



Construction of a Digital-Intelligent Competence Model for Primary and Secondary School Administrators

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Abstract. With the advancement of digital-intelligent technologies driving the digital transformation of education, enhancing the digital-intelligent competence of administrators in primary and secondary schools has become a priority. This study constructs a competence model for school administrators based on insights from literature reviews, semi-structured interviews, and questionnaire surveys. The literature review outlines the development of digital-intelligent competence globally. The study draws on foundational theories, including digital literacy and the European Union's teacher competence framework, while highlighting that research in China has mainly concentrated on theoretical exploration. The research design adopts a combined top-down and bottom-up approach. It extracts conceptual frameworks from existing theories and supplements them with empirical data from interviews. As a result, this study developed a preliminary framework comprising six dimensions: fundamental digital-intelligent literacy, planning and design ability, organizational and implementation ability, evaluation and promotion ability, digital-intelligent awareness, and personal traits. A validation survey conducted with 70 school administrators helped to refine the model, leading to the elimination of overlapping dimensions such as “leadership” and “self-confidence.” The final competence model includes six primary dimensions and twenty secondary characteristics. The findings reveal a high level of recognition for dimensions such as “digital-intelligent skills” (92.8%) and “institutional planning” (85.7%), indicating that the model is both theoretically sound and practically applicable. This study provides evidence-based implications for enhancing the competence of school administrators and promoting the digital-intelligent transformation of education.

Keywords: Administrators in primary and secondary schools, Competence model, Model construction, Status survey

1 Introduction

With the rapid advancement of technologies such as big data, virtual reality, and artificial intelligence, the integration of digital and intelligent systems has become a defining trend of the modern era. Meanwhile, education is undergoing a profound digital-intelligent transformation. As key stakeholders in the development of digital-intelligent

talents, educators significantly influence classroom effectiveness, students' digital intelligent literacy, the digital-intelligent advancement of schools, and finally, the trajectory of educational transformation. Teachers should enhance their digital-intelligent competence to facilitate effective teaching and learning. Additionally, school administrators must also strengthen their digital-intelligent planning, management, and execution capability to support their institutions' digital-intelligent transition.

2 Literature Review

In recent years, scholars globally have increasingly focused on educators' digital competence. The concept of digital-intelligent competence has evolved from earlier frameworks, including information literacy, digital literacy, data literacy, and digital competence. In the 1970s, Harvard professor David McClelland, after extensive research on talent evaluation standards, published *Testing for Competence Rather Than for "Intelligence,"* in which he formally defined the concept of "competence" ^[1]. This work is widely regarded as the official emergence of competence studies. In 2006, the European Union introduced the concept of "digital competence" in its *Recommendation on Key Competences for Lifelong Learning*, and in 2017, it issued the *European Framework for the Digital Competence of Educators*. The International Society for Technology in Education in the United States has systematically classified educators' roles in the digital age, emphasizing an integration of digital-intelligent competence. This classification seeks to delineate required competence domains, clarify professional responsibilities, and strengthen teachers' foundations in the digital era. In June 2022, over 60 U.S. educational institutions endorsed the *Educator Initiatives for Advancing Digital Equity and Educational Transformation*, an initiative designed to enhance teachers' digital-intelligent competence and broaden their knowledge in this field. In China, research on digital-intelligent competence in education has largely centered on theoretical explorations of faculty in higher education institutions, particularly in undergraduate institutions. The methodologies are often limited to literature reviews and conceptual analyses. In a 2020 study on digital-intelligent literacy in human-machine collaborative teaching contexts, Xu et. al. argued that such competence effectively prevents teachers from being marginalized in technology-enhanced environments, a finding that lays a foundation for future study^[2]. In 2024, Ye investigated the evaluation framework for digital-intelligent competence among vocational college teachers in the context of smart education, finding that this competence represents advanced, integrative abilities that promote problem-solving, collaboration, self-directed learning, and innovation through digital technologies^[3].

3 Research Design

This study aims to construct a comprehensive digital-intelligent competence model for administrators in primary and secondary schools. A review of existing approaches to competence model construction reveals that scholars commonly adopt mixed-methods research designs that integrate both quantitative and qualitative techniques such as

questionnaires, the Delphi method, and in-depth interviews. For instance, Li employed the Behavioral Event Interview (BEI) method to examine 34 secondary school principals in Yunnan Province, including 16 exemplary principals and 18 average ones. Based on the collected data, she developed a principal competence excellence model, which was subsequently validated using 53 effective questionnaire responses^[4]. Authoritative frameworks for school administrators' competence are present globally. However, few incorporate personality traits. Therefore, this study adopts a hybrid approach that combines top-down content analysis of existing frameworks with bottom-up empirical insights from interviews. Specifically, the process begins with the extraction of key features of "digital-intelligent competence" from relevant global standards. This is followed by Problem-Centered Interviews (PCI) with school administrators, a semi-structured interview method based on grounded theory, to inductively develop a preliminary competence framework. Finally, the framework's acceptance is tested among school administrators to improve and establish the final digital-intelligent competence model for administrators in primary and secondary schools, as shown in Fig. 1.

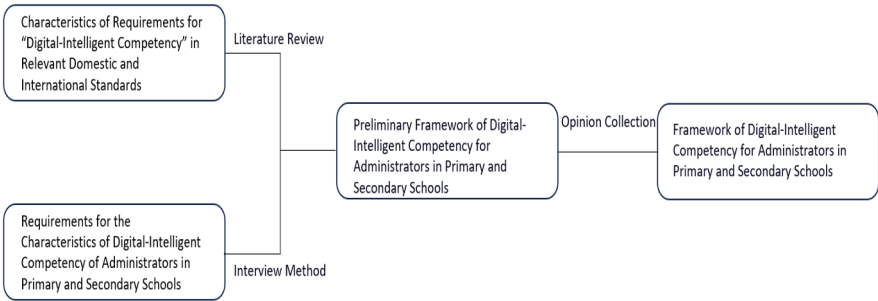


Fig. 1. Ideas for the digital-intelligent competence model for administrators in primary and secondary schools

As shown in Table 1, based on a systematic review of existing frameworks, this study classifies the digital-intelligent competence of administrators in primary and secondary schools into six dimensions: fundamental digital-intelligent literacy, planning, and design ability, organizational and implementation ability, evaluation and promotion ability, digital-intelligent awareness, and personal traits. Surrounding the concept connotation of "competence", the model integrates two classic competence theories to distinguish between explicit and implicit competence characteristics, with particular emphasis on internal factors, notably personal traits, since they are challenging to cultivate. This framework addresses the diverse requirements of China's educational digital transformation in the digital-intelligent era, covering knowledge, skills, attitudes, emotions, and values. This will further enhance primary and secondary school administrators' digital-intelligent competence across multiple dimensions.

Table 1. Primary Dimensions of Digital-Intelligent Competence for Administrators in Primary and Secondary Schools

Category	Primary Dimension (Key Domain)	Literature Source
Foundational Competence	Fundamental Digital-intelligent Literacy	<i>Teacher Digital Literacy Framework</i>
Distinctive Competence	Planning and Design Ability	<i>Standards for Informatization Leadership of Principals in Primary and Secondary Schools (Trial)</i>
	Organizational and Implementation Ability	
	Evaluation and Promotion Ability	<i>Professional Standards for General High School Principals</i>
		<i>Standards for Informatization Leadership of Principals in Primary and Secondary Schools (Trial)</i>
		<i>The European Framework for the Digital Competence of Educators</i>
Personal Traits	Personal Traits	<i>Standards for Informatization Leadership of Principals in Primary and Secondary Schools (Trial)</i>
		<i>Teacher Digital Literacy Framework</i>
		<i>A Competence Dictionary by Spencer</i>
		<i>Questionnaire on Digital Competence of Teachers in Primary and Secondary Schools Based on ONET Job Analysis</i>

A review of global frameworks and policy-derived dimensions indicates that previous competence models have adopted a top-down approach, often based on authoritative global standards. To better align the developed framework with the practical contexts of administrators in primary and secondary schools in China, this research conducts an in-depth exploration of their digital-intelligent competence characteristics. Specifically, eight school administrators from Province H, each with expertise in digital-intelligent competitions and teaching management, participated in a group interview. These participants represented a diverse age range from 27 to 56. All had actively engaged in and earned awards at the province's Digital Innovation and Application

Competition in Education and independently developed digital-intelligent educational resources and integrated digital technologies into teaching management practices.

Based on the analysis and extraction of data from group interviews, as well as a top-down review of existing literature and interview insights, this study developed a scientific framework of digital-intelligent competence characteristic dimensions for administrators in primary and secondary schools. The final model is presented as follows: Table 2.

Table 2. Digital-Intelligent Competence Model for Administrators in Primary and Secondary Schools

Primary Dimension	Secondary Dimension	Description
Fundamental digital-intelligent literacy	Digital-Intelligent Knowledge	Description
	Digital-Intelligent Skills	Administrators can understand the characteristics of common digital-intelligent technologies and their problem-solving processes and methods, such as multimedia, the Internet, big data, virtual reality, and artificial intelligence.
Planning and design ability	Institutional Planning	Administrators can understand principles and methods for selecting digital-intelligent devices, software, and platforms in teaching management.
	Teaching Planning	Administrators can establish and improve school regulations related to digital-intelligent technologies to guide faculty in effectively applying these technologies, ensuring that the school's IT equipment, personnel, and environment enhance teaching management quality.
	Activity Planning	Administrators can adhere to new curriculum reform principles, actively promoting the integration of digital-intelligent technologies with teaching to innovate instructional models.
	Support Planning	Administrators can regularly organize digital-intelligent technology-themed activities and offering related courses, enabling students to benefit significantly from the school's digitalization process.
Organizational and implementation ability	Innovation Promotion	Administrators can formulate school regulations based on national policies to establish mechanisms for safeguarding personnel, financial, and management data.
	Organizing Training	Administrators can encourage teachers to adopt digital-intelligent technologies as instructional tools, leveraging these technologies to acquire, process, and integrate teaching resources for innovative instructional design.
Evaluation and promotion ability	Organizing Assessments	Administrators can conduct seminars or training sessions on integrating digital-intelligent technologies with curricula, combining theory and practice to enhance teachers' digital-intelligent knowledge and skills.

	Strategy Adjustment	Administrators can evaluate teachers' abilities to apply digital-intelligent technologies and adjust professional development strategies accordingly.
Digital-intelligent awareness	Digital-Intelligent Willingness	Administrators can modify school regulations, budgets, and team-building strategies related to digitalization based on assessments of teachers' digital-intelligent proficiency.
	Digital-Intelligent Determination	Administrators can proactively explore the functions of digital-intelligent resources, with a desire to apply them in teaching management and recognize their role in promoting high-quality educational development.
	Digital-Intelligent Ethics	Administrators can overcome challenges in using technical resources and innovative teaching methods during digital-intelligent educational practices, while persistently pursuing such initiatives.
	Digital-Intelligent Safety	Administrators can adhere to principles of legitimacy, necessity, informed consent, clear purpose, and safety when using digital products and services, respecting intellectual property, and prioritizing students' physical and mental well-being.
Personal traits	Critical Thinking	Administrators can ensure data security when collecting, storing, using, or sharing data from students, parents, or others, while identifying, preventing, and addressing network-related risks in school settings.
	Lifelong Learning	Administrators can maintain a critical perspective toward open digital-intelligent resources, effectively collecting, organizing, and analyzing information to form comprehensive insights.
	Achievement Motivation	Administrators can continuously acquire new knowledge and skills, embracing learning as a lifelong process.
	Flexibility	Administrators can demonstrate a strong desire and motivation to excel in digital-intelligent teaching management.
	Perseverance	Administrators can adapt strategies flexibly and diversely. Based on the characteristics of students and teachers, administrators can ensure the smooth implementation of digital-intelligent teaching management activities.
	Collaborative Spirit	Administrators can persist resolutely in applying digital-intelligent technologies to teaching management despite difficulties, setbacks, or obstacles.

4 Analysis of Research Findings

To ensure the scientific rigor and validity of the framework's competence dimensions, this study examined the recognition of each characteristic dimension after developing the digital-intelligent competence framework for administrators in primary and

secondary schools. This verification was based on interviews and a literature review. Specifically, a recognition questionnaire was administered to participants in a training program for ten thousand school principals in Province H. This validation process helped effectively screen and confirm the framework’s characteristic dimensions^[5]. Consequently, this study designed the Digital-Intelligent Competence Recognition Questionnaire for Administrators in Primary and Secondary Schools based on the established framework dimensions. In addition, school administrators were invited to identify the competence items they considered essential from the listed dimensions.

As shown in Table 3, during an online survey conducted from November 23 to 30, 2024, a total of 75 questionnaires were collected, with 70 responses from 34 male and 36 female school administrators being valid. This study analyzes the frequency statistics of the respondents. It defines dimensions with a frequency exceeding 50% as high frequency, with their corresponding competence characteristics retained^[6]. All 22 surveyed competence dimensions achieved frequencies above 50%. The highest-frequency dimensions included Digital-Intelligent Skills (92.8%), Institutional Planning (85.7%), Digital-Intelligent Safety (84.3%), and Critical Thinking (82.9%), while Leadership (64.3%) and Self-Confidence (62.9%) exhibited relatively lower frequencies.

Table 3. Frequency Statistics of Digital-Intelligent Competence Characteristics for Administrators in Primary and Secondary School

Competence Characteristic	Frequency	Percentage	Competence Characteristic	Frequency	Percentage
Digital-Intelligent Knowledge	54	77.1%	Digital-Intelligent Determination	51	72.9%
Digital-Intelligent Skills	65	92.8%	Digital-Intelligent Ethics	54	77.1%
Institutional Planning	60	85.7%	Digital-Intelligent Safety	59	84.3%
Teaching Planning	50	71.4%	Critical Thinking	58	82.9%
Activity Planning	52	74.3%	Lifelong Learning	50	71.4%
Support Planning	51	72.9%	Leadership	45	64.3%
Innovation Promotion	48	68.6%	Achievement	51	72.9%
Organizing Training	49	70.0%	Motivation		
Organizing Assessments	46	65.7%	Self-Confidence	44	62.9%
Strategy Adjustment	45	64.3%	Flexibility	48	68.6%
Digital-Intelligent Willingness	50	71.4%	Perseverance	46	65.7%
			Collaboration	46	65.7%

In addition, the questionnaire included an open-ended question: “Do you have any other revision suggestions for the constructed *Digital-Intelligent Competence Framework for Administrators in Primary and Secondary School*?” This question was designed to further collect feedback from school administrators regarding the competence framework. Among the collected suggestions, some administrators pointed out that the dimension of “Self-Confidence” overlaps with the content expressed in the dimensions of “Self-Confidence” and “Digital-Intelligent Willingness”. They noted that the description of “Digital-Intelligent Willingness” was more fitting than that of “Self-Confidence”. In previous interviews, some respondents indicated that “Leadership” is not an essential digital-intelligent competence for school administrators. They argued that the positive impact of school administrators’ leadership on the digital-intelligent competence of teachers and students was not significant. Therefore, this study decided to eliminate the dimensions of “Self-Confidence” and “Leadership” [7]. As a result, after analyzing the interview content and the questionnaire responses, the final Digital-Intelligent Competence Model for Administrators in Primary and Secondary School was determined to include six primary dimensions and 20 secondary dimensions, as shown in the table 4.

Table 4. Dimensions and Competence Characteristics of the Digital-Intelligent Competence Framework for Administrators in Primary and Secondary School

Dimension	Competence Characteristics
Basic Digital-Intelligent Literacy	1. Digital-Intelligent Knowledge 2. Digital-Intelligent Skills
Planning and Design Ability	3. Institutional Planning 4. Teaching Planning 5. Activity Planning 6. Support Planning
Organizational and Implementation Ability	7. Innovation Promotion 8. Training Organization
Evaluation and Promotion Ability	9. Organizing Assessments 10. Strategy Adjustment
Digital-Intelligent Awareness	11. Digital-Intelligent Willingness 12. Digital-Intelligent Determination
Personal Traits	13. Digital-Intelligent Ethics 14. Digital-Intelligent Safety
	15. Critical Thinking 16. Lifelong Learning 17. Achievement Motivation
	18. Flexibility
	19. Perseverance 20. Collaborative Spirit

5 Conclusion

Based on a preliminary framework developed based on a literature review and interviews, this study examined and revised the competence characteristics through additional interviews. The final Digital-Intelligent Competence Model for Administrators in Primary and Secondary Schools comprises six dimensions: fundamental digital-intelligent literacy, planning and design ability, organizational and implementation ability, evaluation and promotion ability, digital-intelligent awareness, and personal traits. Covering twenty competence characteristics, the framework comprehensively reflects

the key elements required for administrators in primary and secondary schools for effective teaching and management, including knowledge, skills, ability concepts, and personal traits. This framework enriches existing digital-intelligent competence models and offers practical implications.

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