results. Ms. Du Xueping will contact and coordinate all details herself.

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Asst. Prof. R. Adm.Supathra Urwongse, Ph.D
Acting Dean of Graduate School of Education

SU 0210.04 / 051.06

Graduate School of Education
Siam University
38 Phet Kasem Rd., Bang Wa,
Phasi Charoen, Bangkok 10160

12th February 2026

Dear Dr. Zhao Fang,
Xinyang Normal University

Subject: Invitation to be an expert to evaluate the results.

Since Ms. Du Xueping, student ID 6419000028, a doctoral student in the English Program, Graduate School of Education, Siam University. She is currently conducting research entitled *"A Development of a Digital Leadership Model for Primary School Principals in Henan"*, with Associate Professor Dr. Boonmee Nenyod (the advisor) and Dr. Leehsing Lu (the co-advisor), the Graduate School of Education would like to invite you to be an expert to evaluate the results. Ms. Du Xueping will contact and coordinate all details herself.

We really appreciate your help.

Yours sincerely,

Asst. Prof. R. Adm.Supathra Urwongse, Ph.D
Acting Dean of Graduate School of Education

SU 0210.04 / 051.07

Graduate School of Education
Siam University
38 Phet Kasem Rd., Bang Wa,
Phasi Charoen, Bangkok 10160

12th February 2026

Dear Dr. Liu Chang,
Xinyang Normal University

Subject: Invitation to be an expert to evaluate the results.

Since Ms. Du Xueping, student ID 6419000028, a doctoral student in the English Program, Graduate School of Education, Siam University. She is currently conducting research entitled *"A Development of a Digital Leadership Model for Primary School Principals in Henan"*, with Associate Professor Dr. Boonmee Nenyod (the advisor) and Dr. Leehsing Lu (the co-advisor), the Graduate School of Education would like to invite you to be an expert to evaluate the results. Ms. Du Xueping will contact and coordinate all details herself.

We really appreciate your help.

Yours sincerely,

Asst. Prof. R. Adm.Supathra Urwongse, Ph.D
Acting Dean of Graduate School of Education

AUTHOR'S BIOGRAPHY

Full Name:	Du Xueping
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E-Mail:	847314102@qq.com

Bachelor's Degree

Degree:	Bachelor
Major:	Chinese Language and literature
Institution:	Huanghuai University
Country:	Henan, China
Year:	2007-2011

Master's Degree

Degree:	Master
Major:	Chinese International Education
Institution:	Central China Normal University
Country:	Hubei Province, China
Year:	2011-2013