EXPLORING SYSTEMS THINKING IN SCHOOL PRINCIPALS’ EDUCATIONAL TECHNOLOGY LEADERSHIP IN YUNNAN PROVINCE, PRC

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Short Description: We review existing definitions of “educational technology leadership” in China and find definitions that respectively emphasize individual capability, the executive ability of leaders, or understanding of a technical process. Educational technology leadership is often studied separately from the complex environments in which it is embedded. We explore educational technology leadership of school principals in a single region of China as embedded within a wider system that includes the processes of mutual influence and interaction among various elements and requires system thinking by educational leaders.

Two key words: Leadership, system thinking

Under the guidance of national policies and economic demand, many universities and primary and secondary schools in China have accelerated their construction of digital campuses. Scholars have different definitions and names for educational technology leadership. Local Chinese scholars (i.e., those who study school environments) often call it "technological leadership" or "information(ization) leadership" (Lei et al., 2021), while international researchers often use terms such as "e-leadership", "ICT leadership" and "technological leadership".

Although educational technology leadership is a derived and sub-concept of leadership, it cannot simply be equated with overall leadership. It is a new type of leadership generated by integrating the content and attributes of information technology into modes and practices of traditional leadership. It is a two-dimensional fusion product of leaders’ information technology literacy and leadership ability (Zhao, 2017). Scholars have observed and understood this fusion product from the perspective of leadership process (Avolio et al., 2000; Northouse, 2010), constituent elements (Jablokow et al., 2010; Preston & Karahanna, 2009), or affiliation (Avolio et al., 2000; Zhao, 2017). Although the focus is slightly different, the leadership process is the outward manifestation of the elements of leadership, so these different perspectives also reside within a holistic system.

In 2010, China’s Outline of the National Medium- and Long-Term Educational Reform and Development Plan (2010-2020) explicitly proposed the construction of digital campuses. The Ten-Year Development Plan for Educational Informatization (2011-2020) issued by the Ministry of Education in 2012 clearly states that it will vigorously promote the construction of digital campuses in universities and vocational colleges and formulate basic standards for the
construction of digital campuses in primary and secondary schools. This plan includes the principal's “informatization leadership” in the annual evaluation of the principal's work performance. It is planned to improve the principal's informatization planning, management and execution capabilities. The 2018 *Education Informatization 2.0 Action Plan* promulgated by the Chinese Ministry of Education marked the shift of informatization policy orientation from construction and application to integration and innovation. This new policy is driven by three factors: China's promotion of education informatization 1.0, the modernization of education requirements for 2035, and the response to "Wisdom Education" (Yan & Yang, 2020, p.410). In 2019, the Central Committee of the Communist Party of China and the State Council issued the vision of *China's Education Modernization 2035*, which is to further accelerate the reform of education in the information age; to further coordinate the construction of an integrated intelligent teaching, management and service platform; and to advance a modern education management and monitoring system to promote “precise management and scientific decision-making”.

Because principals are at the heart of school reform and change, research on principals' educational technology leadership has gradually become a new research hotspot. When reviewing the existing definitions of technology leadership in China, we find that there are different emphases: Some scholars believe that its essence is a kind of personal ability, which is mainly reflected in the individual quality and behavior of the principal (Huang & Hu, 2012; Zhao, 2017; San, 2018). Others think of it as the executive power of the leader, which is reflected in the completion of the school's information technology construction tasks, implementation of the requirements, and realization of the intended goals (Wang et al., 2007; Sun, 2010). For other scholars, it is a process that reflects the leading role of school leaders in using information technology to change (i.e., improve) school education (Xie et al., 2009; Huo et al., 2008; Zhao & Shen, 2019). Although the foci of these views are different, they all fully affirm that the principal's informatization leadership plays a great role in promoting the construction of school education informatization. From the fusion of these perspectives, the competencies of the principal's educational technology leadership are summarized as follows: In the context of educational informatization, principals can rely on their own information technology literacy to lead the majority of teaching staff to continue to carry out school informatization vision planning, implement informatization resource management, and promote informatization evaluation work on the basis of the school's existing informatization construction.

The premise of the principal's educational technology leadership is the educational informatization situation, which can be viewed in a broad or narrow sense. For example, it can refer to the large social information environment, which can specifically involve various factors such as political development, economic conditions, cultural patterns, and technical conditions. The narrow informatization situation refers to the informatization development status of people's organizations and the informatization environment within the organization. The research and discussion on the influencing factors of principals' educational technology leadership include but are not limited to education policy (Xiao, 2008; Li & Fei, 2020; Lu, 2021), economic factors (Li & Li, 2017; Lu, 2021), demographics learning (Wang et al., 2020; Bian et al., 2016), technology integration (Zhao, 2017), campus culture (Xie, 2015), and teacher support (Pan & Chen, 2020). The influencing factors of principals' educational technology leadership are complex and diverse,
including macro factors, micro factors, subjective factors and objective factors. Our research needs a systematic perspective. This is where complex adaptive systems thinking can play a role.

As early as 2004, the China Educational Technology Association promulgated the "Standards of Educational Technology of China", which for the first time put forward five requirements for educational leaders in educational technology, translated verbatim here from Mandarin into American English:

1. Leaders and managers need to understand the national policies related to educational technology, formulate and implement the educational technology development vision for the school, and clarify the basic composition and operating environment of the relevant information technology system.

2. Education leaders need to make full use of educational technology to optimize the school education and teaching environment - including leading faculty and staff to use educational technology to improve work ability, tap potential, and cultivate innovative technical talents.

3. Educational leaders can use educational technology to support teaching and learning activities in schools - including formulating rules and regulations for the application of technology, promoting the rational application of educational technology in teaching, guiding teaching practice, and ensuring that students have access to high-quality digital learning resource.

4. Educational leaders can use educational technology to strengthen management and improve school management efficiency - including implementing relevant regulations, monitoring implementation to ensure the effective use of educational technology, using technology to communicate with students and teachers, and effectively improve school management.

5. Education leaders need to have information awareness and compliance with technology-related ethics, laws and regulations - including intellectual property and information resource laws and regulations.

From these five requirements, we can see that the construction of educational technology needs to reflect various educational concepts and specific requirements of the country and society in all aspects of school technology construction. There are not only development strategies and laws and regulations at the macro level, but also various entities involved in the practice of school technology at the micro level. Rupert et al. (2008) proposed that the internet is an unstructured, distributed and complex open network containing a large amount of multimedia data. This network is a source of great potential for acquiring knowledge and needs to be screened, organized and maintained for effective use. They argued that the network is similar to a complex adaptive system with self-organized adaptive behavior and proposed to use an adaptive multi-agent orientation to construct complex systems (Rupert et al., 2008). An educational technology system is an abstract expression of a social system. These entities are abstracted into nodes in the information system through the interaction of information among various entities and respective system components.

The concept of a system is fundamentally the grasp of one or more relationships (Jackson, 2019). System philosophy emphasizes that the relationships among elements is more important than the substantiality of the individual elements. Jiang and Yang (2022) searched the China National Knowledge Infrastructure (CNKI) database with the keyword "leadership"
and obtained a total of 1,181 journal articles from 2000 to 2020. They used Cite Space software to analyze the knowledge map and found that only commencing in 2020, did scholars researching schools began to study the connotation of "technological leadership." Most of the research before 2020 includes the construction of a technological leadership model, the internal mechanism of action, the impact on teachers' information application behavior, and research on training paths. Jiang and Yang (2022) argue that the disadvantage of current research is that its range is too narrow and not broad enough to form a necessarily complex multidisciplinary research system blending insights from history, anthropology, and political science.

Chinese scholars studying schools have discussed individually or statically the technological leadership capabilities that individuals or groups should possess (Lu, 2021; Wang, 2020; Yang et al., 2018). There are also some scholars who put the principal in the environment of school education development to summarize the interaction between the principal's technological leadership and school digitalization construction (e.g., Zhou et al., 2021; You, 2021; Lei et al., 2022).

We argue that complex adaptive system thinking may provide school leaders with a framework for understanding major system change and ways to engage, manage, and drive change. In complexity theory, according to Ramage and Shipp (2020), a complex adaptive system refers to a system that is composed of many interconnected parts, and at the same time, these parts can continuously self-organize and adapt to the wider environment. Within the field of organizational management, Jackson (2019) emphasizes that the problems faced by managers are usually chaotic. Because complexity theory promises to find order to our understanding of chaos, it has an irresistible charm. Complexity system thinking can be understood as a theory of change and adaptation that details how change occurs within a system and the principles and mindsets needed to thrive in turbulent environments (Morrison, 2010) – a description apropos for school environments.

In February 2014, the Department of Teachers' Work of the Ministry of Education issued the "Educational Information Leadership Standards for Principals of Primary and Secondary Schools". This seems to be a further refinement of the specific application of 2004 "Standards of Educational Technology of China" in primary and secondary schools. There are a total of six leadership requirements - leading development, collaborative innovation, improving information literacy, planning and design, organization and implementation, and evaluation and promotion. The differences from the 2004 standard are summarized as follows:

1. The 2014 standard proposes that as the organizer of the school informatization construction work, the principal should understand the complexity and systemic nature of this work.

2. Principals should actively cooperate with universities, research institutes and business units to obtain support from various aspects and introduce the development achievements of the school to the society based on the network platform.

3. Principals should organize personnel to formulate vision plans for informatization development as part of the overall development plan.
4. Principals should study and formulate learning plans for teachers' information technology application ability and formulate specific methods for the application of information technology in different disciplines.

5. Principals should rely on the networked virtual training community and learning community to carry out professional improvement learning activities to promote the professional growth of teachers.

6. Principals should regularly evaluate the development and construction of information technology for teachers, students and schools and formulate targeted rectification measures based on the results.

7. Principals should use information technology to manage school personnel and finance, network security, and asset logistics more efficiently.

According to these standards, Principals’ Educational Technology Leadership can be viewed as a series of Complex Adaptive Systems (CAS) of continuous interaction among principals and teachers, students, other departments of the school, and different departments outside the school. Each principal is not only a planner of innovative development and a promoter of system transformation, but also a leader of teaching reform and a modeler of active learning. In a CAS, individual agents interact with each other by acting according to their own rules and principles, adjusting their behavior to achieve their goals (Anderson et al., 1999). Behavior in schools is the result of the interaction of many factors, thus schools are CAS because it is “an emergent phenomenon that is not easily or fully predictable” (Keshavarz et al., 2010, p. 1472). A scoping review of journal articles on schools and CAS by Koh and Askell-Williams (2020) highlights that a key to school improvement is the need to recognize the complexity and adaptability of school systems.

Yunnan Province in China is slightly smaller in size than the US state of California. In 2018, the Yunnan Provincial Party Committee and the Provincial Government began to implement the "Ten Thousand Principals Training Program", organized by the Yunnan Provincial Department of Education and undertaken by Yunnan Normal University. It is planned to complete the training of 10,000 principals, vice principals and key teachers of primary and secondary schools in the province (covering kindergartens, primary schools, junior high schools, regular high schools, and vocational high schools) within five years (2018-2022). According to Kong & Wang (2021), the training plan is divided into ten phases, and 1,000 trainees are selected for each phase to carry out one-semester full-time intensive training. The prefectures and cities in Yunnan are allocated the number of trainees for the program according to the number of their teaching and administrative staff. Trainees are selected with the proportion of full-time principals accounting for 10%, vice-principals accounting for 70%, and key teachers responsible for school education and teaching management accounting for the remaining 20%.

So far, there are only two articles on the Chinese database CNKI analyzing this 10,000 school staff members training program (Kong et al., 2021; Kong & Wang, 2021). According to the survey report of Kong & Wang (2021), the current training mainly adopts listening to lectures (about educational ideas, teaching methods and management experience, etc.), and conducting class discussions in small groups of 50 people after reading two designated books every week.
The training content does not appear to be clearly relevant to actually improving the educational technology leadership of principals or their staffs.

It is not difficult to understand that Yunnan is a province that integrates mountainous areas, frontiers, ethnic groups and poverty. Due to the low level of social development, disconnectedness of local life from wider horizons and interactions, remote geographical environment, and other factors, its educational modernization has been at a low level for a long time. Duan and Gan (2015) point out that a considerable number of schools, education authorities and local governments in Yunnan regard education informatization construction projects as "face projects" to realize political achievements and cope with inspections by higher authorities. In addition, the application of educational technology has technical difficulties for some minority teachers due to too few operational opportunities and insufficient operational training (Duan & Gan, 2015; Ma & Yu, 2020). Kong et al. (2021) analyzed the current situation and characteristics of the implementation of the Yunnan principal training program through questionnaires, group interviews, and field classroom observations. They suggest establishing a talent training data platform to create a community where principals and experts can communicate, learn and grow online (Kong et al., 2021). Such a proposal would be difficult to implement given system inertia already present and its core feasibility and effectiveness would remain to be examined as compared to present arrangements. What is clear is that systems thinking can be better leveraged within the current system constraints in both big and small ways that make it more likely that efficacious training can be enacted, and ongoing professional development achieved.

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