

Digital-enabled Optimization of Ideological and Political Education-oriented Student Management: A study on the Collaborative Mechanism of Mental Health Monitoring and Ideological Literacy Cultivation

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ABSTRACT In the context of the deep integration of digital transformation and ideological and political education, university student management faces the dual challenge of increasingly complex mental health risks and insufficient precision in ideological literacy cultivation. This study constructs a collaborative mechanism for mental health monitoring and ideological literacy development under ideological and political guidance by using multi-source data fusion and intelligent analysis. Data from academic performance, consumption behavior, social interaction, psychological assessment, and campus activity systems are integrated to build dynamic student profiles. On this basis, a mental health risk identification model and an ideological literacy development assessment model are developed to realize realtime perception, risk warning, and precise intervention for students' mental states and educational needs. The study shows that the digital empowerment mechanism significantly improves the accuracy and timeliness of mental health crisis identification and supports the differentiated matching of ideological and political education resources. The proposed mechanism promotes the transformation of student management from experience-driven response to datasupported collaborative governance.

INDEX TERMS digital empowerment, student management, mental health monitoring, ideological literacy, data fusion

I. INTRODUCTION

IN the new era, the paramount mission of student management in higher education institutions is to implement the fundamental task of cultivating virtue and fostering talent, ensuring that future professionals integrate high moral standards with the technical mastery required for innovative engineering and advanced material science. This holistic development prepares students to uphold social responsibility while driving the digital transformation of smart weaving and sustainable fiber production. Mental health and ideological literacy, as two pillars of all-round development of students, have become significant themes in ideological and political work because of their synchronized development. In recent years, the complexity of student mental health issues and their high incidence have caught the broad concern of social society. Academic stress,

conflict with people, and work stress have contributed to mental health crises occurring frequently. Meanwhile, the development of ideological literacy, as an integral part of ideological and political education, faces the dilemma of getting rid of "broad-based" to "precision-based", and to achieve deep integration with mental health work, which is a practical problem that requires urgent resolution. The rapid development of digital technology has opened up the new possibility of solving above problems. The deep application of technologies in the field of education (big data, artificial intelligence, Internet of Things) made it possible to implement a full perception of student behavior, dynamic monitoring of psychological states, and accurate identification of ideological needs. Many universities all over the nation have started to follow the innovative ideology of digitally empowered precision ideological and political education.

By combining the data of different departments such as academic affairs, student affairs, logistics and psychology, they have developed a comprehensive platform of student affairs management, a full cycle data collection system in the dimensions of academic, consumption, social and psychological. This provides the technological basis for the synergy of the development of monitoring of mental health with ideological literacy. This study aims to respond to the practical needs of university student management in the new era, utilizing digital empowerment as a framework to optimize management paths that align ideological and political education with the precision and craftsmanship inherent in modern production. By integrating these digital strategies, the research seeks to cultivate a specialized workforce capable of navigating the technical complexities of smart weaving and high-performance fiber research with a strong sense of social ethics. The main contributions of this paper are: First, at the theoretical level, it breaks through the limitation of existing research that often separates mental health monitoring from ideological literacy cultivation, attempting to construct a collaborative mechanism framework that deeply integrates the two, revealing their interaction principles in the student management field, and providing a new theoretical perspective for innovation in ideological and political work and student management in the new era. Second, at the technical level, it proposes a method for constructing a panoramic student profile based on multi-source data fusion, a mental health risk identification model, and an assessment and personalized resource matching mechanism for ideological literacy development, providing an operable technical path for the transformation from “experience-driven” student management to “data-driven” precision governance. Third, at the practical level, through practical application verification in a university, it demonstrates the significant effectiveness of the digital collaborative mechanism in improving the timeliness of psychological crisis early warning, enhancing the accuracy of ideological literacy cultivation, and forming a synergy in education, providing a referable evidence-based basis and practical paradigm for similar universities.

II. RELATED WORK

Student mental health problems are highly complex and have multiple causes. Cohen et al. [1] assessed the impact of brief school interventions for K-12 students on mental health or well-being. Zając et al. [2] analyzed Australian administrative data and tracked the mental health status and academic trajectory of university students. Kodish et al. [3] showed that a screening and treatment model based on cultural sensitivity and equity can effectively identify and serve minority students with mental health needs, thereby narrowing the gap in the use and outcomes of mental health services among different groups. Frazier et al. [4] assessed the unique impact of the pandemic itself on mental health symptoms and observed its changing trends over time. Stubin et al. [5] confirmed that specially designed

mental resilience projects can effectively improve the mental resilience level of nursing students, thereby promoting their mental health.

Roche et al. [6] investigated the psychological symptoms of college students at different stages during the pandemic and analyzed the trajectory of these symptoms. Kaskoun and McCabe [7] reviewed existing qualitative, quantitative and mixed-method studies on the cognition of school nurses in dealing with students' mental health problems. Kivelä et al. [8] compared the mental health status of international students and local students during the COVID-19 pandemic. Eley and Slavin [9] analyzed various factors that lead to the persistence of mental health problems among medical students and explored potential solutions. Fenton et al. [10] explored the relationship between the proposed anti-LGBTQ+ legislation and the mental health status of LGBTQ+ college students. Although the above studies revealed the multidimensional influencing factors of students' mental health, they did not systematically integrate the perspective of mental health monitoring and ideological literacy cultivation, especially failing to explore the interaction and long-term collaborative mechanism between the two in the field of student management. This study takes digital empowerment as the starting point to explore feasible paths for optimizing student management under the guidance of ideological and political education, and provides evidence-based support and practical approaches for building a collaborative education system that integrates mental health monitoring and ideological literacy cultivation.

III. METHODS

A. MULTI-SOURCE DATA FUSION AND CONSTRUCTION OF A PANORAMIC STUDENT PROFILE

This study uses multi-source heterogeneous data fusion technology to construct a dynamic data collection system covering the entire scenario of student growth. The data sources cover five major categories and 47 data dimensions, including the academic affairs management system (academic performance, course selection, attendance records), student affairs system (award and punishment records, financial aid information, party and league activities), logistics system (one-card consumption, dormitory access control, library borrowing), network behavior system (campus network login, resource access, social interaction) and mental health system (psychological testing, counseling records, crisis intervention) [11].

Data acquisition follows the principle of “one source, one file; one data point, one chain,” achieving automatic data acquisition and real-time synchronization through the deployment of multi-source heterogeneous data acquisition nodes. For heterogeneous data formats from different business systems, time-series feature extraction and categorical variable coding methods are used for standardization, establishing a unified data resource pool. In the data cleaning process, this study constructed a cleaning framework based on a combination of statistical rules and business logic to

clearly define the processing standards for “missing values” and “outliers.” For missing values, a threshold judgment based on business meaning was adopted (a field with a missing rate exceeding 30% was removed) combined with multiple imputation methods for filling. For outliers, the 3σ principle and interquartile range method were used for identification, combined with manual verification to ensure that outliers originated from genuine abnormal behavior rather than data collection errors. Taking a university as an example, a total of 142 data tables and more than 1,700 fields were collected, with a total of 38.96 million records processed, constructing a full-cycle data foundation covering all undergraduate and graduate students.

To ensure data authenticity and ethical compliance, multiple measures were implemented during data collection. First, all data collection was based on students’ informed consent. Upon enrollment, students signed electronic informed consent forms clarifying the scope, purpose, and protective measures of data collection, and students were allowed to withdraw their consent at any time. Second, adhering to the “minimum necessity principle,” highly sensitive data such as consumption and social interactions were collected only for aggregated features necessary for risk identification (e.g., consumption frequency, daily routine patterns), rather than recording specific consumption content and social contacts. Differential privacy technology was used to perturb the raw data, reducing the risk of reverse data tracing from the source. Finally, in the system’s early warning process, monitoring was not the sole assessment method, but rather a “clue” to trigger human intervention. Ultimately, intervention and evaluation relied on face-to-face communication with counselors and school counselors. This design aims to send a clear signal to students: data is a tool to support care, not a basis for judgment or punishment, thereby minimizing the possibility of data distortion due to excessive self-censorship.

In terms of constructing a panoramic profile of students, the weight coefficients of each data dimension are determined by combining expert survey method and hierarchical analysis method. The academic dimension includes indicators such as GPA trend, course pass rate, and number of academic warnings; the life dimension covers indicators such as consumption level, daily routine, and frequency of dining in the canteen; the social dimension involves indicators such as dormitory access control relationship, frequency of sitting together in the library, and participation in clubs; the psychological dimension includes indicators such as psychological test scores, number of consultations, and crisis intervention records. By dynamically weighting the above indicators, a “five-aspect development radar chart” of individual students and a distribution map of group characteristics are generated to realize a three-dimensional presentation of the development status of students [12]. This framework aims to dynamically present the stage-specific characteristics of student development, rather than a pre-set linear growth model. During specific stages of intense

academic focus, students’ social activity may naturally decline; this is a normal developmental fluctuation and should not be mechanically interpreted as a “mental health risk.” Therefore, when applying this profile for risk identification, it will be dynamically interpreted in conjunction with the student’s developmental context (such as semester stage or critical exam period) to distinguish between normal developmental fluctuations and potential mental health issues.

B. CONSTRUCTION OF A MENTAL HEALTH RISK IDENTIFICATION MODEL

Based on student profile data, this study constructed a mental health risk identification model. The model construction employed a combination of supervised and unsupervised learning methods, using student psychological data from the past seven years as the training set, covering four levels of psychological state labels: normal, mild, moderate, and severe. In the feature engineering phase, 20 risk indicators, including a sharp drop in academic performance, social isolation, abnormal spending, and disrupted sleep patterns, were extracted from the raw data, and correlation analysis and principal component analysis were performed on these indicators.

The mental health status monitoring model adopts the gradient boosting tree algorithm, which realizes the quantitative assessment of the probability of psychological risk through deep learning of the abnormal behavior characteristics of students. The model output includes two dimensions: risk probability value (0-100%) and risk level (low risk, medium risk, high risk) [13,14].

To enhance the identification of hidden psychological risks, this study introduces an innovative assessment method that combines traditional questionnaires with dynamic interactive assessment. A self-developed “AI assistant” model, through multi-round dialogue interaction, seamlessly collects students’ vocal characteristics, facial expressions, and semantic expressions. During the dialogue, the system collects multimodal data in real time: the front end uses WebRTC technology to capture the student’s speech stream and uses the OpenSMILE toolkit to extract acoustic features such as Mel-frequency cepstral coefficients (MFCC) and fundamental frequency to analyze emotional fluctuations in the speech; at the same time, it uses the OpenFace open-source tool to analyze the student’s facial expressions in real time, capturing micro-expression changes (such as happiness, sadness, anger, surprise) and head posture; in addition, for the student’s text responses, the system uses a pre-trained language model based on BERT (a bidirectional encoder representation from Transformer) for semantic analysis and sentiment judgment. Combined with biosignal data (such as heart rate variability in VR scenarios), it achieves a quantitative assessment of students’ psychological state. Compared with traditional scale assessments, this method improves the efficiency of identifying psychological problems in freshman screening by nearly 40%, effectively preventing students from intentionally concealing their true

psychological state.

C. ASSESSMENT AND RESOURCE MATCHING MECHANISM FOR THE DEVELOPMENT OF IDEOLOGICAL LITERACY

The assessment system for the development of ideological and political literacy is constructed based on a three-dimensional framework of “moral cultivation, practical training, and value recognition.” The moral cultivation dimension includes indicators such as grades in ideological and political courses, participation in Party and Youth League activities, and hours of volunteer service; the practical training dimension covers indicators such as social practice, scientific and technological innovation competitions, and positions held in student organizations; and the value recognition dimension is comprehensively evaluated by analyzing data such as students’ access to ideological and political education resources, the depth of their interaction, and the content of their feedback.

Table 1 presents the evaluation index system for the development of students’ ideological literacy and its weight allocation. The system was determined through expert consultation and hierarchical analysis, and consists of 3 primary indicators, 9 secondary indicators and 22 observation points, covering the core dimensions of ideological literacy cultivation. The data collection cycle for each observation point is updated monthly, forming a dynamic trajectory of students’ ideological literacy development [15].

Based on the assessment results of ideological and political literacy development, a personalized resource matching mechanism is constructed. First, a knowledge base of ideological and political education resources is established, covering categories such as theoretical learning materials, information on practical activities, and stories of exemplary cases, with each resource tagged. Second, a combination of collaborative filtering and content recommendation is used to intelligently match suitable ideological and political education resources according to students’ ideological and political literacy development level, interests, and behavioral characteristics. For example, for students with high theoretical acceptance but insufficient practical participation, information on volunteer service and social practice projects is prioritized; for students who are active in practice but weak in theoretical learning, high-quality ideological and political courses and theoretical guidance materials are recommended.

This study delves deeper into the underlying logic of resource matching mechanisms. Specifically, the risk levels and characteristics output by the mental health risk identification model (based on a gradient boosting tree) are not directly mapped to educational resources, but rather first enter a “collaborative intervention decision tree.” This decision tree is designed according to the goals of ideological and political education, categorizing student states into “psychologically driven risks” and “ideologically driven risks.” For example, when the model identifies behavioral

characteristics such as “social isolation” and “abnormal consumption,” the decision tree classifies it as a “psychologically driven risk,” and the system prioritizes matching mental health education resources such as psychological counseling appointments, group counseling information, and psychological resilience courses. Conversely, when the model identifies students with “low theoretical test scores” and “negative value expression” but no significant psychological risk characteristics, the decision tree classifies it as an “ideologically driven risk,” and the system prioritizes pushing resources for cultivating ideological literacy, such as role model case stories, positive psychology ideological and political microcourses, and theoretical learning materials. For students exhibiting both characteristics, the system initiates a collaborative intervention strategy, simultaneously pushing both types of resources and generating tasks to be assigned to counselors and psychology teachers for joint assessment. This mechanism ensures that algorithm recommendations are not only based on data relevance, but also incorporate value judgments and intervention logic of ideological and political education.

IV. RESULTS AND DISCUSSION

A. ANALYSIS OF THE EFFECTIVENESS OF MENTAL HEALTH MONITORING AND EARLY WARNING

Based on the constructed mental health risk identification model, the research team has made an application verification in a university for 1 academic year. The system uses data on student behavior, and it analyzes this data in real time to set 20 risk indicators, including a sharp decline in academic performance, social isolation and irregular spending. When a student’s indicator goes over a threshold or the overall risk probability goes over a preset warning line an early warning message is automatically generated and sent to counselors, mental health teachers, and workers in the community grid.

Table 2 presents the verification results of the system’s early warning accuracy.

Analysis of the timeliness of the early warning indicates the timeliness of the early warning system to identify psychological risks is about 23.6 days ahead of traditional detection methods on average. Taking a sophomore student as an example, the system gave an early warning on when the student displayed abnormal behavior for two subsequent weeks, such as a drastic decrease in spending frequency, a high amount of time in the library, and late return to the dormitory. This early warning triggered a collaborative intervention mechanism involving counselors, mental health teachers, and other stakeholders. Through timely intervention and in-depth conversations, the counselor discovered that the student was experiencing severe anxiety due to a sudden family crisis but had not actively sought help. With professional intervention from the mental health center, the student’s emotional state gradually stabilized, thus preventing the psychological crisis from escalating. This case fully

TABLE 1. Evaluation Index System for Students' Ideological and Moral Development

Primary indicators	Secondary indicators	Observation point	Weight (%)	Data source
Moral cultivation	Course Learning	Ideological and political course grades	4	Academic Affairs System
Moral cultivation	Course Learning	Course interaction and participation	5	Classroom behavior data
Moral cultivation	Organizational life	Number of times participating in Party and Youth League activities	6	Student Affairs System
Moral cultivation	Organizational life	Organizational appointment status	4	Student Affairs System
Moral cultivation	Value recognition	Theoretical article readership	5	Network behavior
Moral cultivation	Value recognition	Quality rating of ideological reports	7	Counselor Evaluation
Practice and tempering	Volunteer service	Service Hours	8	Second Classroom
Practice and tempering	Volunteer service	Service Item Level	5	Second Classroom
Practice and tempering	Science and Technology Innovation Competition	Competition Participation Level	7	Academic Affairs System
Practice and tempering	Science and Technology Innovation Competition	Award level	6	Academic Affairs System
Practice and tempering	Social Practice	Practical Project Results	6	Student Affairs System
Practice and tempering	Social Practice	Social evaluation feedback	8	Practice Unit
Value recognition	Theoretical agreement	Theoretical learning time	5	Network behavior
Value recognition	Theoretical agreement	Theoretical test scores	6	Ideological and political platform
Value recognition	Emotional identification	In-depth interaction with educational content	4	Behavioral Analysis
Value recognition	Emotional identification	Positive dimension of value expression	4	Text Analysis
Value recognition	Behavioral identification	Role model	5	Peer evaluation
Value recognition	Behavioral identification	Value practice performance	5	Comprehensive assessment

TABLE 2. Validation Results of the Mental Health Early Warning System

Indicator Categories	numerical values	Remark
The system monitors the total number of students.	23,568 people	Covering all undergraduate and graduate students
The system issued a warning about the number of students.	847 people	The overall risk probability exceeds the warning line.
Matching numbers with offline screening	595 people	Match rate 80.2%
Number of newly added students under warning	252 people	No cases were found during the offline investigation.
Number of newly confirmed issues	57 cases	Confirmed through professional interviews
Early warning accuracy	91.3%	Intervention verification confirmed
Average warning lead time	23.6 days	Earlier than traditional discovery methods

demonstrates the crucial role of digital monitoring systems in the transition from

“passive early warning” to “proactive early warning,” while also highlighting the “sentinel” function of the early warning system, whose ultimate value depends on professional and timely human intervention.

B. EVALUATION OF THE EFFECTIVENESS OF RESOURCE MATCHING IN CULTIVATING IDEOLOGICAL AND MORAL QUALITIES

After the personalized ideological literacy resource matching mechanism was adopted, the research team carried out a follow-up evaluation system of its application effect. The evaluation was a pre-/post-test comparative design where the accuracy of resource delivery, student participation and literacy improvement effect were the main indicators.

Table 3 shows data of comparative before and after the application of resource matching mechanism. As for the accuracy of the recommendation of resources, after the introduction of intelligent recommendation algorithm, the accuracy rate of matching ideological and political education resources with the needs of students was increased from the traditional rate of 41.5% to 78.3%. This improvement can be attributed primarily to intense analysis of behavioral characteristics of all students. For instance, the system can precisely detect the theoretical interests of students depending on their reading time, number of repeated visits and note taking behavior for theoretical articles and make recommendations to find similar quality resources. The average study time for students also increased from 2.8 hours per month to 5.6 hours, which shows that the resource

matching mechanism can effectively stimulate students' learning initiative.

In terms of the effectiveness of improving the quality of students overall, the average mark on the test of knowledge on the theoretical part increased from 72.6 to 81.3, which is an increase of 8.7 points. The practical participation rate increased from 38.2% to 59.7%, and this was 21.5 percentage points greater. The comprehensive index of the ideological quality (calculated according to a weighing average of the evaluation index system) grew from 63.4% to 76.8%, i.e. increase of 13.4 per cent. Particularly worthy of notice is that the resource matching mechanism also played a positive role in cultivating the ideological quality of the students

in the mental health monitoring and early warning group. Follow-up analysis of students under psychological risk revealed that after being provided with personalized ideological and political education resources, students under psychological risk had experienced significant improvement of their perceived social support and scores of positive psychological qualities, preliminarily verifying the synergistic effect of mental health support for psychological quality cultivation and ideological qualities.

C. ANALYSIS OF THE COLLABORATIVE MECHANISM OPERATION AND ITS EDUCATIONAL EFFECTIVENESS

The key to the collaborative mechanism of mental health monitoring and ideological literacy cultivation is an integrated governance mechanism of “data sharing, joint risk assessment, and collaborative action.” The research team created a collaborative educational platform that integrates and analyses information on mental health early warn-

TABLE 3. Evaluation of the effectiveness of resource matching in cultivating ideological literacy

Evaluation indicators	Before application	After application	Increase
Resource active click-through rate (%)	32.7	67.4	+34.7
Average study time (hours/month)	2.8	5.6	+100.0%
Theoretical agreement test score (points)	72.6	81.3	+8.7
Participation rate in practical activities (%)	38.2	59.7	+21.5
Comprehensive Index of Ideological Literacy (%)	63.4	76.8	+13.4

ing, and ideological literacy development data to produce comprehensive student development reports, which offer decision support for the accurate implementation of policies.

Three typical characteristics of the mechanism of collaboration are the following. First, the intelligent linkage of early warning information and resource supply. When the system determines that a student has psychological risks, in addition to sending early warning information to administrators, the system carries out the functions of personalized support plans and resources and is combined to provide resources for mental health education (including psychological counseling appointments, group counseling information, psychological resilience courses, psychological resilience courses), resources for cultivating ideological qualities (including role model case stories, positive psychology ideological and political micro-courses) have also been pushed, so as to achieve a simultaneous effect of “psychological protection” and “ideological shaping.”

Secondly, multi-dimensional fusion of data enables the iterative process of accurate profiling. The collaborative mechanism is used to cross-analyze the data of psychological assessments, behavior monitoring and ideological literacy assessments to build a fusion profile of “psychological and ideological” characteristics of students. For example, for students with anxiety caused by academic pressure, the fusion profile by not only showing their psychological level of risk, is able to show their deficit in ideological literacy development (resilience for example, and the strength of their goals and beliefs) and to give precise suggestions for targeted intervention.

Third, the involvement of many stakeholders creates a united educational force. The cooperative platform, as a form of data interface for different stakeholders, such as counselors, teachers of psychology, ideology and politics, and workers of the community grid, set different data permissions and functional modules based on the role of the individual. When a warning event occurs, the platform automatically generates task allocation suggestions: counselors have the responsibility to counsel and provide daily monitoring, psychology teachers have the responsibility to provide professional assessments and intervention plans, ideological and political education teachers have the responsibility to incorporate relevant educational content in their courses, and community grid workers have the responsibility to strengthen observation and support at the dormitory level. In the 2024-2025 academic year, according to the collaborative mechanism, a total of 89 cases of psychological crisis intervention were jointly carried out, and the objective of

“zero escalation” of the crisis events is achieved.

V. CONCLUSION

This study utilizes digital empowerment to discuss feasible paths for optimizing student management under the guidance of ideological and political education, constructing a collaborative mechanism that monitors mental health and ideological literacy while aligning with the high-precision standards of intelligent manufacturing. By integrating these digital processes, the research ensures that student development remains synchronized with the technical rigor and innovative spirit required for advanced fiber science and modern weaving technologies. Through multi-source data fusion and the construction of a comprehensive student profile, the construction of a warning model for mental health risks, the construction of an ideological literacy development assessment and resources matching mechanism, a collaborative educational closed loop covering the entire process of “data collection-risk warning-resource supply-effect evaluation” is formed. The main contributions of this study include:

- 1) First, the limitation of the previous studies, that is, the separation of the monitoring mechanisms of mental health and the cultivation of the ideological literacy, constitutes a major limitation. A collaborative mechanism framework, which deeply connects the two aspects, is constructed in this study.
- 2) Second, digital technology systems are applied to optimize the student management, thus providing a technical path for the transition from “experience-driven” to “data-driven”.
- 3) The educational effectiveness of the collaborative mechanism or system is verified through empirical data, thus providing evidence-based support for the innovation in the ideological and political work.

This study does have some limitations: the effectiveness of the collaborative mechanism is influenced by a number of factors, e.g., the IT infrastructure in the school and the extent of team building; the results with the present sample sizes need to be validated with other, more samples. Although the accuracy of the mental health risk identification model has improved, there are still false positives and false negatives, and model optimization must be continuously data accumulated and algorithm optimized. Future research can further study multimodal data fusion technology, introduce more advanced deep learning algorithms, and conduct deeper theoretical research on the collaborative education of mental health and ideological literacy to further understand the

interaction mechanism between mental health and ideological literacy, which will lay the solid psychological basis and ideological foundation for training the new generation who will undertake the great responsibility of national rejuvenation.

AUTHOR CONTRIBUTIONS

Conceptualization –Mingxia Lv and Jun Li; methodology – Mingxia Lv and Jun Li; investigation – Mingxia Lv and Jun Li; writing-original draft preparation – Mingxia Lv and Jun Li. All authors have read and agreed to the published version of the manuscript.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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