Research on the Innovative Path of Digital Empowerment of Ideological and Political Practice Courses Taking the Xiaobing Campus Culture Digital Navigation System as an Example

Aibing Wang
School of Marxism, Shanghai Institute of Commerce & Foreign Languages, Shanghai 201339, China
Corresponding author: Aibing Wang (e-mail: zcyx202512@126.com)

ABSTRACT Under the dual drive of the Digital China strategy and the digital transformation of education, ideological and political practice courses still face structural bottlenecks in content presentation, interaction depth, scenario diversity, and process evaluation. These problems are increasingly similar to engineering systems in which digital navigation, wireless sensing, and stable electromagnetic-wave communication jointly determine the reliability of user experience. Taking the "Xiaobing" campus culture digital navigation system as an example, this study constructs a digital empowerment framework for ideological and political practice courses by integrating campus cultural resources, interactive navigation, immersive scene experience, and intelligent evaluation. The system reorganizes campus culture into digital resource units and supports scenario-based learning, personalized interaction, and process-oriented feedback. The proposed path clarifies how digital technology can improve the accessibility, interactivity, and evaluability of ideological and political practice. The study provides a systematic model for transforming campus cultural resources into a smart educational environment and offers a reference for engineering-oriented digital campus platforms that rely on reliable wireless communication and electromagnetic-compatible interaction infrastructure.

INDEX TERMS digital empowerment, campus navigation, wireless sensing, electromagnetic wave communication, ideological education

I. INTRODUCTION

A. RESEARCH BACKGROUND

THE report of the 20th National Congress of the Communist Party of China clearly proposed to "promote the digitization of education" and "cultivate students with socialist core values", which pointed out the direction for the reform of ideological and political education in universities in the new era. Ideological and political practice courses serve as the essential loom of university education, interweaving the heritage of craftsmanship with moral cultivation to guide students in patterning their ideals and practical abilities. However, there are still many practical difficulties in the current ideological and political practice courses in universities: firstly, the content presentation is single, mainly based on theoretical lectures and visiting learning, lacking digital and interactive expression, which is difficult to attract the attention of college students; Secondly, the practical scenarios are limited by factors such as time, space, and resources, making it difficult for students to participate in practice anytime and anywhere, and the coverage of practice is insufficient; Thirdly, there is insufficient interactive participation, mostly in a "one-way indoctrination" mode, lacking personalized and immersive interactive experiences, and the students' subject status has not been fully reflected; Fourthly, the evaluation system is not perfect, mostly results oriented, focusing on written reports and attendance records, lacking comprehensive and intelligent evaluation of students' participation process, ideological changes, and practical abilities [1-4].

B. RESEARCH STATUS

Scholars emphasize the use of community service, social practice, project-based learning, and other methods to enhance students' sense of social responsibility and moral literacy; The application of digital technology in practical teaching mainly focuses on the construction of online course platforms and virtual practice scenarios, such as using virtual reality technology to carry out simulated social service

practices. However, foreign research lacks a deep integration with Chinese characteristic campus culture and ideological and political education goals, making it difficult to directly apply to the reform of ideological and political practice courses in Chinese universities [5,6].

C. TECHNICAL ROADMAP

1. Literature research stage: Sort out the research results in related fields such as digital ideological and political education, reform of ideological and political practice courses, and integration of campus culture, clarify the research status, shortcomings, and entry points.

2. Theoretical construction stage: Analyze the practical difficulties and digital empowerment advantages of ideological and political practice courses, and construct a three in one theoretical framework of "digital technology campus culture ideological and political practice".

3. System design phase: Design the overall architecture, functional modules, and technical support of the "Xiaobing" campus cultural digital navigation system, and develop a system prototype.

4. Path construction stage: Based on system design and combined with the teaching rules of ideological and political practice courses, four innovative paths are proposed.

5. Empirical verification stage: By conducting systematic experiments in pilot universities, this study applies material testing standards to data collection, utilizing quantitative and qualitative analysis to verify how fiber-inspired integration enhances the application effects of the system.

6. Conclusion and Suggestion Stage: Summarize the research results, propose system optimization strategies and promotion suggestions, point out research limitations and future research directions.

II. DESIGN OF THE "XIAOBING" CAMPUS CULTURE DIGITAL NAVIGATION SYSTEM

A. SYSTEM DESIGN PHILOSOPHY AND OBJECTIVES

1) Design Concept

The "Xiaobing" Campus Culture Digital Navigation System is designed with the core concept of "digital empowerment, cultural education, and practical innovation", adhering to the principles of "ideological and political guidance, student centeredness, technical support, and practical efficiency". It deeply integrates digital technology with campus culture and ideological and political practice, and creates an ideological and political practice teaching platform that integrates "resource integration, scene experience, interactive participation, and intelligent evaluation".

2) Design Objectives

1. Digitalization of resources: achieving comprehensive digital integration and multi form presentation of campus ideological and political resources, enriching the supply of ideological and political practice course content;

2. Immersive scene: Build immersive and interactive practical scenes, break through the limitations of time and space, and enhance students' participation experience;

3. Interactive personalization: Provide personalized learning paths and interactive forms, highlight students' subject status, and stimulate participation enthusiasm;

4. Intelligent evaluation: Build a multidimensional intelligent evaluation system to accurately evaluate teaching effectiveness and provide support for teaching optimization;

5. Normalization of application: Achieve deep integration between the system and ideological and political practice courses, forming a normalized and sustainable teaching mode.

Core objective: Precise value guidance (fundamental educational goal);

Supporting objectives:

Digitalization of resource supply: Focus on the "content level", solving the problem of single and limited dissemination of traditional curriculum resources, with the core being multi-form transformation and integration of resources;

Immersion of scene experience: Focus on the "experience level", breaking through time and space limitations, with the core being building a "sense of presence" through technology to strengthen emotional resonance;

Personalization of interactive forms: Focus on the "participation mode", highlighting students' subject status, with the core being diversified interactions and personalized learning paths;

Landing objectives: Intelligentization of the evaluation system, normalization of application promotion (guarantee goals).

B. OVERALL SYSTEM ARCHITECTURE

The "Xiaobing" campus culture digital navigation system adopts a "four layer architecture" design, including data layer, technology layer, application layer, and evaluation layer, which are interrelated and work together to achieve full process digital empowerment of ideological and political practice courses [7].

The technical support logic is integrated into the function layer, eliminating the independent "technology layer"; technologies are divided into "core necessary technologies" and "scene optional technologies" to avoid redundant integration.

1) Data Layer

The data layer is the foundation of the system, responsible for data collection, storage, and management of campus ideological and political resources, mainly including four types of data:

Campus cultural resource data: covering ideological and political resource data such as campus red culture (red education base, revolutionary historical deeds), historical culture (historical buildings, school history stories), exemplary culture (outstanding teachers, alumni deeds), environmental

culture (campus landscape, cultural identity), etc., stored in the form of text, pictures, videos, audios, 3D models, etc;

Student data: including basic information of students, learning behavior data (participation time, interaction frequency, learning path), ideological dynamic data (questionnaire survey results, discussion and speech content), practical achievement data (reports, works), etc;

Teaching data: including teaching objectives, teaching content, teaching plan, assessment standards, etc. of ideological and political practice courses;

System operation data: including system access volume, frequency of function usage, fault records, etc [8]. The data layer adopts a distributed storage architecture to ensure the security, reliability, and scalability of data; Establish data standards and specifications to achieve standardized management and sharing of data.

2) Technical Layer

The technical layer is the core support of the system, integrating big data, artificial intelligence VR/AR, The Internet of Things, mobile Internet and other digital technologies provide technical support for the realization of system functions:

Big data technology: used for data collection, storage, analysis, and mining, supporting student learning behavior analysis, dynamic thinking analysis, and teaching effectiveness evaluation;

Artificial intelligence technology: including natural language processing (NLP), machine learning, intelligent recommendation, etc., to achieve intelligent question answering, personalized learning path recommendation, intelligent evaluation and other functions;

VR/AR technology: used to construct immersive practice scenarios, restore historical events, red education bases, campus cultural landscapes, etc;

Internet of Things technology: used for the interconnection and intercommunication of devices on campus, supporting functions such as positioning, navigation, and scene perception;

Mobile Internet technology: support the mobile application of the system, and realize practical learning and interaction at any time and anywhere;

Cloud computing technology: provides elastic computing, storage, and service deployment capabilities to ensure system stability and scalability [9].

3) Application Layer

The application layer is the core functional module of the system, targeting three types of users: students, teachers, and administrators, providing comprehensive ideological and political practice teaching services:

Student side functions: including resource browsing, scene experience, interactive participation, practical tasks, achievement sharing, learning evaluation, etc;

Teacher side functions: including teaching management, resource management, task release, interactive guidance, evaluation analysis, data statistics, etc;

Administrator side functions: including system management, user management, data management, permission management, security management, etc.

A "Technology Collaborative Scheduling Center" is added to clarify the integration logic of heterogeneous technologies, with the core process of "user demand triggering - central scheduling - multi-technology linkage - experience output":

Demand identification: Trigger corresponding technology combinations through user operation behaviors (e.g., clicking the VR roaming function) and system preset scene tags;

Central scheduling: The system's core control module dynamically allocates functional weights and interaction sequences of each technology according to scene requirements;

Linkage mechanism: Take the collaboration between IoT and VR as an example - IoT devices (e.g., campus positioning sensors, environmental sensors) collect real-time user physical location and scene environmental data (e.g., whether in the real scene of a red education base), transmit it to the scheduling center, and synchronously trigger the VR system to load immersive content corresponding to the scene (e.g., historical scene restoration of the base), realizing seamless connection of "real-scene positioning + virtual immersion".

4) Evaluation Layer

The evaluation layer is responsible for evaluating the teaching effectiveness of ideological and political practice courses, constructing a multi-dimensional intelligent evaluation system of "process+result+idea+ability", and realizing the full process automation of evaluation data collection, analysis, and feedback [10].

C. CORE FUNCTION MODULE DESIGN

1) Resource Integration and Display Module

This module is responsible for the digital integration and multi form display of campus ideological and political resources, with main functions including:

Resource classification navigation: Divide campus ideological and political resources into four categories: red culture, historical culture, exemplary culture, and environmental culture. Each category has a sub column that supports searching by keywords, categories, location, and other methods;

Multi form display: Resources are presented in various forms such as text, images, videos, audio, 3D models, VR/AR scenes, etc., such as VR panoramic display of the Red Education Base, video explanations of school history stories, and graphic and textual introductions of exemplary deeds;

Resource update and maintenance: Support teachers and administrators to update resource content in real time, ensuring the timeliness and pertinence of resources;

Resource sharing and interaction: Support students to share resources of interest, post comments and insights, and promote the dissemination and exchange of resources [11,12].

2) Immersive Scene Experience Module

This module is based on VR/AR technology to construct immersive practice scenarios, breaking through the limitations of time and space, and enhancing students' practical experience. Its main functions include:

VR panoramic scene: Construct VR panoramic scenes of campus red education bases, historical buildings, school history museums, etc. Students can immerse themselves in the tour through VR devices or mobile devices, freely switch perspectives, and obtain detailed explanations.

When students enter the campus red education base with mobile devices, the IoT positioning sensor identifies the location and automatically sends a trigger signal to the VR module. The VR system loads the 360° panoramic historical scene of the area without manual operation, and adaptively adjusts the brightness and contrast of the VR screen based on the environmental light data collected by IoT, ensuring coordination between the immersive experience and the real environment.

3) Personalized Interactive Participation Module

This module provides personalized interactive services based on artificial intelligence technology, highlighting the student-centered status. Its main functions include:

Intelligent Q&A: Integrated with intelligent customer service "Xiaobing", it can answer students' questions about ideological and political knowledge, campus culture, practical tasks, and provide real-time guidance;

Personalized learning recommendation: Based on students' learning interests, behavioral data, and knowledge mastery, recommend personalized learning resources, practical tasks, and scenario experiences;

Interactive games: Design ideological and political interactive games, such as "Ideological and Political Knowledge Challenge", "Campus Culture Puzzle", "Historical Event Simulation", etc., to enhance students' participation enthusiasm in a fun way;

Online discussion: Support students to engage in online discussions around ideological and political topics, learning experiences, practical achievements, etc. Teachers can participate in guiding and promoting ideological exchange and collision [13].

4) Practical Task Management Module

This module is responsible for the task release, execution, and management of ideological and political practice courses, achieving standardization and normalization of practical teaching. Its main functions include:

Task release: Teachers can release personalized practical tasks based on teaching objectives, such as resource learning tasks, scenario experience tasks, research practice tasks, achievement creation tasks, etc., setting task requirements, deadlines, and evaluation criteria;

Task execution: Students can view the task list, complete tasks according to requirements, and upload practical results (such as reports, pictures, videos, audios, etc.);

Task tracking: Teachers can track students' progress in completing tasks in real time, view the submission status of results, and provide targeted guidance;

Task feedback: The system automatically conducts a preliminary evaluation of students' task completion status, and teachers conduct a secondary evaluation to provide feedback on the evaluation results and improvement suggestions [14].

5) Intelligent Evaluation Module

This module constructs a multidimensional intelligent evaluation system to accurately evaluate the teaching effectiveness of ideological and political practice courses. Its main functions include:

Evaluation data collection: Automatically collect students' participation process data (participation duration, interaction frequency, task completion progress), learning behavior data (resource browsing records, scene experience trajectory), ideological dynamic data (discussion and speech, questionnaire survey), and practical achievement data (report quality, work creativity);

Multidimensional evaluation: Evaluate from four dimensions: participation, knowledge mastery, value recognition, and practical ability, with specific evaluation indicators set for each dimension;

Intelligent analysis: using big data and artificial intelligence technology to analyze evaluation data, generate personalized evaluation reports, and point out students' strengths and weaknesses;

Evaluation feedback: Real time feedback of evaluation results to students and teachers, providing data support for students' subsequent learning and teachers' teaching optimization [15].

Remove indicators relying solely on browsing records and interaction frequency;

Add multi-source data: emotional analysis of thematic discussion content, value recognition questionnaires, value orientation analysis of practical reports (the proportion of subjective feedback data is not less than 70%).

D. SYSTEM TECHNICAL SUPPORT

1) Development Environment

Hardware environment: The server adopts high-performance cloud computing servers and supports distributed deployment; The client supports multi terminal access such as PC, mobile (iOS/Android), VR devices, etc;

Software environment: The operating system adopts Linux, the database adopts a mixed storage of MySQL and MongoDB, the development framework adopts Spring

Boot+Vue. js, and VR/AR development adopts Unity3D engine [16].

Ethical Norms for Data Collection and Use:

Informed consent: Students must sign an informed consent form for data collection before using the system, clearly informing them of the type, purpose, and storage method of collected data, and allowing them to independently choose whether to participate in data collection;

Anonymization processing: All behavioral data is desensitized and associated with personal identity information, and only used for teaching evaluation with anonymous IDs without disclosing personal privacy;

Data control rights: Students can query and delete personal data at any time, and the system sets a data retention period (automatically deleted 6 months after the end of the course) to ensure students' data sovereignty.

2) Key Technology Implementation

Big data processing: using the Hadoop ecosystem (HDFS, MapReduce, Hive) for data storage and analysis, achieving deep mining of student learning behavior and thought dynamics;

Artificial Intelligence Applications: Building an intelligent question answering system based on natural language processing technology, implementing personalized recommendations using collaborative filtering algorithms, and constructing evaluation models using machine learning algorithms;

VR/AR scene construction: Unity3D engine is used to construct VR panoramic scenes and AR interactive scenes, and 3D modeling technology is used to restore campus cultural resources.

III. INNOVATIVE PATH OF DIGITAL EMPOWERMENT IN IDEOLOGICAL AND POLITICAL PRACTICE COURSE

Based on the design and application of the "Xiaobing" campus culture digital navigation system, this article proposes four innovative paths for digital empowerment of ideological and political practice courses, including content digitization transformation, immersive scene experience, interactive personalized adaptation, and intelligent evaluation upgrade. The paths are interrelated and synergistic, and a new model for ideological and political practice courses in the digital age is constructed [17].

A. PATH 1: DIGITAL TRANSFORMATION OF CONTENT - ENRICHING SUPPLY AND ENHANCING ATTRACTIVENESS

The digital transformation of content is the foundation of digital empowerment of ideological and political practice courses. By transforming campus ideological and political resources into digital, multi form, interactive teaching content, enriching supply, and enhancing the attractiveness of ideological and political practice courses.

B. PATH 2: IMMERSIVE EXPERIENCE IN SCENES - BREAKING THROUGH LIMITATIONS AND EXPANDING COVERAGE

Scene immersive experience is the core of digital enabling ideological and political practice course. Through VR/AR, mobile Internet and other technologies, we can build immersive and borderless practice scenes, break through the time and space constraints, and expand the coverage of ideological and political practice course [18].

C. PATH THREE: INTERACTIVE PERSONALIZED ADAPTATION - HIGHLIGHTING THE SUBJECT AND ENHANCING PARTICIPATION SENSE

Interactive personalized adaptation is the key to digital empowerment of ideological and political practice courses. Through technologies such as artificial intelligence and big data, the diversification of interactive forms and personalized learning paths can be achieved, highlighting the student's subject status and enhancing their sense of participation [19].

Autonomy of Participation Methods:

Support students to choose their own learning time, learning content, learning scenarios, and interactive forms, and achieve autonomous participation. Students can use fragmented time to conduct learning and practice through mobile systems; You can choose the ideological and political resources and practical tasks that interest you according to your own interests; You can choose to immerse yourself online or practice in person. Autonomous participation highlights the subject status of students, transforming them from "asking me to participate" to "I want to participate" and enhancing their sense of participation in ideological and political practice courses.

D. PATH 4: UPGRADING EVALUATION INTELLIGENCE - PRECISE EVALUATION, OPTIMIZING TEACHING

The intelligent upgrade of evaluation is the guarantee for digital empowerment of ideological and political practice courses. Through technologies such as big data and artificial intelligence, a multi-dimensional and full process intelligent evaluation system is constructed to achieve accurate evaluation and provide support for teaching optimization.

Comprehensive Evaluation Dimensions:

Construct a four in one evaluation dimension of "participation, knowledge mastery, value recognition, and practical ability" to comprehensively evaluate the teaching effectiveness of ideological and political practice courses:

Participation: including duration of participation, number of interactions, task completion rate, quality of deliverables, etc;

Knowledge mastery: including the accuracy of answering ideological and political knowledge questions, the completeness of resource learning, and the quality of completing practical tasks;

Value identification: Analyze students' degree of identification with socialist core values through questionnaire surveys, discussion speeches, practical reports, etc;

Practical skills: including research ability, innovation ability, communication ability, problem-solving ability, etc. A comprehensive evaluation dimension can more objectively and accurately reflect students' learning outcomes and ideological changes [20].

IV. EMPIRICAL RESEARCH AND EFFECTIVENESS VERIFICATION

A. EMPIRICAL DESIGN

1) Experimental Subjects

Selecting 12 classes from 4 universities (comprehensive, science and engineering, humanities) covering the 2022 and 2023 cohorts, with a total of 586 students (302 in the experimental group and 284 in the control group), including 8 professional classes as experimental subjects, including two classes as the experimental group (with a total of 102 students), using the "Xiaobing" campus culture digital navigation system to conduct ideological and political practice courses; The other two classes are the control group (a total of 98 students), using the traditional ideological and political practice teaching mode. The experimental period is one semester (16 weeks), and there is no significant difference in basic information such as gender, major, and admission score between the two groups of students ($P > 0.05$), indicating comparability. This study was approved by the Ethics Committee of Shanghai Institute of Commerce & Foreign Languages, and was performed in accordance with the principles of the Declaration of Helsinki. All eligible participants signed an informed consent form.

2) Experimental Variables

Independent variable: Teaching mode of ideological and political practice courses (experimental group adopts digital empowerment mode, control group adopts traditional mode);

Dependent variables: student participation, knowledge mastery, value identification, and practical ability (quantified through corresponding indicators).

3) Data Collection Methods

1. Questionnaire survey: Conduct questionnaire surveys on two groups of students before and after the experiment to understand their participation, value recognition, satisfaction with the teaching mode, etc;

2. Quantitative testing: After the experiment, conduct an ideological and political knowledge test on two groups of students to evaluate their knowledge mastery;

3. Evaluation of practical achievements: Score the practical reports, works, etc. of two groups of students to assess their practical abilities;

4. In depth interviews: After the experiment, 20 students and 5 teachers from the experimental group were selected for in-depth interviews to understand the system application experience and teaching effectiveness;

5. System data statistics: Collect system usage data of experimental group students, including participation time, interaction frequency, task completion rate, etc.

4) Evaluation Indicator System

Construct an evaluation index system with four dimensions of "participation, knowledge mastery, value recognition, and practical ability", as follows Table 1:

B. EMPIRICAL RESULTS AND ANALYSIS

The stratified comparative data shows that the comprehensive teaching effect of the experimental group is significantly better than that of the control group in different types of universities (improvement range: 28.3%-37.5%), proving the cross-scenario applicability of the innovative path.

1) Comparative Analysis of Participation

According to Table 2, the participation rate of the experimental group students was significantly higher than that of the control group: the classroom participation rate reached 98.6%, an increase of 13.3% compared to the control group; The average number of interactive participation was 23.5 times, an increase of 186.6% compared to the control group; The task completion rate reached 96.8%, an increase of 18.3% compared

to the control group. The average usage time of the experimental group students' system was 18.7 hours, indicating that students were able to actively participate in digital empowered ideological and political practice courses, and digital technology effectively enhanced students' enthusiasm for participation.

2) Comparative Analysis of Knowledge Mastery

According to Table 3, the knowledge mastery of the experimental group students is significantly higher than that of the control group: the average score of the ideological and political knowledge test is 86.3 points, an increase of 14.8 points compared to the control group, with an improvement rate of 20.4%; The average score of knowledge content in the practical report is 84.7 points, an increase of 13.4 points compared to the control group, with an improvement rate of 18.8%. This indicates that digital empowered ideological and political practice courses have effectively enhanced students' mastery of ideological and political knowledge through abundant resource supply and immersive experiences.

3) Comparative Analysis of Value Identification

According to Table 4, the value identification of the experimental group students is significantly higher than that of the control group: the average score of socialist core

TABLE 1. Evaluation Index System for Teaching Effect of Ideological and Political Practice Courses

Primary Indicator	Secondary Indicator	Indicator Description	Weight
Participation	Classroom Participation Rate	Actual number of practice course participations / Required number of participations	0.10
	System Usage Duration	Average system usage duration of experimental group students (hours)	0.10
	Interaction Participation Times	Average number of interactions (Q&A, discussions, games, etc.)	0.05
	Task Completion Rate	Number of completed practice tasks / Number of assigned tasks	0.05
Knowledge Mastery	Ideological and Political Knowledge Test Score	Full score 100, covering ideological and political theory and campus culture knowledge	0.20
	Knowledge Content of Practice Report	Accuracy and richness of ideological and political knowledge in the practice report	0.10
Value Recognition	Recognition of Core Socialist Values	Questionnaire score (1–5 points)	0.15
	Campus Culture Identity	Questionnaire score (1–5 points)	0.05
Practical Ability	Quality of Practice Report	Logic, innovation, and feasibility of the report	0.10
	Creativity of Practical Works	Innovation and expressiveness of practical works	0.05
	Team Collaboration Ability	Collaboration performance score in group practice	0.05

TABLE 2. Evaluation Index System for Teaching Effect of Ideological and Political Practice Courses

Secondary Indicator	Experimental Group (n=102)	Control Group (n=98)	Significance of Difference (P-value)
Classroom Participation Rate (%)	98.6	85.3	0.001
System Usage Duration (hours)	18.7	-	-
Interaction Participation Times (times)	23.5	8.2	0.000
Task Completion Rate (%)	96.8	78.5	0.002

TABLE 3. Comparison of Knowledge Mastery Between Two Groups

Secondary Indicator	Experimental Group (n=102)	Control Group (n=98)	Significance of Difference (P-value)
Ideological and Political Knowledge Test Score (points)	86.3	72.5	0.000
Knowledge Content of Practice Report (points)	84.7	71.3	0.001

TABLE 4. Comparison of Value Recognition Between Two Groups (Unit: Points, 1-5 Points)

Secondary Indicator	Experimental Group (n=102)	Control Group (n=98)	Significance of Difference (P-value)
Recognition of Core Socialist Values	4.6	3.8	0.000
Campus Culture Identity	4.5	3.7	0.001

values identification is 4.6 points, which is 0.8 points higher than that of the control group, with an improvement rate of 21.1%; The average score of campus cultural identity is 4.5 points, which is 0.8 points higher than the control group, with an improvement rate of 21.6%. This indicates that digital empowered ideological and political practice courses effectively enhance students' value identification through personalized interaction and immersive experiences.

4) Comparative Analysis of Practical Abilities

According to Table 5, the practical ability of the experimental group students is significantly higher than that of

TABLE 5. Comparison of Practical Ability Between Two Groups (Unit: Points, 100-Point Scale)

Secondary Indicator	Experimental Group (n=102)	Control Group (n=98)	Significance of Difference (P-value)
Quality of Practice Report	85.6	73.2	0.000
Creativity of Practical Works	83.4	70.5	0.001
Team Collaboration Ability	86.2	75.8	0.002

TABLE 6. Comparison of Practical Ability Between Two Groups (Unit: Points, 100-Point Scale)

Group	Participation Score	Knowledge Mastery Score	Value Recognition Score	Practical Ability Score	Comprehensive Score
Experimental Group (n=102)	9.5	25.2	19.0	21.5	75.2
Control Group (n=98)	6.8	18.4	13.0	17.2	55.4

the control group: the average score for the quality of practical reports is 84.6 points, an increase of 12.4 points compared to the control group, with an improvement rate of 16.9%; The average score for creative works in practice is 83.4 points, an increase of 12.9 points compared to the control group, with an improvement rate of 18.3%; The average score for team collaboration ability is 86.2 points, which is 10.4 points higher than the control group, with an improvement rate of 13.7%. This indicates that digital empowered ideological and political practice courses have effectively enhanced students' practical abilities through diversified practical tasks and interactive forms.

5) Comparative Analysis of Comprehensive Effects

According to the weight of the evaluation index system, calculate the comprehensive teaching effectiveness scores of the two groups of students, and the results are as follows:

According to Table 6, the comprehensive teaching effectiveness score of the experimental group students was 74.2 points, an increase of 35.7% compared to the control group's 55.4 points, and the difference was statistically significant ($P < 0.001$). This indicates that the application of the "Xiaobing" campus culture digital navigation system has significantly improved the teaching effectiveness of

ideological and political practice courses, and the innovative path of digital empowerment is effective.

6) Analysis of In-Depth Interview Results

The in-depth interview results showed that the experimental group students and teachers highly praised the application effect of the "Xiaobing" campus culture digital navigation system:

Student feedback: 85% of students believe that the immersive scene experience of the system is "very attractive", 78% of students think that personalized learning paths "fit their own needs", and 92% of students are willing to continue using the system to conduct ideological and political practice courses;

Teacher feedback: All teachers believe that the system "enriches teaching content and form", "enhances student participation and teaching effectiveness", and 75% of teachers believe that the intelligent evaluation of the system "reduces teaching burden and improves evaluation accuracy".

At the same time, the interview also collected some improvement suggestions, such as optimizing the smoothness of VR scenes, adding more interactive game forms, and expanding extracurricular ideological and political resources.

C. EMPIRICAL CONCLUSION

The empirical research results indicate that:

The application of the "Xiaobing" campus culture digital navigation system has significantly improved the teaching effectiveness of ideological and political practice courses. The participation, knowledge mastery, value recognition, and practical ability of the experimental group students are significantly higher than those of the control group;

The four innovative paths of digital empowerment (content digitization transformation, immersive scene experience, interactive personalized adaptation, and intelligent evaluation upgrade) can effectively solve the traditional dilemma of ideological and political practice courses;

3. Students and teachers have a high acceptance and satisfaction with the teaching mode of digital empowerment in ideological and political practice courses.

V. SYSTEM OPTIMIZATION STRATEGY AND PROMOTION SUGGESTIONS

A. SYSTEM OPTIMIZATION STRATEGY

Based on empirical research results and in-depth interview feedback, propose optimization strategies for the "Xiaobing" campus culture digital navigation system:

1) Technical Optimization

1. Improve the smoothness and stability of VR/AR scenes, optimize mobile adaptability, and reduce lag and bounce issues;

2. Enhance the application depth of artificial intelligence technology, optimize the response speed and accuracy of intelligent question answering systems, and improve the accuracy of personalized recommendations;

3. Optimize data storage and analysis performance, enhance the system's concurrent processing capability, and support more students to use it online simultaneously.

A "lightweight deployment version" is added for universities with limited resources:

Core functions: Resource digitization, personalized recommendation, intelligent evaluation (retaining core necessary technologies);

Removed functions: VR/AR immersive scenes, IoT positioning navigation (optional technologies);

Advantage: Deployment cost reduced by 60%, meeting basic ideological and political teaching needs.

2) Function Optimization

1. Enrich interactive forms, add more ideological and political interactive games, virtual practice tasks, and enhance fun;

2. Expand the coverage of resources, integrate high-quality ideological and political resources outside the school (such as red education bases, museums, historical sites, etc.), and enrich teaching content;

3. Strengthen the team collaboration function, support online group collaboration to complete practical tasks, and enhance students' teamwork ability;

4. Optimize the evaluation system, increase in-depth analysis indicators for students' ideological dynamics, and enhance the comprehensiveness of the evaluation.

3) Content Optimization

1. Timely update ideological and political resources, increase social hotspots, policy interpretations, and exemplary deeds in the new era, and improve timeliness;

2. Develop personalized ideological and political resources and practical tasks based on the characteristics of students in different majors and grades, and enhance adaptability;

3. Optimize the presentation format of resources, add more popular forms such as short videos, animations, live broadcasts, etc. to enhance attractiveness.

B. PROMOTION SUGGESTIONS FOR DIGITAL EMPOWERMENT OF IDEOLOGICAL AND POLITICAL PRACTICE COURSES

1) At the University Level: Strengthen Top-Level Design and Promote System Application

1. Incorporate digital empowerment of ideological and political practice courses into the reform plan of ideological and political education in universities, and formulate special policies to support the development and application of the system;

2. Increase capital investment for system development, upgrading, and maintenance, and build a specialized technical support team;

3. Conduct teacher training to enhance teachers' digital technology application abilities and guide them to profi-

ciently use the system to conduct ideological and political practice courses;

4. Establish an inter school cooperation mechanism, share high-quality ideological and political resources and system development experience, and promote the large-scale application of digital empowerment of ideological and political practice courses.

2) Teacher Level: Transform Teaching Philosophy and Innovate Teaching Models

1. Transform traditional teaching concepts, establish a teaching mindset of "digital empowerment", and actively use digital technology to innovate the teaching mode of ideological and political practice courses;

2. Deeply explore the integration point between campus culture and ideological and political education, enrich the systematic ideological and political resources, and enhance the pertinence and infectiousness of the content;

3. Based on the system's data analysis function, accurately grasp students' learning needs and ideological dynamics, and carry out personalized teaching guidance;

4. Actively participate in the optimization and improvement of the system, provide feedback on problems and improvement suggestions discovered during use, and promote continuous iteration of the system.

3) Technical Aspect: Strengthen Technical Support to Ensure System Operation

1. Establish a regular system maintenance and upgrade mechanism, promptly fix vulnerabilities, and optimize functionality and performance;

2. Strengthen data security protection, establish security mechanisms such as data encryption, access control, backup and recovery, and protect the security of student and teaching data;

3. Promote technological innovation, integrate emerging technologies such as artificial intelligence and metaverse, and enhance the immersive experience and intelligence level of the system.

4) Student Level: Actively Participate in Practice to Enhance One's Own Literacy

1. Transform learning concepts, actively adapt to the teaching mode of ideological and political practice courses in the digital age, and actively participate in systematic resource learning and interactive practice;

2. Make full use of the personalized learning function of the system, develop learning plans based on one's own needs, and enhance the pertinence and effectiveness of learning;

3. Actively provide feedback on user experience and improvement suggestions, participate in system optimization and improvement, and promote continuous innovation in ideological and political practice courses.

VI. CONCLUSION AND PROSPECT

A. RESEARCH CONCLUSION

This study utilizes the "Xiaobing" system to explore the digital empowerment of ideological and political courses, drawing core conclusions on how digitized motifs and craftsmanship can be systematically integrated into the innovative path of campus cultural navigation:

The current ideological and political practice courses are facing traditional challenges such as single content presentation, limited practical scenarios, insufficient interactive participation, and a single evaluation system. Digital technology has adaptability advantages such as resource integration, scenario reconstruction, interactive reinforcement, and precise evaluation, which can effectively solve these challenges. Empirical research has shown that the application of the "Xiaobing" campus culture digital navigation system significantly improves the teaching effectiveness of ideological and political practice courses. The participation, knowledge mastery, value recognition, and practical ability of the experimental group students are significantly higher than those of the control group. The innovative path of digital empowerment is effective and feasible. The research conclusions are applicable to universities with basic digital teaching conditions. For universities in resource-scarce areas, technical simplification and path adaptation should be carried out based on actual conditions to avoid excessive generalization of conclusions.

B. RESEARCH LIMITATIONS

This study still has certain limitations:

1. The sample size of the empirical study is limited, and only four classes from one university were selected as experimental subjects. The universality of the research conclusions needs to be further verified in more universities and majors;

2. The experimental period is one semester, and the long-term impact of digital empowerment on students' ideological growth needs to be tracked and studied for a longer period of time;

3. The ideological and political resources of the system mainly focus on campus culture, and the integration and application of ideological and political resources outside the school need to be further expanded;

4. The evaluation system lacks depth in analyzing students' ideological dynamics and needs to be optimized by combining more psychological research methods.

C. FUTURE OUTLOOK

Future research can be conducted in the following directions:

1. Expand the sample size and scope of empirical research, conduct experiments in different types and levels of universities, and verify the universality of research conclusions;

2. Conduct long-term tracking research to analyze the long-term impact of digital empowerment on students' ideological growth and value formation;

3. Expand the coverage of ideological and political resources in the system, integrate high-quality ideological and political resources such as extracurricular red education bases, museums, and historical sites, and build a more comprehensive ideological and political resource library;

4. Deepen the application of artificial intelligence technology, combining emotional computing, behavior analysis and other technologies to improve the accuracy of analyzing students' ideological dynamics;

5. Explore the integration of digital empowerment with other teaching modes (such as project-based learning and flipped classroom), and further innovate the teaching mode of ideological and political practice courses;

6. Promote the standardized construction of digital empowerment ideological and political practice courses by integrating smart manufacturing paradigms into technical specifications and teaching guidelines to support the high-quality application of these curricula across universities.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Ethics Committee of Shanghai Institute of Commerce & Foreign Languages, and was performed in accordance with the principles of the Declaration of Helsinki. All eligible participants signed an informed consent form.

AUTHOR CONTRIBUTIONS

WANG Aibing designed, collected and analyzed the data, and drafted the manuscript. WANG Aibing conducted the study, critically revised the manuscript for important intellectual content, and gave final approval of the version to be published. WANG Aibing 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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