The Connotation Evolution and Enhancement Strategies of Digital Leadership in China's Universities in the Context of Digital Transformation

Yaoyu Xie [1, a], Nan Wang [1, b]

[1] School of Network Education, Beijing University of Posts and Telecommunications, Beijing

[a] 17835202628@163.com, [b] etwangnan@126.com

Abstract. Global digital transformation is affecting all walks of life in a subtle way, and higher education is among them. Digitalization has undoubtedly become one of the core issues in school governance decision-making, and the digital leadership of college leaders is the key to promote the digital transformation of school education to adapt to the digital wave. However, considering the theoretical level, practical level and individual level, it is found that the level of digital leadership of university leaders is weak and urgent changes need to be made. Based on the evolution of the connotation of the dual theories of informatization leadership and digital leadership, the study traces the origins of digital leadership at home and abroad through the literature research method, and combs through the essential differences between educational informatization leadership and digital leadership from four aspects: leadership concept, application scope, data value, and competence requirements, so as to put forward the strategy of improving digital leadership for college leaders: The first is to transform the cognition of digital technology and improve the inductive reflection power of digital application; the second is to strengthen the cultivation of digital planning power and formulate the standard of digital leadership; the third is to cultivate the power of data decision-making and analysis, and to call for the formation of school data team. In order to provide certain reference for the reform and construction of digital team of leaders in China's colleges and universities in the new era.

Keywords: Digital leadership in colleges and universities; informatization leadership; the evolution of connotation.

1. Introduction

The global digital transformation (DT) is affecting higher education and has been greatly intensified by COVID-19. The incoming wave of digital technologization has brought great impact and challenges to the traditional way of education. Digitalization has forced changes in school education and has undoubtedly become one of the central issues in school governance decisions. From the point of view of the school field, the leader is the leader, organizer and practitioner of school digital construction, and the construction of its digital leadership is of extreme importance to promote the digital transformation of school education, the implementation of the national education digitalization and even the "digital China" strategy, which is even more urgent and necessary. The Education Informatization 2.0 Action Plan issued in 2018 states that the construction and application of digital campuses at all levels and in all types of schools will be comprehensively promoted, with school leaders acting as chief information officers (CIOs) to coordinate the promotion;The "Primary and Secondary School Teachers' IT Application Capacity Enhancement Project 2.0" project developed in 2019 proposes to promote IT leadership training activities for school management teams; The Guiding Opinions on Promoting the Construction of New Educational Infrastructure to Build a High-Quality Educational Support System, published in 2021, pointed out that it is important to effectively improve school administrators' ability to improve their informatization leadership, and to support colleges and universities in applying cutting-edge technologies to new educational infrastructure; in 2022, the State implemented a strategic action on the digitization of education, to promote the improvement of digitization leadership and governance capacity; in 2023, the Central Committee of the Communist Party of China (CPC) and the State Council issued the Overall Layout Plan for the Construction of Digital China," stating that it will

enhance digital thinking, digital cognition, and digital skills of leading cadres and civil servants. Focusing on the macro background, based on the overall strategy for the construction of digital China and the development trend of education, from informationization leadership to digital leadership. It is easy to see that school education urgently needs effective digital leadership practices to keep up with changing needs and opportunities, and the key core lies in the corresponding digital leadership of school leaders.

Higher education digitization is a complex systematic project involving multiple subjects and factors, which requires concerted efforts and systematic promotion by stakeholders, and university leaders are precisely the core driving force of this organization. Therefore, enhancing the digital leadership of university leaders has become an inevitable choice to promote the strategic action of education digitization and practice the digital transformation of school education. However, from the theoretical level of analysis, academics generally focus on the research of informatization leadership of primary and secondary school principals, and fail to pay sufficient attention to the responsibilities and capacity building of university leaders to lead the application of digital construction in schools; from the practical level of analysis, the current degree of digitization of higher education lags far behind that of most other industries, and talents cultivated in higher education system can't satisfy the demand of the employment of the development of the digital economy, and lack of composite digital talents has become a constraint to the economic development of the economy. The lack of digital talents has become a key shortcoming that restricts the digital transformation of the economy; from the individual level analysis, the personal digital literacy of most university leaders can not support the requirements of digital education and governance, digital management concepts and design capabilities are generally not high, and digital leadership is weak. In view of this, this study will focus on the digital leadership of college leaders in the context of digital transformation, aiming to clarify the evolution of the concept, and try to make clear the essential difference between educational informatization leadership and educational digital leadership, so as to clarify the enhancement strategy of digital leadership in colleges and universities, with a view to providing theoretical references for the enhancement of digital capacity of college leaders in China in the new era.

2. Digital transition of information process

2.1 E-leadership and digital leadership

Leadership has long been recognized as the key to the success of any educational reform and has traditionally been defined as the ability to influence others to achieve goals [1,2].

Internationally, digital leadership in higher education is a branch of research that has rapidly developed from e-leadership research. E-leadership is a combination of the terms "electronic technology" and "leadership". On the whole, it is a kind of ability that electronic technology and leadership interact and influence each other in the organizational process[3]. The first comprehensive definition of "e-leadership" was given by Avolio et al in their 2014 update[4], however, Avolio et al. 's definition is highly abstract. On the basis of the former, Van Wart et al. proposed a more specific definition: e-leadership is the effective use and integration of electronic and traditional communication methods[5]. It means understanding current information and communication technologies, selective adoption of new information and communication technologies for oneself and the organization, and the technical capacity to use the selected information and communication technologies. This pragmatic understanding arguably led to an evolution in thinking about the limitations of the concept of "e-leadership." At the same time, the concept of "digital leadership" is gradually introduced. Ehlers is one of those trying to clarify the concept of "digital leadership[6]," but he equates it with the existing concept of "transformational leadership." Eberl and Drews distinguish between e-leadership and digital leadership in a broader context, based on the previous definition of e-leadership[7].

From an education perspective, Sheninger defines digital leadership as it relates to schooling in a broad way, identifying it as "setting direction, influencing others, initiating sustainable change through access to information, and building relationships to anticipate changes that are critical to a school's future success[8]." With regard to the definition of digital leadership in higher education, Brown et al focus on digital literacy and inclusion[9], taking a critical look at the adoption of technology and applying it to higher education in the broader socio-cultural teaching context, thus introducing a new specific term "digital educational leadership", which is used to distinguish "e-leadership" in business and educational technology. They believe that the latter focus more on technology in education. Ordu et al also proposed from an educational perspective that "digital leadership can be defined as creating an innovative vision through the effective use of technology in the management process in order to create a sustainable culture of change in the organization"[10].

Despite differences and ambiguities in previous definitions, digital leadership is broader than "e-leadership" and involves fundamental change at three levels: leader, organization, and individual. The concept of "digitization" as a limited ICT-based process of change has evolved into a broader concept of "digitization" based on emerging technologies such as Artificial Intelligence, IoT, ChatGPT, Blockchain, etc., which has been accelerated by the COVID pandemic of 2020 - 2022.However, despite the considerable growth in research on digitalization in education, the conceptual and empirical research on this digital leadership is still nascent, incomplete, and relatively underdeveloped, especially in higher education.

2.2 Information leadership and digital leadership

Early research in this field in the domestic academic community generally used terms such as "information technology leadership, educational technology leadership, information leadership, principal information leadership", among which principal information leadership has received more attention. For example, Xiao Yumin et al. regarded principal technology leadership as one of the categories of principal role-playing, the structure of which includes four aspects, namely, technology-related decision-making, management, service, and evaluation, and focuses on the principal's executive ability to promote the effective use of technology in all aspects of the school[11].Sun Zhenxiang et al. believe that principal informatization leadership is the ability and wisdom of the principal or the school management team to be able to plan and build a vision of informatization development and to influence and lead all teachers, students, and staff to work together to achieve this vision in the process of promoting education informatization in the school[12].According to Xie Zhongxin et al, the information technology leadership of principals is specifically expressed in four aspects: principals' information awareness and information technology ability, information technology decision-making and planning ability, information technology organization and management ability, and information technology evaluation and development ability[13].The study found that the introduction of the "Guidelines for the 11th Five-Year Plan of National Educational Science Research" in 2006 drew the attention of many scholars to the field of informatization leadership in education. In the following 10 years, the field has been in a lukewarm state, but the overall trend is slowly rising, and the research is mainly subdivided into the fields of informatization leadership theory research, promotion strategy and informatization evaluation of primary and secondary school principals. In 2015-2016, research in the field of education informatization leadership began to heat up significantly, which is greatly related to the "13th Five-Year Plan for Education Informatization" issued by the Ministry of Education in 2016, which points out that it is necessary to promote management informatization in-depth, and to expand from serving education management to comprehensively improving the ability of education governance[14,15]. Until 2022, the critical year of China's education digital transformation, the concepts of digitally empowered principal informational leadership, digital leadership, and data leadership have been frequently proposed. For example, Jiaojiao Qu et al. pointed out the current dilemmas and enhancement strategies of principals' information technology leadership[16]. Zhu Zhiting et al. believe that digital leadership influences the value tendency and

practice process of education digital transformation, in which education digital transformation involves both organizational leadership and technology leadership[17]. Right from the beginning, the development of information technology leadership is a dynamic process, and its connotation is always changing with the continuous development of technology and the continuous advancement of educationalization. Digital leadership, on the other hand, is oriented to the digital transformation of education and the era of informationization 2.0. It is found that digital leadership started earlier in foreign countries, and due to the limitations of the development of school informatization technology at that time, digital leadership focuses more on technical leadership, i.e., e-technology leadership. Domestic research in this field started later, and under the impetus of education informatization 1.0, information technology leadership came into being. It can be seen that e-leadership and informational leadership are practically synonymous. This paper attempts to sort out the past literature, focus on the development of domestic informational leadership on the basis of foreign research in this field, focus on the essential differences between informational leadership and digital leadership in terms of the leadership concept, scope of application, value of data, and competence requirements, and deepen the understanding of digital leadership in education.

3. The difference between educational information-based leadership and educational digital leadership

3.1 Leadership concept: The shift from tools to thinking

In terms of leadership philosophy, it is a shift from tools to thinking. Information technology in education informatization is generally used as an auxiliary and instrumental application, in a subordinate and marginal position in education. College leaders pay more attention to the effectiveness of school application of information technology and management efficiency, advocate teachers and students to use new technologies to improve school operations and management, such as the traditional paper teacher and student files electronically, offline resources through information technology to build a platform online, etc., the fundamental purpose is to simplify and facilitate the traditional centralized management of the school leaders, more or a tool to serve the management of the line to analyze and make decisions. The essence of digitalization is to reconfigure the educational ecology, digital technology can not be limited to the application of tools or minutiae of the repair, digital transformation of education is not a simple superimposition of digitalization and education, but to reconfigure the educational ecology through digital thinking. This requires university leaders to have digital insight, strategic thinking ability, digital system planning, digital empowerment and inspiration, digital evidence-based innovation, etc.; to establish a new educational philosophy, focus on technological innovation rooted in the actual work of education, explore and study the laws of student development, examine the personalized needs involved, think about how to use the latest technology to improve the digital literacy of disciplines, and encourage students to take the initiative in learning and promote the optimization of educational services. learning initiative, and promote the optimization of educational services. Digital leadership puts more emphasis on decentralization so that everyone knows what they should do. It shows how information technology only provides reference, while digitalization can provide decision-making, pointing to actions to empower everyone.

3.2 Application scope: local to the whole innovation

Informatization leadership arose in the era of education informatization 1.0, pointing to the tasks of leading the school informatization basic facilities construction, personnel basic capacity building, basic technology application and solving the informatization basic problems, etc. It is mainly aimed at the application of a single department, simple local optimization, the lack of efficient connection among departments and even among universities, and the efficiency is relatively low; it is easy to trigger the digital divide and fall into the misunderstanding of "technology for technology's sake"

and "informatization for informatization's sake". It is easy to cause the digital divide and fall into the misunderstanding of "technology for technology's sake" and "informatization for informatization's sake". Digital leadership, on the other hand, is geared towards the digital transformation of education and the informationization 2.0 era, focusing on leading and stimulating the role of data, algorithms as the core of big data, artificial intelligence and other key, driving technological elements of the digital transformation of education in empowering innovation. The key is demand-oriented, application-oriented, focusing on "service teaching, service teachers, service students, service assessment and evaluation, service administration and management"; it is to promote the overall creation of change, to promote the efficient connection between the internal and external parts of colleges and universities, to strengthen the integration of industry and education and the process of multi-college cooperation; and it can even bridge the digital divide in education to promote educational fairness and realize the transition from large-scale standardized training to large-scale personalized training. It can even bridge the digital divide in education, promote educational equity, and realize the leap from large-scale standardized training to large-scale personalized training. The two can be said to complement each other. Informational leadership has paved the way for digital leadership, laying a solid foundation for the transformation of digital education; while digital leadership expands the scope of informational leadership, shifting the focus from the application of information technology to the use of digital technology to promote the innovation and development of talent training.

3.3 Data value: Application of quantitative change to qualitative change

Educational data is a potentially huge treasure, and analyzing, understanding and mining data will add unlimited value to that treasure and is an important means of understanding the laws of education. In terms of the value of data, informational leadership focuses on the collection, classification, and management of data, emphasizing how information technology can be used to improve the efficiency of data collection and management; data are often processed using database technology or other information management tools to improve the accuracy and speed of educational decision-making. Informational leaders use data to determine the quality of instruction, student performance, and the outcomes and effectiveness of teaching methods; the value of the data is to help external decision makers (e.g., school leadership) understand the trends and status of the school's various efforts and to provide support for the school's future direction. In contrast, digital leadership focuses on extracting value from data, accurately analyzing and predicting educational benefits, and promoting learning outcomes. This kind of thinking about the value of data needs to start with big data analytics and artificial intelligence technologies, and allow the data itself to mediate the process of improvement. School leaders collect daily school data and conduct correlation explorations to dig out the hidden and unknown complex correlations and causal relationships, so as to summarize the educational and teaching laws and influencing factors that are unique to their school or even to a specific class, subject, or individual, or even to try to discover "gray knowledge" or "dark knowledge" about the laws of parenting, which cannot be understood by traditional theories and experiences. They even try to discover the "gray knowledge" and "dark knowledge" about the laws of human education that traditional theories and experiences cannot recognize and understand, so as to provide evidence-based support for the development and innovation of educational change. To sum up, informational leadership focuses more on the perspective of data management, processing and integration, while digital leadership emphasizes deeper data value discovery, and data management is only a process of providing data platforms and means, and helping corresponding leaders make decisions faster.

3.4 Competency requirements: Tools to skills

Both informational and digital leadership in education refer to a competency that educational leaders must possess, but there are some differences between the two in terms of competency requirements.

In terms of technology application, information technology leadership emphasizes the leader's ability to use and manage information technology, including: familiarity with and use of a variety of educational technology equipment and software; ability to use information technology effectively to support instruction and management; ability to evaluate and select appropriate educational technology; and familiarity with information management and cybersecurity. Digital leadership, on the other hand, places a greater emphasis on leaders' competence in data-driven decision-making and innovation, including: familiarity with and understanding of data analytics and forecasting in education; the ability to integrate data with instructional practices and management strategies; the ability to make research and innovative solutions for improving instruction and management; and the ability to provide digital support and leadership for educational change.

In terms of call-response, it is a long and complex process for teachers and students to accept the mutation of themselves and the environment. How to make teachers and students truly accept and normalize digital teaching is often more challenging. This requires university leaders to have digital leadership, that is, to create a good digital use culture atmosphere, lead teachers and students to participate in the process of digital planning, construction and decision-making, promote teachers to assume certain digital leadership responsibilities and roles, and create opportunities for teachers and students to use digital systems. Use daily data analysis to understand the confusion of teachers and students in campus life, teaching work, learning development and other aspects, provide practical professional help, encouragement and care to teachers and students, and absolutely avoid unethical monitoring and oppressive data snooping and application, so as to lead teachers and students to carry out digital work happily; Teachers and students are encouraged to use digital recording of learning work logs, cultivate awareness of data analysis, conduct teaching reflection and evaluation, and maximize teaching effectiveness.

In terms of personal literacy, with the digital transformation of education and the changing shape of technology, the personal literacy requirements for leaders have changed. Information literacy is the technique or skill of using adequate information tools and resources to solve practical problems, emphasizing more on a kind of information tool literacy. Digital literacy, on the other hand, includes digital knowledge, digital competence, digital thinking, digital awareness, digital ethics and morality, and is more of a skill literacy.

In summary, while there are some intersections between the two, informational leadership and digital leadership focus in different directions in education, and they emphasize different depths and breadths of technical practices. As you can see from these competency requirements, information technology leadership is more concerned with the application of specific technologies and devices, while digital leadership is more concerned with digital mindset awareness and data analysis, decision-making, and innovation. Certainly, both are very important competencies, and any educational leader should have both areas covered.

4. Digital empowerment: strategies to enhance digital leadership for college and university leaders

4.1 Change the cognition of digital technology, improve the induction and reflection of digital application

Digital insight is the ability of college and university leaders to see the impact of digital technology on their organizations and industries, and to anticipate and grasp future trends, as well as to make cognitive judgments and practical inclinations about the process of applying digital technology to education. The wave of digitalization will sweep over any individual and organization, whether understood or not, accepted or not, none of us can be alone. For college and university leaders, both traditional leadership and supportive informational leadership will no longer be applicable, and this poses a huge challenge to the traditionalized way of decision-making based on experience and intuition of college and university leaders. The first and foremost task to improve

digital insights is to transform college leaders' perception of digital technology, a continuous radiating ability that is self-initiated towards outgrowth. For example, when to introduce the latest technology; where to apply the latest technology, etc. In addition to transforming the inherent technology cognition, it is also necessary to improve the ability to reflect on the practice of digital technology application in education, summarize the deficiencies in the process of digital technology application from multiple perspectives of teaching-learning-management-assessment-examination, so as to target effective interventions and promote the direction of practice.

4.2 Strengthen the training of digital planning ability and formulate digital leadership standards

The power of digital system planning determines the overall structure of the school's digital practice program, which is the reference and basis for other digital leadership activities and behaviors. This requires university leaders to first understand the national education policy, grasp the current positioning of education digital transformation, have a high degree of digital inclusiveness, sensitivity and insight, and rooted in the education digital gene, so as to scientifically customize the school's medium- and long-term development planning. At the same time, reference can also be made to the "primary and secondary school principals informatization leadership standards (for trial implementation)", re-establishing the standard of digital leadership in colleges and universities, the formulation of the policy can set the target direction for major leaders.

4.3 Cultivate the ability of data decision-making and analysis, and call for the formation of school data team

Data decision-making and analyzing power is mainly the ability of college leaders to use appropriate statistical analysis methods to dig out all kinds of valuable or meaningful clues from a large amount of collected and complex data, to grasp the factual status quo, relational laws, and causal mechanisms in school management, education and teaching, and to form professional judgments and produce corresponding conclusions and resolutions accordingly[19]. The improvement of decision analysis ability is a gradual process, which can be started from the following points: 1 is to improve the ability to obtain information. School data involves many educational individuals and scenarios, a large number and complexity, how to quickly and effectively extract high-value, diversified information and data from it is worth thinking about. This requires college leaders to understand the rich educational value embedded in the data and to generate education-oriented data leadership.2. Establish a clear and powerful decision-making framework. Establishing a clear decision-making framework can help college leaders analyze educational management problems and make decisions in a more systematic and orderly way. A decision-making framework can include steps such as problem definition, goal setting, information gathering, program evaluation, risk assessment, and implementation planning. "All hands on deck", the digital transformation of schools is not enough to rely on the power of leaders alone, but also requires the collaborative efforts of different levels and individuals, so it is necessary to call for the formation of a school data team, including front-line teachers, information technology managers, administrators, and other multiple roles in a project-based approach to practice the use of school data as scaffolding for decision-making and applying it to large and small school practice scenarios.

5. Summary

In the era of education information 2.0, it has already broken through the simple technical category of 1.0, but digital technology causes the overall innovation of education. College leaders should firmly grasp this basic direction, and promote and effectively implement the digital transformation of education. Due to objective factors, this study still has shortcomings, and the following work will be promoted in the future: First, explore the connotation framework of digital leadership of university leaders, so as to form a more general theoretical basis. Second, the process

of improving the digital leadership of college leaders is dynamic and complex. Empirical research methods will be adopted in the future to explore the influencing factors of the development of digital leadership of college leaders, and finally form a more universal optimization path. The third is to focus on the evaluation of digital leadership ability of university leaders, and build a general digital leadership research maturity framework and evaluation tool for higher education in China.

References

[1] Ghamrawi, N. (2011). Trust me your school can be better: A message from teachers to principals. British Educational Leadership Management & Administration Journal, vol. 39, 3, p. 333–348. London: Sage.

[2] Northouse, P . G. (2021). Leadership: theory and practice. Sage publications.

[3] Jameson J, Rumyantseva N, Cai M, et al. A systematic review, textual narrative synthesis and framework for digital leadership research maturity in Higher Education[J]. Computers and Education Open, 2022: 100115.

[4] Avolio BJ, Sosik JJ, Kahai SS, Baker B. E-leadership: re-examining transformations in leadership source and transmission. Leadersh Q 2014;25(1): 105–31.

[5] Van Wart M, Roman A, Wang X, Liu C. Operationalizing the definition of e- leadership: identifying the elements of e-leadership. Int Rev Administrative Sci 2019;85(1):80–97.

[6] Ehlers UD. Digital leadership in higher education. J Higher Educ Policy Leadership Studies 2020;1(3):6–14. https://doi.org/10.29252/johepal.1.3.6.

[7] Eberl JK, Drews P. Digital Leadership–Mountain or molehill? A literature review. In: International Conference on Wirtschaftsinformatik. Springer; 2021. p. 223–37.

[8] Sheninger E. Digital leadership: changing paradigms for changing times. London: Corwin Press; 2019.

[9] Brown C, Czerniewicz L, Huang CW, Mayisela T. Curriculum for digital education leadership: a concept paper. Canada: Commonwealth of Learning; 2016.

[10] Ordu A, Nayır F. What is digital leadership? A suggestion of the definition. E-Int J Educational Research 2021;12(3):68–81. https://doi.org/10.19160/e-ijer.946094.

[11] Xiao Yumin. Research on Technology Leadership of Principals [D]. Doctoral dissertation, East China Normal University, 2008．

[12] SUN Zhenxiang,WENG Jialong. The development history and revelation of the connotation of principal informational leadership outside China[J]. China Electronic Education (CEE), 2014(02):27-34.

[13] Xie Zhongxin, Zhang Jiping. Research on the evaluation indexes of principals' informatization leadership based on system perspective[J].modern educational technology, 2009，19(4):73 -77

[14] Ren Miaomiao. Research on Domestic educational Informatization Leadership: Review and Prospect: A visual analysis based on CNKI journal literature [J]. Software guide, 2022,21(02):189-194. ZHAO Leilei, Dai Ruihua. Informatization Leadership and Leadership Effectiveness of Principals: Connotation, characteristics and Enlightenment [J]. Teacher Education Research,2016,28(05):49-56.DOI:10.13445/j.cnki.t.e.r.2016.05.009.

[15] ZHAO Leilei, Dai Ruihua. Informatization Leadership and Leadership Effectiveness of Principals: Connotation, characteristics and Enlightenment [J]. Teacher Education Research,2016,28(05):49-56.DOI:10.13445/j.cnki.t.e.r.2016.05.009.

[16] Qu Jiaojiao, Gao Chunmei. Digital Empowerment: The era orientation and promotion strategy of school principals' information-based leadership [J]. Chinese Audio-visual Education,2022(12):129-135.

[17] Zhu Zhi-Ting, Hu Jiao. Digital Transformation of Education: A future-oriented educational "transgenic" project [J]. Open Education Research,2022,28(05):12-19.DOI:10.13966/j.cnki.kfjyyj.2022.05.002.

[18] Ghamrawi N, M Tamim R. A typology for digital leadership in higher education: the case of a large-scale mobile technology initiative (using tablets)[J]. Education and Information Technologies, 2023, 28(6): 7089-7110.

[19] Yang Xin, Gou Rui, Xie Yueyue. Principal Data Leadership: The key ability to implement the National Education Digitization strategy [J]. E-education in China,2023(05):65-73.