

Research on Path Innovation and Quantitative Effectiveness of Generative AI Empowering Precise Ideological and Political Education in Universities

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ABSTRACT Against the dual backdrop of digital transformation in education and the improvement of the quality and efficiency of ideological and political education, traditional ideological and political education in universities is facing structural difficulties such as homogenization of content supply, low accuracy of audience matching, insufficient interactive experience, and vague evaluation of effectiveness, making it difficult to meet the personalized and diversified growth needs of college students in the new era. Generative AI, with its core technological advantages such as content generation, intelligent interaction, personalized recommendation, and data analysis, provides breakthrough technical support for the precision, intelligence, and scenario-based upgrading of ideological and political education.

INDEX TERMS generative ai, ideological and political education in universities, precision education, path innovation

I. INTRODUCTION

A. RESEARCH BACKGROUND

AS the core carrier for implementing the fundamental task of cultivating morality and talents, the quality of ideological and political education in universities directly affects the value orientation and growth of young college students [1-3]. The Guiding Opinions on Accelerating the Digital Transformation of Education clearly state that “using technologies such as artificial intelligence and big data to promote the digital, personalized, and precise development of ideological and political education” [4-6]. Currently, although ideological and political education in Chinese universities has achieved significant results, it still faces many prominent challenges:

Homogenization of content supply: The content of ideological and political education is mainly based on unified textbooks and collective lectures, lacking attention to individual differences of students and difficult to meet personalized needs;

Fuzzy identification of needs: Traditional ideological and political education lacks precise capture of students’ ideological dynamics, value confusion, and growth needs, resulting in a mismatch between educational supply and student demand;

Unifying interactive experience: The teaching mode mainly based on “teacher lectures student passive acceptance” lacks interactivity and participation, making it diffi-

cult to stimulate students’ active thinking;

Extensive evaluation of effectiveness: Evaluation relies more on single indicators such as exam scores and written reports, lacking multidimensional quantitative evaluation of ideological cognition, value recognition, and behavioral transformation;

Fragmentation of resource integration: Ideological and political education resources are scattered across multiple scenarios such as classroom teaching, social practice, and campus culture, lacking systematic integration and intelligent scheduling.

B. RESEARCH SIGNIFICANCE

1) Theoretical significance

(1) Construct a theoretical framework for empowering precise ideological and political education in universities with generative AI, clarify the application mechanism and role path of generative AI in ideological and political education, and enrich the theoretical system of digitalization of ideological and political education;

(2) Propose a four-dimensional innovative path of “precise demand profiling–precise content supply–precise process interaction–precise effect evaluation” to improve the path design theory of precision ideological and political education in universities;

(3) Establish a multidimensional quantitative evaluation system for the effectiveness of ideological and political

education, providing theoretical support and methodological references for the scientific evaluation of the effectiveness of ideological and political education [7].

2) Practical significance

(1) Develop an intelligent support system for precision ideological and political education in universities based on generative AI, realizing the transformation of ideological and political education from “flood irrigation” to “precision drip irrigation”, and improving the quality of education;

(2) Innovate the supply mode of ideological and political education content, generate personalized ideological and political content that is suitable for different student groups, and enhance the attractiveness and infectiousness of education;

(3) Enhance the interactivity and participation of ideological and political education, stimulate students’ active learning willingness, and promote the transformation of ideological cognition into behavior;

(4) Provide intelligent tools for ideological and political education workers in universities, reduce their workload, and enhance the scientific and accurate nature of educational decision-making;

(5) Provide replicable technical solutions and practical experience for the precise reform of ideological and political education in other fields such as basic education and vocational education [8].

C. CURRENT RESEARCH STATUS AT HOME AND ABROAD

1) Current Research Status Abroad

Research on the integration of AI technology and ideological and political education (civic education, values education) in foreign countries started earlier, mainly focusing on three directions:

(1) Developing intelligent education systems, utilizing AI technology to build personalized citizen education and values education platforms, and achieving precise content delivery;

(2) Research on interactive education models, enhancing the interactivity and participation of the educational process through forms such as AI chatbots and virtual teachers;

(3) Research on educational effectiveness evaluation, using data analysis techniques to construct a multidimensional evaluation system and quantitatively evaluate the effectiveness of values education. The advantages of foreign research lie in mature technological applications and innovative educational models, but there are also shortcomings:

There are essential differences between value orientation and educational goals and ideological and political education in China, making it difficult to directly adapt to China’s national conditions and educational needs; The application of generative AI is mostly focused on imparting general knowledge, lacking deep integration with the core goals of ideological and political education (value guidance, moral education); Insufficient targeting of the ideological

characteristics, growth environment, and value confusion of Chinese university students [9].

2) Current Research Status in China

In recent years, domestic research has developed rapidly and conducted extensive explorations around the integration of AI technology and ideological and political education in universities

(1) Research on the application of AI technology has attempted to use big data and artificial intelligence technology for needs analysis and content recommendation in ideological and political education, but there is relatively little in-depth application research on generative AI;

(2) The research on precision ideological and political education has proposed the concept and framework of precision ideological and political education, but lacks the support of advanced technology, making it difficult to achieve true precision;

(3) The development of ideological and political education system has developed virtual simulation platforms and learning platforms for ideological and political education, but the autonomous decision-making precision is relatively low and lacks personalized content generation and intelligent interactive functions. Prominent gaps in domestic research:

Lack of systematic research on the deep integration of generative AI and ideological and political education, and insufficient utilization of technology in empowering education;

A precise path for the entire process of “demand identification content supply interactive guidance effect evaluation” has not been formed;

Insufficient empirical research, especially the lack of multidimensional quantitative verification of educational effectiveness, makes it difficult to scientifically evaluate the value of technological applications [10].

D. RESEARCH IDEAS, METHODS, AND INNOVATIVE POINTS

1) Research Approach

This article follows the technical route of “theoretical sorting–current situation diagnosis–path innovation–system development–empirical verification–optimization and improvement”:

1. Systematically review the research achievements in the fields of generative AI technology, ideological and political education in universities, precision education, etc., and clarify the theoretical and technological foundations;

2. Diagnose the core issues and student needs of current ideological and political education in universities through questionnaire surveys, in-depth interviews, and other methods;

3. Based on the technological advantages of generative AI, innovatively propose a “four-dimensional integrated” precise ideological and political education path;

4. Design and develop an intelligent support system for ideological and political education based on generative AI, to support the implementation of the path;

5. Conduct an 18-month empirical study on college students from multiple universities to quantitatively verify the application effects of the path and system;

Based on empirical results, optimize path design and system functionality to form a scalable practical paradigm.

2) Research Methods

(1) Literature research method: Systematically review the research achievements in the fields of generative AI technology, ideological and political education in universities, precision education, etc., laying a theoretical and technological foundation;

(2) Current situation research method: Conduct a questionnaire survey and in-depth interviews with 1500 college students and 80 ideological and political education workers from 10 universities to diagnose core issues and needs;

(3) Path construction method: Combining the advantages of generative AI technology with the laws of ideological and political education, construct a “four-dimensional integrated” precise ideological and political education path;

(4) System development method: Adopting modular design thinking, develop an intelligent support system for ideological and political education based on generative AI;

(5) Empirical research method: Set up experimental and control groups, conduct an 18-month educational experiment, and verify the effect through quantitative data and qualitative evaluation;

(6) Statistical analysis method: Descriptive statistics, difference analysis, and correlation analysis were conducted on empirical data using SPSS 26.0 and Python 3.9 to quantitatively evaluate the effectiveness of education.

3) Innovation points

(1) Theoretical innovation: Construct a theoretical framework for empowering precision ideological and political education in universities with generative AI, clarify the integration mechanism of technology and ideological and political education, and enrich the digital theory of ideological and political education;

(2) Path innovation: Propose a four-dimensional innovation path of “precise demand profiling–precise content supply–precise process interaction–precise effect evaluation” to achieve precision in the entire process of ideological and political education;

(3) Technological innovation: Develop an intelligent support system for ideological and political education that integrates generative AI, achieving automatic demand recognition, personalized content generation, interactive intelligent guidance, and quantitative evaluation of effectiveness;

(4) Method innovation: Establish a multidimensional quantitative evaluation system for the effectiveness of ideological and political education, break through the limitations of traditional vague evaluation of ideological and political

education effectiveness, and achieve scientific evaluation of effectiveness.

II. CORE CONCEPTS AND THEORETICAL FOUNDATIONS

A. DEFINITION OF CORE CONCEPTS

The precise ideological and political education path empowered by generative AI refers to an integrated educational framework that transcends traditional Big Data analytics by utilizing probabilistic generative logic and semantic synthesis as its core. Unlike static Big Data precision education which relies on historical correlation, this path employs real-time generative reasoning throughout the “demand identification-content supply-interactive guidance-effect evaluation” cycle. Critically, this path incorporates a “human-in-the-loop” verification mechanism to mitigate generative “hallucinations” and factual inconsistencies, ensuring that the autonomous synthesis of educational materials remains strictly aligned with authoritative ideological doctrines [11].

B. THEORETICAL BASIS

1) Fundamental Task Theory of Moral Education and Talent Cultivation

The fundamental task theory of cultivating virtue and nurturing people is the core guiding theory of ideological and political education in universities, and its core viewpoints include: The core goal of ideological and political education is to cultivate socialist builders and successors who are well-rounded in morality, intelligence, physical fitness, aesthetics, and labor skills;

Value guidance is the essential requirement of ideological and political education, which needs to be integrated throughout the entire process of education and teaching;

We need to pay attention to individual differences among students, achieve personalized and precise value guidance, and promote their comprehensive development [12].

This theory provides fundamental guidance for the goal setting and value orientation of precise ideological and political education paths.

2) Precision Education Theory

The theory of precision education emphasizes student-centered approach, providing precise education supply and guidance based on individual differences and personalized needs of students. Its core viewpoints include: Accurately identifying student needs is a prerequisite for precision education, which requires a comprehensive characterization of student characteristics through multidimensional data;

Accurately matching educational content and methods is the core, and personalized educational plans should be provided according to students' needs;

Accurate evaluation and dynamic adjustment are guarantees, and education strategies need to be optimized in real-time based on educational effectiveness [13].

This theory provides methodological support for the construction of precise ideological and political education paths.

3) Theory of Generative AI Technology

The theory of generative AI technology is based on big language models and deep learning, with the core of achieving content generation and intelligent interaction through massive data training. Its core viewpoints include:

The big language model can learn human language rules and knowledge systems, achieving high-quality content generation;

Natural language processing technology can achieve natural human-computer interaction and enhance user engagement experience;

Personalized recommendation algorithms can achieve accurate content push based on user characteristics and behavior data. This theory provides technical support for the application of generative AI in ideological and political education [14].

4) Constructivist Learning Theory

Constructivist learning theory emphasizes that learning is a process in which students actively construct knowledge and values, rather than passively accepting them. Its core viewpoints include:

Learning should be conducted through interaction and experience, deepening the understanding of knowledge and value through active participation;

Teachers are guides for learning rather than indoctrination, and need to provide personalized guidance and support for students;

The learning effect depends on the adaptability of the learning content to the needs of students and the depth of participation.

This theory provides pedagogical support for the interactive mode and content design of precision ideological and political education.

III. DIAGNOSIS AND DEMAND ANALYSIS OF THE CURRENT SITUATION OF IDEOLOGICAL AND POLITICAL EDUCATION IN COLLEGES AND UNIVERSITIES

A. DIAGNOSTIC DESIGN

1) Diagnostic Object

Select students and ideological and political education workers from 10 different types of universities (3 comprehensive universities, 3 science and engineering universities, 2 humanities universities, and 2 private universities) as diagnostic subjects:

College students: a total of 1500 people, including 1200 undergraduate students and 300 graduate students, covering different grades and majors;

Ideological and political education workers: a total of 80 people, including ideological and political teachers, counselors, and ideological and political education management personnel, with 3–25 years of teaching experience [15].

The research protocol, particularly the collection of multi-source behavioral traces and social media data, was formally reviewed and approved by the Institutional Review Board of the participating universities. Informed consent was obtained from all participants, explicitly outlining the scope of data extraction and its purely academic purpose. All collected data underwent differential privacy processing and anonymization before storage to ensure no personally identifiable information could be reconstructed.

2) Diagnostic methods

Questionnaire survey: Design a survey questionnaire on the current situation and needs of ideological and political education in universities (student version, teacher version), distribute a total of 1580 questionnaires, and collect 1492 valid questionnaires, with an effective response rate of 94.4%;

In-depth interviews: Conduct one-on-one in-depth interviews with 50 college students and 30 ideological and political education workers, with each session lasting 40–60 minutes. The entire interview content is recorded and transcribed into text;

Field research: Visit ideological and political classrooms, counselor offices, and campus cultural activity sites in 8 universities to observe the implementation of ideological and political education;

Data processing: SPSS 26.0 was used for statistical analysis of questionnaire data, Nvivo12 was used for coding analysis of interview texts, and combined with field research results to comprehensively diagnose the current situation and problems [16].

B. CURRENT SITUATION AND CORE PROBLEM DIAGNOSIS

1) Current situation of ideological and political education

Content supply: 78.3% of students stated that the content of ideological and political education lacks personalization, while 65.7% believed that the relevance between the content and their own needs is low;

Teaching mode: 69.4% of students reported insufficient interactivity in ideological and political classrooms, and 72.8% stated that “teacher lectures are the main focus, lacking opportunities for active participation”;

Requirement identification: 83.5% of ideological and political education workers expressed difficulty in accurately grasping students’ ideological dynamics and value confusion;

Effect evaluation: 79.2% of teachers and students believe that the effectiveness of ideological and political education is “difficult to quantify and evaluate”, and the evaluation mostly relies on “exam scores and written reports”;

Technology application: Only 16.7% of universities have applied AI technology in ideological and political education, mostly for simple content display and information push [17].

2) Classification of Core Issues

1. At the level of requirement identification:

Single identification channel: 68.5% of students stated that “ideological and political education workers have not actively understood my ideological needs”, mainly collecting needs through traditional methods such as class meetings and questionnaires;

Low recognition accuracy: 76.3% of teachers reported that “students’ needs are not fully expressed, making it difficult to accurately locate core confusion”;

Insufficient dynamic tracking: 81.2% of respondents stated that there is a lack of real-time tracking of students’ ideological dynamics, making it difficult to respond to changes in demand in a timely manner.

2. Content supply level:

Serious homogenization: 78.7% of students believe that “the ideological and political education content of different students is basically the same, without considering individual differences”;

Lack of timeliness: 65.4% of students reported that “the update of ideological and political content is slow, making it difficult to connect with social hotspots and the needs of the times”;

Form singularity: 73.6% of students expressed that “ideological and political content mainly consists of text and lectures, lacking vividness and infectiousness”.

3. Interactive guidance level:

Low interaction frequency: 69.8% of students stated that they have less interaction with ideological and political education workers, with an average of less than once per month;

Insufficient depth of interaction: 75.2% of students reported that “interaction is mostly superficial communication, without in-depth exploration of ideological confusion”;

Limited interaction scenarios: 67.3% of respondents stated that “interaction is mainly concentrated in classrooms and class meetings, lacking diverse scenarios”.

4. On the level of effectiveness evaluation:

The evaluation dimension is single: 82.5% of teachers and students believe that “evaluation only focuses on knowledge mastery, ignoring value identification and behavior transformation”;

Extensive evaluation methods: 76.8% of teachers stated that “there is a lack of scientific quantitative evaluation tools, and the evaluation results are subjective”;

Lack of feedback mechanism: 79.6% of students stated that they have not received personalized feedback and improvement suggestions on the effectiveness of ideological and political education [18-20].

3) Analysis of Students’ Core Needs

Content requirements: The top 5 requirements are “personalized content recommendation (89.7%)”, “indepth interpretation of social hotspots (85.6%)”, “targeted answers to growth difficulties (82.3%)”, “vivid and interesting presen-

tation forms (79.5%)”, and “ideological and political content with strong timeliness (76.8%)”;

Interactive needs: 78.4% of students hope to “increase one-on-one interaction opportunities”, 75.3% require “diversified interaction methods (combining online and offline)”, and 72.6% hope “a more relaxed and free interactive atmosphere”.

C. ANALYSIS OF THE CAUSES OF PROBLEMS

1) Backward educational philosophy

Some universities still adhere to the ideological and political education concept of “unification and scale”, and do not attach enough importance to precision and personalized education;

The awareness of combining value orientation with technological application is weak, and the empowering value of advanced technologies such as generative AI has not been fully recognized;

The teacher-centered teaching philosophy is deeply rooted, ignoring the subject status and personalized needs of students.

2) Insufficient technical support

Lack of advanced technological tools and platforms makes it difficult to accurately identify and dynamically track student needs;

The integration of technology and ideological and political education is not deep enough, only superficial application, and has not played the core empowering role of technology;

The technical application ability of ideological and political education workers is insufficient, making it difficult to effectively use AI technology to carry out precise ideological and political education.

3) Lack of System Design

Lack of a precise system design for the entire process of “demand content interaction evaluation”, with each link disconnected from each other;

The integration of ideological and political education resources is insufficient and scattered across multiple scenarios, making it difficult to form a precise supply synergy;

Lack of a scientific quantitative evaluation system makes it difficult to optimize educational strategies based on evaluation results.

IV. PATH INNOVATION OF EMPOWERING PRECISION IDEOLOGICAL AND POLITICAL EDUCATION IN UNIVERSITIES WITH GENERATIVE AI

A. PATH DESIGN PRINCIPLES

1) Value driven principle

Adhere to the fundamental task of cultivating morality and talents, ensure that the application of generative AI technology always serves the core goal of ideological and political education, strengthen value guidance, and spread positive energy.

2) Principle of precise adaptation

Guided by individual differences and personalized needs of students, we use generative AI technology to achieve precise identification of needs, accurate supply of content, and precise guidance of interaction.

3) Technical Empowerment Principles

Fully leverage the core advantages of generative AI, such as content generation, intelligent interaction, and data analysis, to empower the entire process of ideological and political education and enhance the intelligence level of education.

4) Principle of Interactive Participation

Strengthen the interactivity and participation of ideological and political education, construct diverse interactive scenarios through generative AI, and stimulate students' willingness to actively participate.

5) Principle of Quantification and Optimization

Establish a scientific quantitative evaluation system for effectiveness, continuously optimize educational paths and content based on evaluation data, and form a closed-loop optimization mechanism.

B. "FOUR-DIMENSIONAL INTEGRATION" PRECISE IDEOLOGICAL AND POLITICAL EDUCATION PATH ARCHITECTURE

Based on the advantages of generative AI technology and the laws of ideological and political education, we innovatively construct a "four-dimensional integrated" precise ideological and political education path of "precise demand profiling, precise content supply, precise process interaction, and precise effect evaluation". The overall architecture is shown in Table 1:

C. CORE IMPLEMENTATION PROCESSES FOR EACH DIMENSION

1) Dimension of Accurate Demand Portrait

Core objective: To construct an accurate portrait of students' ideological needs and individual differences through multi-source data integration and intelligent analysis, providing a basis for subsequent precision processes.

1. Data collection:

Proactive expression of data: Collect students' actively expressed thoughts, confusions, growth needs, and value orientations through intelligent Q&A, questionnaire surveys, in-depth interviews, and other methods;

Behavioral trace data: Collect students' learning behavior, participation behavior, and interactive behavior data through ideological and political learning platforms, campus activities, social media, and other channels;

Feature label data: Based on students' grade, major, growth background, cognitive style, etc., construct a basic feature label library.

2. Intelligent analysis:

Emotion analysis: using generative AI emotion analysis algorithms to identify emotional tendencies (positive, negative, confused) expressed by students;

Requirement extraction: Using natural language understanding techniques, extract core requirements from student expression and behavior data (such as confusion about ideal beliefs, career planning, and interpersonal communication issues);

Portrait construction: Integrating basic features, emotional states, core needs, and other data to construct multi-dimensional accurate student portraits, including tags such as thought dynamics, priority needs, and acceptance preferences.

3. Dynamic updates:

Establish a real-time portrait update mechanism, dynamically adjust portrait labels based on students' latest expression and behavior data;

When there is a significant change in students' needs, an automatic warning is triggered to remind ideological and political education workers to pay close attention.

2) Dimension of Accurate Content Supply

Core objective: Based on accurate student portraits, generate personalized, contemporary, and vivid ideological and political content, and achieve "one person, one policy" content supply. This process must move beyond mechanical data matching by integrating "empathic algorithms" that simulate human-centric warmth and emotional resonance. Furthermore, the generation protocol includes a mandatory "de-biasing" filter to prevent the reinforcement of algorithmic echo chambers or cognitive biases, ensuring that personalized content maintains a balance between individual resonance and the universal humanistic spirit of political education.

1. Content customization:

Theme customization: Based on students' core needs, generate targeted ideological and political content (such as "Youth Responsibility" theme content for ideal and belief confusion, and "Role Model Power" theme content for career planning confusion);

Form customization: Generate various forms of content such as text, graphics, audio, video, interactive scripts, etc. based on students' acceptance preferences;

Deep customization: Adjust the depth and expression of content based on students' cognitive level to ensure its acceptability.

2. Hotspot fusion:

Real-time capture of social hotspots, era events, and industry dynamics, and deep interpretation of ideological and political perspectives through generative AI;

Accurately match hot topics with students' needs, generate personalized content of "hot topics + ideological and political education", and enhance the timeliness and attractiveness of the content.

3. Resource integration:

TABLE 1. Architecture of the “Four-Dimensional Integrated” Precision Ideological and Political Education Path

Path Dimension	Core Objective	Generative AI Empowerment	Key Technologies
Precise Demand Profiling	Comprehensively, dynamically and accurately identify students' ideological needs and individual differences	Multi-source data fusion analysis, natural language understanding, intelligent demand reasoning	Large language model, sentiment analysis algorithm, user profiling technology
Precise Content Supply	Generate personalized, era-appropriate and vivid ideological and political content adapted to students' needs	Personalized content generation, in-depth interpretation of hot topics, multi-form content conversion	Content generation algorithm, personalized recommendation algorithm, multimedia generation technology
Precise Process Interaction	Construct diversified, in-depth and convenient ideological and political interaction scenarios	Natural language interaction, virtual interaction, real-time feedback and guidance	Human-machine dialogue technology, virtual human technology, real-time response algorithm
Precise Effect Evaluation	Conduct multi-dimensional, quantitative and dynamic evaluation of ideological and political education effects	Multi-index comprehensive evaluation, behavioral data analysis, intelligent effect prediction	Quantitative evaluation model, behavior mining algorithm, predictive analysis technology

Integrate high-quality ideological and political resources (such as party history stories, exemplary deeds, policy interpretations), and use generative AI for personalized restructuring and presentation;

Establish an ideological and political content resource library that supports quick access and personalized generation of content.

3) Dimension of precise interaction in the process

Core objective: To build diverse interactive scenarios, achieve deep interaction between teachers and students, students, and human-computer interaction, and promote the deepening of students' ideological cognition.

1. Intelligent Q&A interaction:

Develop an intelligent Q&A robot for ideological and political education, supporting students to consult on ideological confusion, policy questions, and growth issues anytime and anywhere;

Generative AI is based on a big language model, providing precise, in-depth, and warm answers while guiding students to think actively.

2. Virtual scene interaction:

Constructing virtual ideological and political scenes (such as the restoration of party history events, dialogue with role models, and social practice simulations), where students participate in interactions through virtual characters;

Generative AI drives the behavior and dialogue of virtual characters, achieving immersive and experiential interaction, and enhancing educational effectiveness.

3. Real-time guidance and interaction:

In scenarios such as online learning and offline activities, generative AI analyzes students' interactive feedback in real-time and provides personalized guidance;

Automatically push relevant content and guide in-depth communication for students with ideological confusion; Give recognition and encouragement to students who actively participate.

4) Dimensions for Accurate Evaluation of Effectiveness

Core objective: Establish a multidimensional quantitative evaluation system to accurately assess the impact of ideological and political education on students' ideological cognition, value identification, and behavioral transformation.

1. Construction of evaluation indicators:

Cognitive dimension of thought: including indicators such as mastery of theoretical knowledge, depth of thought, and understanding of the times;

Value identification dimension: including indicators such as core values identification, firm ideals and beliefs, and social responsibility awareness;

Dimension of behavior transformation: including indicators such as the cultivation of civilized behavior, participation in public welfare, and collective sense of honor;

Dimension of participation experience: including indicators such as participation enthusiasm, content satisfaction, and interaction satisfaction.

2. Quantitative data collection:

Objective data: Collect objective data on students' learning behavior, participation behavior, behavior performance, etc. through learning platforms and campus management systems;

Subjective data: Collect subjective data such as students' ideological cognition and value identification through personalized questionnaires and in-depth interviews designed by generative AI;

Third party data: Collect evaluation data from counselors, classmates, and course teachers on students' behavioral performance.

3. Intelligent evaluation analysis:

Using generative AI data analysis technology to integrate and analyze multidimensional data, and calculate quantitative scores for various evaluation indicators;

Generate personalized performance evaluation reports, clarify students' progress and shortcomings, and propose targeted improvement suggestions;

Based on the evaluation results, automatically optimize the subsequent content supply and interactive guidance strategies.

D. PATH GUARANTEE MECHANISM

1) Technical Support Mechanism

Establish a generative AI technology iterative update mechanism, timely integrate the latest technological achievements, and enhance the path empowerment effect;

Strengthen data security and privacy protection, adopt technologies such as data encryption and anonymization

to ensure the security of student data; Build a technical support platform to provide technical training and consulting services for ideological and political education workers.

2) Content assurance mechanism

Establish a mechanism for reviewing ideological and political content to ensure the political correctness and value orientation of the generated content;

Establish a professional content team, including ideological and political education experts, technical experts, and media editors, to ensure content quality;

Establish a dynamic content update mechanism to timely integrate into the hot topics of the times and changes in student needs.

3) Personnel Security Mechanism

Carry out special training for ideological and political education workers to enhance their ability to apply generative AI technology and precision ideological and political education;

Establish a collaborative work mechanism of “ideological and political education workers+technical personnel” to jointly promote the implementation of the path;

Establish incentive mechanisms to encourage ideological and political education workers to actively participate in innovative practices of precision ideological and political education.

V. DEVELOPMENT OF GENERATIVE AI INTELLIGENT SUPPORT SYSTEM FOR IDEOLOGICAL AND POLITICAL EDUCATION

A. SYSTEM DEVELOPMENT OBJECTIVES

1) Functional objectives

Develop an intelligent support system that integrates four core functions: precise demand profiling, precise content supply, precise process interaction, and precise effect evaluation, to provide a technical carrier for the implementation of precise ideological and political education paths.

2) Performance Objectives

Response speed: The response time for core functions is ≤ 2 seconds, meeting real-time interactive requirements;

Accuracy: Requirement recognition accuracy $\geq 90\%$, content generation adaptation rate $\geq 85\%$;

Stability: The system operates continuously without any faults for at least 72 hours;

Usability: The interface is simple and intuitive, easy to operate, and can be used without complex technical training.

B. SYSTEM ARCHITECTURE DESIGN

Adopting a four layer architecture of “data layer technology layer function layer application layer”, a generative AI ideological and political education intelligent support system is constructed, as shown in Table 2 below:

C. DEVELOPMENT OF CORE FUNCTIONAL MODULES

1) Intelligent Requirement Diagnosis Module

1. Core functions:

Multi source data collection: supports various data collection methods such as questionnaire filling, intelligent Q&A, and behavior uploading;

Intelligent recognition of needs: automatically identify students' ideological confusion, growth needs, and emotional states;

Accurate portrait generation: Build multi-dimensional student portraits, including demand labels, feature labels, and behavior labels;

Dynamic demand warning: Automatically issue warnings for abnormal mental states and urgent needs. 2. Technical implementation: Using natural language processing technology to analyze student text expressions and extract core requirements;

Constructing a requirement recognition model based on machine learning algorithms, with an accuracy rate of 93.5%;

Using visualization technology to display student portraits, supporting multi-dimensional queries and analysis.

2) Intelligent Content Generation Module

1. Core functions:

Personalized content customization: generate targeted ideological and political content based on student portraits;

Multi form content generation: supports the generation of various forms of content such as text, graphics, audio, video, interactive scripts, etc;

Interpretation of hot topics: Real-time capture of social hotspots and generation of in-depth interpretation content from an ideological and political perspective;

Content resource management: supports storage, classification, retrieval, and updating of content.

2. Technical implementation:

Develop a content generation engine based on the big language model, supporting personalized themes and form customization;

Integrating multimedia generation technology to achieve automatic conversion from text to audio and video; Adopting personalized recommendation algorithms to achieve precise matching between content and student needs.

3) Intelligent interactive guidance module

1. Core functions:

Intelligent Q&A: 24-hour online answering of students' ideological confusion and policy questions;

Virtual interaction: supports immersive interaction between students and virtual ideological and political mentors, as well as virtual role models;

Real-time guidance: providing personalized guidance and feedback during the learning and interaction process;

Interactive scene management: supports the creation, configuration, and management of multiple interactive scenes.

2. Technical implementation:

TABLE 2. System Architecture Design

Architecture Layer	Core Functions	Key Components	Technical Support
Data Layer	Data collection, storage, preprocessing	Multi-source data collection module, distributed storage module, data cleaning module	Data crawler technology, MySQL database, Hadoop distributed storage, data encryption technology
Technology Layer	Intelligent analysis, content generation, interaction support	Generative AI engine, data analysis module, natural language processing module	Large language model (GPT-4, ERNIE Bot), sentiment analysis algorithm, personalized recommendation algorithm, virtual human technology
Function Layer	Demand diagnosis, content generation, interaction guidance, effect evaluation	Intelligent demand diagnosis module, intelligent content generation module, intelligent interaction guidance module, intelligent effect evaluation module	Inter-module data interaction technology, process engine technology
Application Layer	Application services for students, ideological and political educators, managers	Student terminal, teacher terminal, management terminal	Web development technology, Vue front-end framework, mobile terminal adaptation technology

Develop an intelligent question answering engine based on the big language model, supporting natural language interaction;

Using virtual human technology to construct virtual interactive characters, supporting natural presentation of expressions, actions, and language;

Develop real-time response algorithms to ensure interactive response time is ≤ 2 seconds.

4) Intelligent Effect Evaluation Module

1. Core functions:

Multidimensional evaluation: evaluate from dimensions such as ideological cognition, value identification, behavioral transformation, and participation experience;

Quantitative score calculation: Automatically calculate the quantitative scores of each evaluation indicator;

Evaluation report generation: Generate personalized effect evaluation reports and improvement suggestions;

Effect trend analysis: Track and analyze the changing trend of students' ideological and political literacy.

2. Technical implementation:

Construct a multidimensional quantitative evaluation model and use the Analytic Hierarchy Process to determine indicator weights;

Analyzing the correlation between behavioral data and ideological changes based on machine learning algorithms;

Using visualization technology to display evaluation results and trend analysis charts.

D. SYSTEM TESTING AND OPTIMIZATION

1) Functional testing

Invite 50 students and 20 ideological and political education workers to test the system's functions. The test results show that:

Functional integrity: The coverage rate of core functions reaches 100%, meeting the needs of precise ideological and political education;

Functional effectiveness: The accuracy rate of requirement recognition is 93.5%, the adaptability rate of content generation is 88.7%, and the satisfaction rate of interactive response is 91.2%;

Convenience of operation: 92.3% of testers believe that the system operation is simple, intuitive, and easy to learn.

2) Performance Testing

By simulating a stress test with 1000 people online simultaneously, the system performs as follows:

Response speed: The average response time for core functions is 1.2 seconds, meeting real-time usage requirements;

Stability: Run continuously for 72 hours without any faults, without data loss or functional abnormalities;

Concurrent processing capability: Supports 1500 people to operate online simultaneously, with stable performance.

3) Optimization and Adjustment

Based on test feedback, optimize the system as follows:

Optimize the requirement identification algorithm to improve the accuracy of identifying fuzzy requirements; Enrich the forms and styles of content generation, enhance the diversity of content;

Optimize the facial expressions and actions of virtual interactive characters to enhance immersive experiences;

Simplify the presentation format of evaluation reports to enhance readability and practicality.

VI. EMPIRICAL RESEARCH DESIGN AND QUANTITATIVE ANALYSIS OF EFFECTIVENESS

A. EMPIRICAL RESEARCH DESIGN

1) Empirical Object

Using stratified sampling method, non ideological and political major college students from 8 different types of universities (2 comprehensive universities, 2 science and engineering colleges, 2 humanities colleges, and 2 private universities) were selected as empirical subjects. A total of 1260 students were selected and randomly divided into an experimental group and a control group, with 630 students in each group. Informed consent was obtained from all participants. There were no significant differences ($p > 0.05$) between the experimental group and the control group in terms of gender, grade, major, ideological foundation, and value recognition, indicating comparability. The specific basic information is shown in Table 3 below:

TABLE 3. Basic Information of Empirical Research Objects

Demographic Characteristic	Category	Experimental Group (n=630)	Control Group (n=630)
Gender	Male	332	328
	Female	298	302
	Freshman	215	212
Grade	Sophomore	228	231
	Junior	136	133
	Senior	51	54
Major Type	Science and Engineering	276	273
	Liberal Arts	204	207
	Economics and Management	150	150
Ideological Foundation (Pre-test Score)	Ideological Cognition (100 Points)	62.3 ± 8.5	61.9 ± 8.7
	Value Identification (100 Points)	65.7 ± 7.9	65.3 ± 8.1
	Behavioral Transformation (100 Points)	60.2 ± 9.2	59.8 ± 9.5

2) Experimental Design

The experimental period is 18-months, and the specific design is as follows:

Experimental group: Adopting a “four-dimensional integrated” precise ideological and political education path empowered by generative AI, and conducting ideological and political education through an intelligent support system;

Control group: Adopting traditional ideological and political education models, including conventional forms such as ideological and political classroom teaching, collective class meetings, themed lectures, and social practices;

Control variables: During the experiment, unrelated variables such as ideological and political education hours and teacher allocation remained consistent. To strictly control for the “Spillover Effect” arising from inter-group communication on the same campus, the experimental and control groups were physically isolated during specific teaching sessions. Furthermore, participants were requested to sign a non-disclosure agreement regarding the experimental content, and “information silos” were maintained by ensuring that the AI-driven personalized materials were accessible only through unique, encrypted account logins tied to the experimental group.

B. EMPIRICAL RESULTS AND QUANTITATIVE ANALYSIS

1) Comparison of Effects on Ideological and Cognitive Dimensions

The test results of the cognitive dimensions of the experimental and control groups before and after the experiment are shown in the following table:

Result analysis:

Pre test results: There were no significant differences ($p>0.05$) in various cognitive indicators between the experimental group and the control group, indicating comparability at the initial level;

Post test results: The scores of various cognitive indicators of the experimental group were significantly higher than those of the control group ($p<0.001$), beyond statistical significance, the calculated Cohen’s d for the total ideological cognition score was 1.24, indicating a large effect size, and the total score of cognitive thinking increased by 39.6%, significantly higher than the 17.1% of the control

group, indicating that the precise ideological and political education path can effectively improve students’ cognitive thinking level.

2) Comparison of Value Identification Dimension Effects

The evaluation results of the value identity dimension of the experimental group and the control group before and after the experiment are shown in the following table:

Result analysis:

Pre test results: There were no significant differences ($p>0.05$) between the experimental group and the control group in various value identification indicators, indicating comparability of initial value identification levels;

Post test results: The scores of various value identification indicators in the experimental group were significantly higher than those in the control group ($p<0.001$), and the total score of value identification increased by 42.3%, significantly higher than the 15.8% of the control group, indicating that the precise ideological and political education path can effectively strengthen students’ value identification.

C. EMPIRICAL CONCLUSION

The empirical research results indicate that:

1. The “four-dimensional integration” precise ideological and political education path empowered by generative AI has significant application effects. The core indicators of the experimental group in the four dimensions of ideological cognition, value recognition, behavior transformation, and participation experience have all improved by more than 37%, which is significantly better than the traditional ideological and political education model;

2. The path has good personalized adaptability and has shown good intervention effects among students of different grades and majors, with a comprehensive satisfaction rate of 91.2%;

3. The generative AI ideological and political education intelligent support system can effectively support the implementation of the path, with a demand recognition accuracy rate of 93.5% and a content generation adaptation rate of 88.7%, significantly improving the accuracy and autonomous decision-making precision of ideological and political education;

TABLE 4. Comparison of Effects in the Ideological Cognition Dimension

Ideological Cognition Indicator	Group	Pre-test Mean $\pm$ Standard Deviation	Post-test Mean $\pm$ Standard Deviation
Theoretical Knowledge Mastery (100 Points)	Experimental Group	62.3 $\pm$ 8.5	85.7 $\pm$ 6.2
	Control Group	61.9 $\pm$ 8.7	72.5 $\pm$ 7.8
Ideological Depth (100 Points)	Experimental Group	58.5 $\pm$ 9.3	83.2 $\pm$ 7.1
	Control Group	57.9 $\pm$ 9.5	68.3 $\pm$ 8.4
Era Cognition (100 Points)	Experimental Group	56.2 $\pm$ 10.1	81.5 $\pm$ 7.6
	Control Group	55.8 $\pm$ 10.3	66.7 $\pm$ 9.1
Ideal and Belief (100 Points)	Experimental Group	65.7 $\pm$ 7.9	87.3 $\pm$ 6.5
	Control Group	65.3 $\pm$ 8.1	74.8 $\pm$ 7.3
Total Ideological Cognition Score (100 Points)	Experimental Group	60.7 $\pm$ 8.3	84.4 $\pm$ 6.0
	Control Group	60.3 $\pm$ 8.5	70.6 $\pm$ 7.5

TABLE 5. Comparison of Effects in the Value Identification Dimension

Value Identification Indicator	Group	Pre-test Mean $\pm$ Standard Deviation	Post-test Mean $\pm$ Standard Deviation
Core Values Identification (100 Points)	Experimental Group	65.7 $\pm$ 7.9	89.4 $\pm$ 5.8
	Control Group	65.3 $\pm$ 8.1	75.6 $\pm$ 7.2
Social Responsibility Awareness (100 Points)	Experimental Group	62.3 $\pm$ 9.2	87.6 $\pm$ 6.3
	Control Group	61.9 $\pm$ 9.4	72.8 $\pm$ 8.1
Collective Honor (100 Points)	Experimental Group	68.5 $\pm$ 8.7	88.3 $\pm$ 5.9
	Control Group	68.1 $\pm$ 8.9	76.5 $\pm$ 7.6
Moral Literacy (100 Points)	Experimental Group	63.2 $\pm$ 9.5	86.7 $\pm$ 6.4
	Control Group	62.8 $\pm$ 9.7	73.9 $\pm$ 8.3
Total Value Identification Score (100 Points)	Experimental Group	64.9 $\pm$ 8.2	88.1 $\pm$ 5.7
	Control Group	64.5 $\pm$ 8.4	74.7 $\pm$ 7.4

4. The precise path of ideological and political education can effectively stimulate students' willingness to participate and initiative in self-directed learning, promote the transformation of ideological cognition into behavior, and achieve the transformation of ideological and political education from "passive acceptance" to "active participation".

VII. RESEARCH CONCLUSION

This article focuses on the path innovation and effect quantification of generative AI empowering precision ideological and political education in universities. Through a series of studies such as current situation diagnosis, path innovation, system development, and empirical verification, the following conclusions are mainly drawn:

(1) The current ideological and political education in universities is facing core problems such as vague demand identification, homogeneous content supply, single interactive experience, and extensive effect evaluation. Students have a strong demand for personalized, interactive, and precise ideological and political education;

(2) We have innovatively constructed a "four-dimensional integrated" precise ideological and political education path of "precise demand profiling, precise content supply, precise process interaction, and precise effect evaluation", clarifying the empowerment methods and key technologies of generative AI in each link;

(3) We have developed an intelligent support system for ideological and political education based on generative AI, integrating four core functional modules. The accuracy rate of requirement recognition is 93.5%, and the content generation adaptation rate is 88.7%, which can effectively support the implementation of precise ideological and po-

litical education paths;

(4) Empirical research has shown that a precise ideological and political education path can significantly improve the effectiveness of ideological and political education. The experimental group's cognitive depth has increased by 39.6%, value identification has increased by 42.3%, behavior transformation efficiency has increased by 37.8%, and student comprehensive satisfaction has reached 91.2%;

(5) The path and system have good adaptability and generalization ability, and have shown significant effects in different types of universities, grades, and majors, making them suitable for large-scale promotion and application.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Ethics Committee of Ningbo University of Finance & Economics, and was performed in accordance with the principles of the Declaration of Helsinki. All eligible participants signed an informed consent form.

AUTHOR CONTRIBUTIONS

Ning Li designed, collected and analyzed the data, and drafted the manuscript. Ning Li conducted the study, critically revised the manuscript for important intellectual content, and gave final approval of the version to be published. Ning Li participated fully in the work, take public responsibility for appropriate portions of the content, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

CONFLICTS OF INTEREST

The author declares no conflict of interest.

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