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Mechanism Construction and Path Optimization of Big Data Empowering Family-School-Society Collaborative Education in Ideological and Political Education at Colleges and Universities

Liu Kaiyuan[1], Lv Yanjiao[2,*]
[1]*College of Journalism and Communications, Jiangxi Normal University, Nanchang, Jiangxi, China*
[2]*College of Marxism, Jiangxi Normal University, Nanchang, Jiangxi, China*

Abstract: The deep integration of big data technology provides the technical support and opportunities needed to reshape the collaborative education mechanism involving schools, families, and communities in ideological and political education at universities. Based on the intrinsic logic of how big data empowers collaborative education, this paper systematically analyzes the practical challenges currently faced by universities in advancing collaborative education among families, schools, and community, including data barriers, capacity gaps, and institutional shortcomings. Building on this foundation, the paper explores the development of a targeted, systematic, and routine approach to collaborative education from three dimensions—innovation in data governance, innovation in capacity building, and innovation in coordination mechanisms—with the aim of providing a theoretical basis and practical guidance for enhancing the overall effectiveness and quality of ideological and political education in higher education institutions in the new era.

Keywords: Big Data Empowerment; Ideological and Political Education in Higher Education; Family-School-Society Collaboration; Education Mechanism

1. Introduction

The Opinions on Strengthening and Improving Ideological and Political Work in the New Era stressed that the need to build a "comprehensive framework for jointly advancing ideological and political work" and explicitly call for the skillful use of new technologies to enhance the quality and efficiency of ideological and political work. Against this backdrop, how to leverage emerging technologies such as big data to drive the transformation of ideological and political education in higher education institutions from traditional models toward more targeted and collaborative approaches has become an urgent issue of our time that demands a response. Colleges and universities are the main venues for ideological and political education. However, ideological and political education cannot be accomplished by schools alone. Rather, it requires the concerted efforts and overlapping influences of families, schools, and society. Collaborative education among families, schools, and community involves clarifying the respective roles and functions of these three parties, leveraging their unique strengths to create a synergistic effect, generating a combined educational force, and achieving the best possible educational outcomes [1]. The roles of the three subsystems—school education, family education, and social education—are distinct; only when these three work in harmony and influence one another can the overall effectiveness of education be enhanced [2]. The rise of big data has provided a technological opportunity to break through the impasse in traditional collaboration among schools, families, and community: through the collection, integration, and analysis of data, it is possible to gain a comprehensive understanding of students' thought processes, thereby shifting collaborative education from "empirical judgment" to "data-driven" approaches, and from "fragmented communication" to "systematic coordination".

However, a closer look at current practices in home-school-community collaboration in ideological and political education in higher education institutions reveals that they still face multiple practical challenges. Under the traditional model, families, schools, and community often operate "in isolation" with long-standing issues such as poor communication, blurred lines of responsibility, and difficulties in sharing resources, making it difficult to build a cohesive force for education.

Although the introduction of big data has made collaboration technically possible, issues such as inconsistent data collection standards, the difficulty of breaking down information silos, varying levels of digital literacy among stakeholders, and the lack of a well-established collaboration mechanism have severely limited the full realization of the benefits of this technology. How to systematically address these challenges and explore effective pathways for leveraging big data to empower collaborative education among families, schools, and community has become a key issue in enhancing the effectiveness of ideological and political education in the new era.

2. The Theoretical Logic and Functional Mechanism of Big Data Empowering Family-School-Society Collaborative Education in Ideological and Political Education at Colleges and Universities

2.1 The Theoretical Foundations of Collaborative Education from the Perspective of Technology Empowerment

2.1.1 Synergetics

Synergy theory, founded by German physicist Hermann Haken, aims to reveal how a large number of subsystems in an open system, through nonlinear interactions and under the influence of order parameters, transition from disorder to order and generate a systemic synergy effect in which the whole is greater than the sum of its parts [3]. Synergy theory emphasizes that the key to a system's transition from disorder to order lies in the coordination among its subsystems. As big data empowers collaborative education among families, schools, and community in higher education's ideological and political education, these three entities—families, schools, and community—together form a complex educational system, and the theory of collaborative education provides the theoretical foundation for such collaboration from a technology-enabled perspective.

2.1.2 Systems theory

Systems theory was founded by L.Von.Bertalanffy, an Austrian-born American theoretical biologist. Bertalanffy defined a system as a collection of elements that interact with one another and are interconnected with their environment [4]. Systems theory provides the theoretical foundation for using big data technology to promote collaborative education among families, schools, and community. From a systems theory perspective, the collaborative education of students in higher education institutions—involving families, schools, and community—is a complex system in which families, schools, and community are all core elements. Big data provides technical support for this collaborative education, jointly driving the advancement of ideological and political education in higher education institutions.

2.2 The Core Mechanism of Big Data Reshaping the Landscape of Collaborative Education

2.2.1 From "flood irrigation" to "drip irrigation": Enhancing the effectiveness of education

Artificial intelligence-based multimodal analysis technology can empower the creation of precise profiles of learners, enabling a thorough understanding of their individual differences [5]. Ideological and political education in higher education institutions can leverage big data technology to collect, analyze, and monitor student behavior data, thereby creating "user profiles" of students. Schools, families, and community can use students' "user profiles" to gain a clear understanding of their ideological state and provide them with targeted, personalized ideological and political education. Based on students' "user profiles", big data technology can be used to precisely deliver personalized educational content—such as relevant books and micro-lectures—to students, thereby enabling personalized, targeted education. In the collaborative education process involving "home, school, and community" in the ideological and political education of college students, digital technology is driving the development of ideological and political education toward greater precision and intelligence [6]. This has greatly enhanced the effectiveness of ideological and political education, moving away from the traditional "one-size-fits-all" approach to ideological and political education in higher education institutions.

2.2.2 From "islands" to "interconnection": achieving synergy among stakeholders

In past efforts to promote ideological and political education in higher education institutions, the family, school, and society were often viewed as three separate entities, and the relationship among these three parties frequently

resembled a “siloed” situation. Parents are not fully aware of their children’s behavior and mindset at school; teachers are unaware of how students behave at home; and relevant social agencies do not know how to collaborate with schools and families in the educational process, making it impossible to effectively utilize the abundant social resources available. The use of big data technology can break down these “silos”. By leveraging big data technology, a collaborative platform can be established to synchronize students’ behavioral data from the three settings-home, school, and community-on the platform, enabling families, schools, and community to provide appropriate education based on students’ varying behaviors in each of these settings. At the same time, families, schools, and community can engage in real-time dialogue on the platform. For example, teachers responsible for specific areas at school can analyze students’ performance at school and guide families and relevant community organizations to work together in educating the students, thereby improving educational outcomes.

2.2.3 From "singularity" to "plurality": enriching the forms of education

The application of big data technology has transformed the traditional model of collaborative education among schools, families, and communities in ideological and political education at universities. From the perspective of the nature of education, families, schools, and society should work closely together and support one another to jointly form the educational foundation that promotes students’ well-rounded development [7]. In the past, ideological and political education in higher education institutions has involved limited interaction between schools, parents, and society, and such interactions were mostly one-sided. Through the use of big data technology, initiatives such as cloud-based classrooms and online meetings can be implemented to diversify collaboration methods and strengthen communication and exchange among these three parties. At the same time, diverse media platforms can be used to present knowledge from textbooks in ways that students find engaging and accessible. For example, schools can collaborate with revolutionary cultural venues in community to provide students with ideological and political education. These venues can utilize technologies such as AR and VR to bring revolutionary stories to life in a vivid and interactive way. This approach can significantly boost students’ enthusiasm for learning and enhance the effectiveness of education.

3. Realistic Dilemmas and Cause Analysis of Big Data Empowering Family-School-Society Collaborative Education in Ideological and Political Education at Colleges and Universities

3.1 Realistic Dilemmas of Big Data Empowering Family-School-Society Collaborative Education in Ideological and Political Education at Colleges and Universities

3.1.1 The data governance dimension: imbalance in collection and application coexisting with security risks

Imbalance between Data Collection and Application. In the process of using big data to empower ideological and political education in higher education institutions and to foster a collaborative approach to education involving schools, families, and community, there is a conflict between data collection and data application. First, there are no uniform standards among families, schools, and society regarding the collection and use of data, making it difficult to integrate the data for analysis and application, and hindering the effective sharing and utilization of information resources. Second, the collected data is one-sided. At home, parents’ collection of information about students is primarily based on subjective perceptions and lacks objectivity. At school, student information is mostly gathered through academic performance, classroom behavior, and student management platforms; data on students’ daily interactions with classmates is rarely collected.

Privacy and Security Risks. As big data empowers universities to advance ideological and political education through collaborative efforts among schools, families, and community, privacy and security issues must not be overlooked. When collecting student information, it is difficult for schools, families, and community to establish a unified baseline for privacy protection, and the collection of certain types of students’ private data poses a threat to their privacy. The database storing student information also lacks a “firewall” to protect the security of that information, making it easy for “hackers”, viruses, and other threats to infiltrate

the database and compromise student data. Furthermore, individuals in charge of student data within families, schools, and society may lack awareness of information privacy and security protection, thereby threatening students' privacy and security.

3.1.2 The stakeholder capability dimension: weak information literacy and insufficient technology application

Weak Information Literacy. In the process of leveraging big data to empower collaborative education among families, schools, and community, there is a problem of weak information literacy. At home, parents primarily focus on their children's academic performance and daily routines. Their approach to educating their children largely consists of verbal guidance and setting a good example, and they rarely collect, analyze, or share data on their children's thoughts and behaviors. Many parents also do not understand how to use data to educate their children and collaborate with schools and community in fostering their development. In schools, some ideological and political education professionals rely on traditional teaching methods, often educating students through classroom instruction and verbal lectures. They are reluctant to adopt big data technologies in their work and lack a full understanding of the value of big data in ideological and political education. In society, the work of most social workers involves providing students with explanations and demonstrations, but they lack an awareness of the need to collect and provide feedback on students' behavioral data.

Insufficient Technology Application. In efforts to leverage big data to facilitate collaborative education among families, schools, and community, technical training for relevant personnel in these sectors is rarely provided, resulting in a lack of proficiency in applying big data technologies. Many teachers, parents, and social workers do not know how to collaborate using data platforms. They find some complex data visualizations and metrics difficult to interpret and understand, and are unable to analyze or apply the data. Some platforms lack the capabilities to query and categorize data. This lack of technical capabilities makes it difficult to effectively utilize data, and the results of collaborative education are less than satisfactory.

3.1.3 The institutional mechanism dimension: ambiguous rights-responsibility boundaries and weak platform support

Ambiguous Rights-Responsibility Boundaries. There is no clear division of responsibilities among families, schools, and community. As specialized educational institutions, schools serve as key venues for instilling values in students [8]. In the process of collaborative education among families, schools, and community, schools, as professional educational institutions, should play a leading role. However, some schools believe they do not have the right to take the lead in family and societal matters and are reluctant to assume the corresponding responsibilities. As for families, parents view schools as the primary providers of formal education for students and are hesitant to take the lead. On the societal front, most relevant social organizations view themselves merely as "supporting players". This has led to a reluctance on the part of all three parties to take the lead, resulting in a "fragmented" state within the education sector. Even when big data technology is used to promote collaboration among families, schools, and community in the area of ideological and political education in higher education institutions, there remains a lack of a clearly designated entity to lead information collection efforts, establish unified standards for data collection and application, or organize training on the relevant technologies.

Lack of Collaborative Platforms and Normalized Management Mechanisms. The "home-school-community" collaborative education support mechanism needs to be further improved, it currently lacks specific, actionable methods and measures that can be directly implemented and promptly replicated and scaled up [9]. The implementation of collaborative education among families, schools, and community requires a comprehensive platform for information collection, data analysis, communication, and resource sharing. However, many colleges and universities have not yet established such platforms, communication between schools and families still relies on traditional methods such as phone messages and in-person meetings, and school-industry collaboration still depends on paper agreements and in-person events, making it difficult to share information promptly and effectively among schools, families, and community. Some universities have already established comprehensive platforms for this purpose, but their operation and functionality are not yet fully

optimized, and there is significant room for improvement in terms of user experience and smooth operation. At the same time, collaborative education lacks a regular management mechanism; some collaborative efforts are undertaken merely to satisfy inspection requirements, and collaborative activities and information updates are not conducted on a regular basis.

3.2 Cause Analysis of the Dilemmas in Technology-Empowered Collaborative Education

3.2.1 Cause analysis of the data governance dilemma

As big data technology enables collaborative education, the nature of the data itself presents unique challenges, making its governance relatively complex. One shortcoming of data governance technologies is that the use of technology to drive educational development is still in its early stages, and technologies for data collection, storage, and application designed specifically for the education sector have not yet fully matured. There is a lack of unified data standards for data collection and application. In the process of using technology to facilitate collaborative education, the three parties-families, schools, and community-lack unified standards for data collection and application. Instead, they each use their own data standards, storage formats, and application methods, making it difficult to effectively integrate data across these three parties. Another aspect of the inadequacy of data governance technologies is the lag in privacy protection technologies. Most universities lack sufficiently advanced privacy protection technologies in their efforts to use technology to enhance education, and basic security measures such as safety protections are inadequate. Security technologies and protective capabilities in the home and society are even more lacking, which leads to significant security risks.

3.2.2 Cause analysis of the stakeholder capability dilemma

Weak information literacy and a lack of technical skills are primarily attributable to an inadequate training system and misguided evaluation criteria. First, in the practice of using data to empower collaborative education among families, schools, and community, a comprehensive training system has not been established. Training programs for college and university educators in ideological and political education rarely include instruction on technical literacy; moreover, much of the technical training offered to teachers is merely perfunctory and lacks practical application and continuity. For parents and social workers, technical training is extremely scarce-or even nonexistent-which leads to a situation where families and social services are unable to use certain collaboration platforms and are reluctant to do so when working together. Second, there is a bias in the evaluation criteria. In the performance evaluations of ideological and political education professionals, teachers' information literacy and technological proficiency are rarely included in the evaluation criteria. There is also a lack of corresponding evaluation mechanisms in the family and social spheres to encourage active participation in collaborative efforts.

3.2.3 Cause analysis of the institutional mechanism dilemma

The blurring of the boundaries between rights and responsibilities and the lack of robust platform support stem primarily from the absence of top-level design and the lack of well-developed institutional mechanisms. First, the lack of top-level design has led to a lack of clear guidelines regarding the rights, obligations, and boundaries of authority and responsibility among families, schools, and community in the process of collaborative education. This has resulted in blurred boundaries of authority and responsibility, making it difficult for all parties to carry out their collaborative work in an effective, orderly, and standardized manner. Second, imperfect mechanisms and systems have led to a situation where families, schools, and community operate independently of one another. The process of collaborative education in higher education institutions suffers from both an absence of effective communication linkages between ideological and political educators and the family and society, and a notable spatial fragmentation among the three parties-family, school, and community [10]. Schools, families, and society operate within different systems; they lack the institutional foundation for a collaborative platform for joint development and shared benefits, and have not established a routine management mechanism.

4. Path Innovation and Practical Strategies for Big Data Empowering

Family-School-Society Collaborative Education in Ideological and Political Education at Colleges and Universities

4.1 Data Governance Innovation: Building a Unified, Standardized, Secure, and Controllable Data Ecosystem

4.1.1 Establishing unified data standards

Schools, families, and community should establish uniform data standards and use a unified standard system for data collection, storage, and application. The scope, type, and format of data collection must be clearly defined. The scope of data collection should be comprehensive without infringing on students' privacy and security. When collecting data, there must be clear guidelines specifying which data should be collected by schools, which by families, and which by external organizations. Collected data should be stored in a standardized format and analyzed using uniform criteria. This will facilitate resource sharing and collaboration among families, schools, and community, thereby enhancing the effectiveness of collaborative education.

4.1.2 Strengthening data security protection

Efforts to strengthen data security measures must be intensified. First, schools should take the lead in establishing a comprehensive management system that covers the entire data lifecycle, clearly defining data access permissions and responsible parties, and standardizing data processing procedures to ensure that all data from schools, families, and community is effectively protected. Second, we must strengthen data literacy training for personnel responsible for managing student data in schools, families, and community, ensuring they understand that students' information rights and privacy are inviolable, and enhancing their awareness and capabilities regarding data security and protection. Finally, technical safeguards must be consolidated. We will establish a data protection system centered on a security monitoring platform and a dynamic early-warning mechanism. By employing multiple technical measures-such as data encryption, access control, and firewalls-we will enhance the system's ability to withstand attacks and prevent data leaks, thereby fortifying the technical defenses for data security.

4.2 Capacity Building Innovation: Enhancing the Digital Literacy and Application Skills of Diverse Stakeholders

4.2.1 Strengthening information literacy training for personnel across families, schools, and society

Information literacy training for relevant personnel needs to be strengthened. First, theoretical training must be strengthened to help relevant personnel from schools, families, and community gain a deeper understanding of the cutting-edge concepts and educational logic of ideological and political education in the era of big data, enhance their data literacy and information ethics, and lay a solid ideological foundation for "education through data". Second, efforts to establish a routine training system need to be strengthened. By regularly organizing activities such as lectures, assessments, and exchange sessions that integrate data literacy with ideological and political education, and through institutional safeguards, the cultivation of information literacy should be carried out as a routine task. Finally, an online training platform should be established—a dedicated information literacy training platform. Teacher information competence can be understood as the composite ability of teachers to acquire, process, apply, and innovate with new educational technologies and information within the digital education ecosystem [11]. At the same time, efforts should be made to ensure that parents and community workers can more conveniently receive training on information literacy and accordingly improve their information literacy capabilities.

4.2.2 Strengthening technical training for personnel across families, schools, and society

Strengthening practical information technology training for relevant personnel and enhancing the technical capabilities of teachers, parents, and social workers in data collection, analysis, and application is a key measure to enable them to proficiently use big data tools to carry out collaborative education efforts in targeted and intelligent ideological and political education. First, the training content can include case studies, hands-on demonstrations, and expert lectures. Second, tiered and categorized training resources should be developed and tailored to the specific needs of teachers, parents, and social workers, thereby enhancing the personalization and precision of the training. Finally, a training platform that integrates online and offline components should be established to maximize overall training effectiveness.

4.3 Collaborative Mechanism Innovation: Refining a Clear-Cut and Well-Ordered Institutional Framework with Defined Rights and Responsibilities

4.3.1 Clarifying rights-responsibility mechanisms

Clear delineation of responsibilities is a prerequisite for collaboration among families, schools, and community. Universities should clearly define their leading role, coordinate the planning of campus-wide collaborative education efforts involving families, schools, and community, establish relevant rules and regulations, form dedicated working groups to coordinate major matters, and conduct timely evaluations of the results achieved. Families and society should work in tandem with the school's guidance, fulfill their obligation to provide feedback on student data, and protect students' privacy. With regard to information and data, the three parties-schools, families, and community-must clearly define their respective rights and responsibilities regarding data collection and use. Regarding responsibilities for data collection, the school is responsible for providing data on students' performance at school; parents are responsible for providing data on students' behavior at home; and community partners are responsible for providing data on students' performance during community service activities. Each of the three parties fulfills its respective duties, with clear delineation of responsibilities. With regard to the rights and responsibilities related to data use, schools, families, and society must protect students' private data. Schools should take the lead, with families and society cooperating to ensure that each party is responsible for the data under its management, thereby safeguarding the privacy and security of students' information.

4.3.2 Establishing a coordinated and synergistic education platform

In the traditional process of collaborative education among families, schools, and society, issues such as poor communication and the absence of platforms for exchange have long hindered effective collaboration [12]. It is therefore imperative to build an integrated, digital, and collaborative education platform to foster a collaborative framework that integrates online and offline efforts and involves multiple stakeholders. First, an on-campus system should be established. This system should be led by universities, integrating various departments such as the Student Affairs Office, the Academic Affairs Office, and the Communist Youth League Committee, and ensuring effective coordination with families and social organizations to create a comprehensive, integrated, and all-encompassing platform architecture. Second, resources from all parties should be effectively integrated. By pooling various resources from schools, families, and community-such as resources for revolutionary history education, family education, and social practice-the platform facilitates the joint development and sharing of these resources, eliminates data silos, enriches the supply of resources for collaborative education among families, schools, and community, and provides data support for this collaborative effort. Finally, the platform for the operational support mechanism must be fully developed, with clear definitions of the platform's managing entity, access permissions, and security policies, to establish a standardized and institutionalized operational model that ensures the platform's routine management and sustainable operation.

5. Conclusion

The advent of the big data era has brought unprecedented opportunities for the collaborative education of students in ideological and political education among universities, families, and communities, while also creating an urgent need for profound transformation in this area. Centered on the core theme of "Mechanism Construction and Path Optimization of Big Data Empowering Family-School-Society Collaborative Education in Ideological and Political Education at Colleges and Universities", this paper systematically elaborates on its underlying mechanisms and identifies the practical challenges facing collaborative education among families, schools, and communities in higher education's ideological and political education in the era of big data. These challenges include three major categories: data-related challenges, capacity-related challenges, and mechanism-related challenges, it also explored innovative approaches to collaborative education from three key dimensions: innovation in data governance, innovation in capacity building, and innovation in collaborative mechanisms. It should be recognized that leveraging big data to empower the collaborative education mechanism among schools, families, and communities in

higher education institutions' ideological and political education is an ongoing, evolving systemic endeavor that cannot be achieved overnight. There is an urgent need to pool the collective efforts of multiple stakeholders through theoretical deepening and practical exploration, continuously iterate the mechanism, and optimize the approach, so as to steer the collaborative education among schools, families, and communities in ideological and political education in the new era toward a more precise, scientific, and efficient path of development.

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