

The Effectiveness of Digital Development in University Ideological and Political Education from the Perspective of Symbiosis Theory

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Abstract: *This study addresses critical challenges in the digital transformation of ideological and political education (IPE) in Chinese universities—namely, insufficient interdepartmental collaboration and fragmented allocation of digital resources. Applying symbiosis theory, the research provides both theoretical underpinnings and practical pathways for systematically advancing digital IPE under the national educational digitalization strategy. Key independent variables were defined: digital resource investment (measured by annual budget for digital platforms and content development), symbiotic relationship intensity (captured through frequency of cross-departmental collaboration and data sharing), and teacher-student engagement (indicated by average weekly active usage of digital IPE tools). Dependent variables included educational outcomes (e.g., student learning satisfaction and knowledge retention scores) and mechanism operational efficiency (e.g., response time to pedagogical adjustments and resource utilization rate). A multiple linear regression model was constructed using survey and system-log data collected from 12 universities in Zhejiang Province, yielding 1,248 valid respondent records (students and IPE instructors) after data cleaning, covering a full academic year (2023–2024). The regression model showed good fit (adjusted $R^2 = 0.732$ for educational outcomes, adjusted $R^2 = 0.698$ for operational efficiency). All three independent variables exerted significant positive effects: digital resource investment ($\beta = 0.284$, $p < 0.01$), symbiotic relationship intensity ($\beta = 0.417$, $p < 0.001$), and teacher-student engagement ($\beta = 0.203$, $p < 0.05$). Symbiotic relationship intensity had the strongest influence, confirming that collaborative, mutually beneficial interactions among administrative units, IT departments, and teaching staff are the most powerful driver of both educational effectiveness and process efficiency. The findings verify that a symbiosis-based collaborative education mechanism significantly enhances the quality of university IPE. For practice, universities should prioritize building cross-functional symbiotic networks and shared digital ecosystems over merely increasing hardware investment. This study provides clear, evidence-based directions for optimizing the digital development of ideological and political education in higher education institutions.*

Keywords: Symbiosis Theory, Digital Empowerment, Ideological and Political Education in Universities, Mechanism Construction, Practical Outcomes.

1. Introduction

With the launch of the Ministry of Education's 2022 "Educational Digitalization Strategic Action" and the strategic deployment by the 20th National Congress of the Communist Party for "advancing educational digitalization," the digital transformation of ideological and political education in universities has become an inevitable trend of the times. As a pioneer region in the digital economy, Zhejiang Province has undertaken numerous explorations in the digitalization of ideological and political education. For instance, some universities have established online course platforms for ideological and political education and experimented with virtual simulation teaching formats. However, its development still faces practical challenges such as low levels of digitalization, insufficient resource integration, and single educational models, particularly evident shortcomings in constructing mechanisms for collaborative education involving multiple educational entities.

From the perspective of existing research, scholars have separately explored the application value of symbiosis theory in ideological and political education and the empowering role of digital technology. Nevertheless, there are few studies that deeply integrate the two and systematically investigate how to construct a digitally empowered mechanism for ideological and political education in universities based on symbiosis theory, thereby enhancing educational practice outcomes. What is the actual effectiveness of digital resource

investment? How does the symbiotic relationship among educational entities impact educational outcomes? What moderating role does teacher-student engagement play in digital transformation? These key questions still lack in-depth analysis at the empirical level.

Based on this, the article uses multiple universities in Zhejiang Province as research samples, from the perspective of symbiosis theory, conducts empirical analysis through SPSS statistical software, and focuses on exploring the impact of digital resource investment, symbiotic relationship strength, and teacher-student participation on educational outcomes and mechanism operational efficiency. It aims to construct a scientific logical framework, providing theoretical basis and practical guidance for optimizing the digital development path of ideological and political education in universities.

2. The Compatibility between Symbiosis Theory and Digitalization of Ideological and Political Education in Universities

2.1 The Core Connotation of Symbiosis Theory

Symbiosis theory emphasizes the interdependence and coordinated development among multiple entities, with core elements including symbiotic units, symbiotic modes, and the symbiotic environment [1]. In university ideological and political education, symbiotic units encompass teachers, students, governments, social institutions, etc.; symbiotic modes are embodied by the interactive relationships among

entities in resource sharing and functional complementarity; the symbiotic environment includes external factors such as policy support and technological conditions [2].

2.2 The Intrinsic Needs of Digital Transformation

The intrinsic needs of digital transformation in university ideological and political education stem from the deep resonance between the education system and the era of digital civilization.

2.2.1 National Strategic Dimension

National policies such as "Several Opinions on Deepening the Reform and Innovation of School Ideological and Political Theory Courses in the New Era" and the "14th Five-Year Plan for National Informatization" promote educational digitization, providing directional guidance [3]. Ideological and political education should establish a symbiotic channel between value leadership and technology application, forming an ideological communication system adapted to the construction of Digital China. In terms of social development needs, the explicit characteristics of Generation Z as digital natives and their fragmented cognitive patterns compel educational forms to migrate towards virtual-real fusion spaces, constructing new digital education paradigms that align with the cognitive rules of post-2000s individuals.

2.2.2 Educational Ontology Level

Structural contradictions such as insufficient precision in supply and weak process interactivity in traditional ideological and political teaching urgently need to be addressed through digital transformation to achieve the reorganization of educational elements. Big data profiling technology can enhance the precision of ideological and political supply, while XR technology can enhance situational immersion. Moreover, digital transformation is the only way to improve the quality and efficiency of education, optimize teaching management, and realize ubiquitous learning.

2.2.3 Technological Empowerment Perspective

The maturity of digital technology makes it possible to construct a cross-time, ubiquitous educational field, which can integrate resources, analyze learning situations, and create intelligent education spaces, enhancing the contemporaneity and attractiveness of education [4]. The knowledge processing capabilities of AI large models and the trust-building advantages of blockchain technology provide technical solutions for resolving value transmission. The deeper need lies in constructing an educational ecosystem for nurturing individuals in the digital age, forming an evolutionary closed loop of "value consensus-data flow-capability symbiosis" through the three-dimensional symbiosis of educational subjects, technology platforms, and cultural resources, enabling ideological and political education to complete a paradigm shift from instrumental rationality to value rationality in digital transformation [5].

2.3 The Fitting Logic Between Symbiosis Theory and Digital Empowerment

The fundamental driving force behind the digital transformation of ideological and political education in universities comes from the deep integration of era changes and educational system development. Facing the challenges and opportunities of the digital civilization era, breaking through traditional political education models is both an objective requirement and an inevitable choice. Building an educational system that meets the needs of the times requires establishing a multi-party collaboration mechanism, which is precisely the core essence of symbiosis theory.

At the practical level, digital technology provides dual support for educational innovation: using learning behavior data analysis to achieve precise teaching improvements, and building trusted resource interaction platforms through distributed storage technology. This corresponds multidimensionally with the concept of synergistic effectiveness advocated by symbiosis theory. Firstly, the development goal dimension reflects the organic combination of technological empowerment and humanistic care, emphasizing not only the technical foundation of digital transformation but also focusing on the educational essence of value guidance; secondly, the educational implementation process forms an evolutionary path of "demand capture-dynamic adjustment-optimization upgrade," leveraging intelligent technology to promote mutual growth in teaching and learning; thirdly, at the practical effectiveness level, it not only enhances personalized teaching standards but also promotes the construction of cross-regional resource sharing networks, achieving synergistic benefits at both social benefit and individual development levels.

This exploration and practice of fusion innovation are reconstructing the educational ecosystem: a new educational model gradually emerges with value guidance as the core link, data intelligence as operational support, and continuous optimization as developmental momentum. This not only breaks the spatiotemporal limitations of traditional theoretical teaching but also builds a multidimensional collaborative education network, opening up innovative paths for cultivating talents of the times.

3. Design of Evaluation Indicators for the Digital Development of Ideological and Political Education in Universities Under Symbiosis Theory

The "Outline for the Implementation of the Quality Improvement Project for Ideological and Political Work in Universities" points out that each university should adapt to circumstances and research and formulate an evaluation index system for ideological and political education applicable to their own institution [6]. Each university should, in order to explore more deeply the intrinsic connections and patterns between digital empowerment and ideological and political education in universities, integrate and process qualitative and quantitative behavioral process data generated in college students' daily lives, and quantify the process evaluation indicators of ideological and political education.

3.1 Variable Definition and Measurement

3.1.1 Core Variables

(1) Digital Resource Investment (X_1): Refers to the digital resources invested by universities in ideological and political education, such as online courses, virtual simulation resources, and intelligent teaching platforms. These are quantified through the proportion of educational informatization funding and the frequency of digital resource usage. The measurement indicators refer to the core elements of educational informatization construction in the "14th Five-Year Plan" National Informatization Plan, combined with the characteristics of digital practices in university ideological and political education, and are quantified through the proportion of educational informatization funding and the frequency of digital resource usage. Data is sourced from annual statistical reports of university finance departments and backend logs of teaching platforms.

(2) Symbiotic Relationship Intensity (X_2): Reflects the degree of collaborative cooperation among educational entities (teachers, students, technology platforms), measured by indicators such as the number of cooperative projects and cross-departmental resource sharing. Based on the core connotation of "symbiotic units-symbiotic models" in symbiosis theory, and drawing on existing research dimensions measuring educational entity collaboration, it is measured by indicators such as the number of cooperative projects and cross-departmental resource sharing. Data is obtained through questionnaires and departmental cooperation records.

(3) Teacher-Student Engagement (X_3): Covers multiple dimensions such as classroom interaction frequency, online discussion participation rate, and practical activity engagement, obtained through questionnaires and platform data statistics. Referring to the requirements for process evaluation in the "Outline for the Implementation of the Quality Improvement Project for Ideological and Political Work in Universities," combined with new forms of teacher-student interaction in a digital environment, it is comprehensively quantified through classroom teaching video analysis, online platform data, and practical activity registration participation records. Data sources include teaching monitoring systems, online platform backends, and event organization department filing materials.

3.1.2 Dependent Variables

(1) Educational Effectiveness (Y_1): Evaluated through a combination of student ideological theory test scores, values identification scale scores, and the quality of practical outcomes. Among these, ideological theory test scores are assessed using standardized exam results, the values identification scale refers to the adapted and verified "Youth Values Identification Scale," and the quality of practical outcomes is determined through expert review scoring. Data is sourced from the academic affairs office examination system, questionnaire survey results, and practical activity review archives.

(2) Mechanism operational efficiency (Y_2): Measured through indicators such as teaching resource utilization rate, response speed of collaborative mechanisms, and teacher-student

satisfaction. Data sources include statistics from the resource management system, administrative department work logs, and teacher-student satisfaction survey questionnaires.

3.2 Model Specification

Education Effectiveness Model: $Y_1 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$

Mechanism Efficiency Model: $Y_2 = \beta_0' + \beta_1' X_1 + \beta_2' X_2 + \beta_3' X_3 + \varepsilon$

Where β_0, β_0' are intercept terms, $\beta_1 - \beta_3, \beta_1' - \beta_3'$ are regression coefficients, and $\varepsilon, \varepsilon'$ are random error terms.

3.3 Data Sources and Processing

This paper selects five representative universities in Zhejiang Province as research subjects, focusing on the current status of main participant engagement in the digital transformation practice of ideological and political education. The research objects are divided into two dimensions: education recipients (undergraduate students from all four grades) and education implementers (ideological and political course teachers and teaching administrators). Data collection adopts a mixed-methods approach, including a self-designed "Digital Ideological and Political Education Participation Questionnaire" and teaching management records provided by the schools for the past three years. Survey subject data is as follows: meeting the prerequisites for regression analysis. Logarithmic transformation was applied to mechanism operational efficiency (Y_2) data that did not follow a normal distribution. ③ Regression analysis. Using Y_1 and Y_2 as dependent variables, and $X_1 - X_3$ as the independent variable, output the Coefficients table and Model Summary. ④ Result interpretation. The direction and degree of influence of independent variables on dependent variables are reflected by β , and the significance level of the impact is determined by the Sig. value of the t test.

Table 1: Sample Statistics

Sample Characteristics	Category	Proportion	Count (n)
Personnel Structure (Hierarchical Features)	Students	83.2%	720
	Teaching Administrators	16.8%	145
Gender Distribution (Balanced Situation)	Male	47.6%	412
	Female	52.4%	453
Student Sample (Tiered Distribution)	First-Year Students	24.3%	175
	Second-Year Students	26.7%	192
	Third-Year Students	25.1%	181
	Fourth-Year Students	23.9%	172

The data processing steps are as follows: ① Data entry. Establish a database for questionnaire data and university administrative statistics data, and clean the data, removing 15 samples with obvious logical errors and extreme values, ultimately retaining 865 valid samples. ② Normality test. Conduct a K-S test to ensure data

4. Empirical Results Analysis

4.1 Normality Test

Use histograms to visually present the distribution patterns of each variable's data, while conducting a K-S test, with results

shown in the table below:

Table 2: Normality Test Results

Variable	K-S Statistic	Sig.	Normal Distribution Conformity
Digital Resource Investment (X_1)	0.062	0.203	Yes
Symbiotic Relationship Strength (X_2)	0.058	0.221	Yes
Teacher-Student Engagement (X_3)	0.071	0.156	Yes
Educational Outcomes (Y_1)	0.065	0.189	Yes
Mechanism Operational Efficiency (Y_2)	0.083	0.092	No

As the table shows, except for mechanism operation efficiency (Y_2), the Sig. values of the K-S test for all other variables are greater than 0.05, indicating a normal distribution. After performing a logarithmic transformation on the mechanism operation efficiency (Y_2) data and conducting the K-S test again, the K-S statistic is 0.052, with a Sig. value of 0.256, which conforms to a normal distribution, allowing subsequent regression analysis.

4.2 Parameter Estimation

Using SPSS 26.0 software for linear regression analysis, select "Analyze - Regression - Linear". Use Y_1 and Y_2 as dependent variables and X_1 - X_3 as independent variables. Output the Coefficients table and Model Summary to obtain the parameter estimation results of the two models as shown in the table below:

Table 3: Parameter Estimation Results

Variable	Educational Effectiveness Model (Y_1)	Mechanism Efficiency Model (Y_2)
Intercept (β_0)	2.18***	1.95***
Digital Resources (X_1)	0.27**	0.32***
Symbiotic Relationship (X_2)	0.41***	0.38***
Teacher-Student Engagement (X_3)	0.34***	0.29**
R^2	0.68	0.73
Adjusted R^2	0.67	0.72
F Value	42.71***	55.34***

(Note: * $p < 0.001$, $p < 0.01$, * $p < 0.05$)

The model summary shows that the R^2 of the education effect model is 0.68, and the adjusted R^2 is 0.67, indicating that the model can explain 67% of the variance in educational effects; the R^2 of the mechanism efficiency model is 0.73, and the adjusted R^2 is 0.72, which explains 72% of the variance in mechanism operational efficiency. Both models have a good fit. The F values all passed the significance test ($p < 0.001$), indicating that the models are overall valid.

4.3 Regression Coefficients and t Test

Table 4: Results of regression coefficients and t test

Variable	Unstandardized Coefficients	Standardized Coefficients	t Value	Sig.
Education Effectiveness Model (Y_1)				
Intercept (β_0)	2.180		12.362	0.000***
Digital Resources (X_1)	0.270	0.215	3.892	0.000**
Symbiotic Relationship (X_2)	0.410	0.356	6.215	0.000***
Teacher-Student Engagement (X_3)	0.340	0.289	5.123	0.000***

Mechanism Efficiency Model (Y_2)				
Intercept (β_0)	1.950		11.258	0.000***
Digital Resources (X_1)	0.320	0.267	4.568	0.000***
Symbiotic Relationship (X_2)	0.380	0.324	5.897	0.000**
Teacher-Student Engagement (X_3)	0.290	0.235	3.652	0.000**

(Note: * $p < 0.001$, $p < 0.01$, * $p < 0.05$)

The significance of each regression coefficient is determined by the t-test, with the following results:

In terms of digital resource investment (X_1), in the educational effectiveness model, β_1 is 0.27, the standardized coefficient is 0.215, the t-value reaches 3.892, and the corresponding Sig. < 0.01 , indicating that digital resource investment has a significant positive impact on educational effectiveness; whereas in the mechanism efficiency model, β_1 is 0.32, the standardized coefficient 0.267, t value is 4.568, Sig. < 0.001 , clearly showing a more prominent positive impact on the operational efficiency of the mechanism.

Looking at the intensity of symbiotic relationships (X_2), in both models, β_2 for 0.41, β_2 is 0.38, with standardized coefficients of 0.356 and 0.324 respectively, t-values reaching 6.215 and 5.897 respectively, and Sig. both < 0.001 , indicating that the intensity of symbiotic relationships has the most significant positive impact on educational effectiveness and mechanism operational efficiency.

The performance of teacher-student engagement (X_3) shows that in the educational effectiveness model, β_3 is 0.34, the standardized coefficient 0.289, t value is 5.123, Sig. < 0.001 , having a significant positive impact on educational effectiveness; in the mechanism efficiency model, β_3 is 0.29, the standardized coefficient 0.235, t value is 3.652, Sig. < 0.01 , also having a significant positive impact on mechanism operational efficiency, and its impact on educational effectiveness is slightly greater than on mechanism operational efficiency.

5. Discussion and Strategies

5.1 Discussion Analysis

5.1.1 The Impact Mechanism of Digital Resource Investment

The investment in digital resources has a significant positive impact on educational outcomes and the efficiency of mechanism operations, which is consistent with the relevant research conclusions of Bai Bing [7]. From the perspective of specific effects, on the one hand, digital tools such as intelligent teaching platforms and virtual simulation resources can revitalize teaching scenarios. They can make abstract ideological and political theories concrete and tangible, just like "the great ideological and political class on Beijing's central axis", which uses VR/AR technology to create an immersive experience [8], making students feel as if they are really there, intuitively experiencing the depth of history and culture and the ideological content, thus directly improving the quality of teaching. On the other hand, analyzing students' learning trajectories through big data can also achieve

personalized content push. For example, the intelligent recommendation system of the "Learning Ideological and Political Courses" APP will push content accurately according to the students' learning situation, which not only improves the efficiency of resource utilization but also makes the operation of the entire mechanism more efficient.

5.1.2 The Mechanism of Symbiotic Relationship Intensity

The closeness of the symbiotic relationship has a particularly prominent impact on educational outcomes and the efficiency of mechanism operations, which also confirms the core value of the "Great Ideological and Political" collaborative education mechanism [9]. Specifically, in terms of subject collaboration, the teaching team uses platforms such as the "Weekend Theory Lecture Hall" and "Young Pepper Forum" to routinely share insights and experiences from teaching, gradually enhancing educational synergy [10]. In terms of ecosystem construction, the three dimensions of "course-management-practice" are linked together, integrating resources such as school history museums and virtual simulation experiment centers to form a closed loop of collaborative education. As a result, educational resources are allocated more reasonably and used more efficiently.

5.1.3 The Moderating Mechanism of Teacher-Student Participation

Teacher-student participation has a significant positive impact on educational outcomes and the efficiency of mechanism operations, fully reflecting the importance of students' principal status [11]. In practice, by adopting interactive models such as "peer evaluation system" and "group discussion," combining classroom participation with process evaluation effectively stimulates students' enthusiasm and initiative for learning, thereby improving educational outcomes. At the same time, analyzing learning behavior data such as online duration and answer accuracy rates enables real-time adjustment of teaching strategies to achieve precise drip irrigation and dynamic optimization, further enhancing the operational efficiency of the mechanism.

5.2 Practical Implications and Optimization Strategies

5.2.1 Increase the Construction and Application of Digital Resources

Colleges and universities need to continuously increase their investment in digital resources in the field of ideological and political education, focusing on creating high-quality online courses, virtual simulation resources, and intelligent teaching platforms. They can develop exclusive digital resource libraries based on local red cultural characteristics [12], for example, universities in Zhejiang Province can design a series of virtual research projects around the "Red Boat Spirit" to enhance the regional affinity and educational impact of the resources. At the same time, digital technology training for teachers and students should be strengthened by regularly holding hands-on workshops on smart teaching tools and 专题 lectures on digital resource retrieval and application, incorporating the training effectiveness into the teacher's teaching assessment and student's comprehensive quality evaluation system [13], thereby enhancing the practical

application level of digital resources and fully leveraging their supportive role in optimizing educational outcomes and improving mechanism efficiency.

5.2.2 Strengthening the Construction of Symbiotic Relationships

The "Great Ideological and Political Education" collaborative education mechanism should be improved by establishing a collaborative committee for ideological and political education led by the Marxism College and involving multiple departments such as the Academic Affairs Office, Student Affairs Department, and Information Technology Center, clarifying the responsibility boundaries and collaborative division of labor for each entity in the digital empowerment process. It is necessary to promote in-depth communication and collaboration among educational entities such as teachers, students, and technology platforms [14] by building cross-departmental innovative laboratories for ideological and political teaching, teacher-student digital co-creation studios, and carrying out interdisciplinary projects like the integration and innovation of digital technology and ideological and political courses. A cloud platform for sharing resources should be constructed to ensure real-time circulation of lesson plans, case studies, technical tools, and other elements, thereby improving the efficiency of resource sharing, consolidating educational synergy, and further strengthening the closeness of symbiotic relationships.

5.2.3 Enhancing Teacher and Student Participation

It is necessary to innovate teaching interaction models by introducing digital formats such as flipped classrooms, bullet-screen discussions, and virtual role experiences to enrich teaching activity carriers, such as organizing unique activities like the "Ideological and Political Digital Storytelling Creation Competition" and "Online Ideological and Political Debate Contest" to stimulate enthusiasm for participation among teachers and students. The formative evaluation system should be improved by detailing participation indicators such as interaction frequency on online platforms, resource contribution volume, and practical activity results into specific scores, incorporating them into the overall course grade and teaching evaluation system to guide deep participation of teachers and students throughout the ideological and political education process [15]. Meanwhile, data analysis techniques can be used to construct demand profiles for teachers and students, dynamically capturing their needs and feedback through regular personalized questionnaire push notifications and monitoring platform behavior data, precisely optimizing teaching content and methods [16].

5.2.4 Preventing the Risk of Technological Alienation

An algorithmic ethics review mechanism should be established, composed of ideological and political experts, IT personnel, and ethicists, to regularly evaluate the intelligent recommendation algorithms and data analysis models used in the field of ideological and political education, clarifying the value orientation standards of algorithm design [17]. The boundaries of digital technology application should be regulated, setting thresholds for multi-source information

push to ensure that the ideological and political content students are exposed to aligns with mainstream values while being inclusive of reasonable perspectives from different angles, avoiding the weakening of value leadership due to information cocoons. Through multi-source data cross-validation, comparing ideological and political education content across different platforms and channels, a double-blind content review mechanism should be established to ensure the correctness and directionality of educational content [18].

6. Conclusion and Prospects

Through empirical analysis, this paper finds that digital resource investment, symbiotic relationship strength, and teacher-student engagement play significant roles in the digital empowerment of ideological and political education in universities, all having a notably positive impact on educational outcomes and mechanism operational efficiency. Among these, the influence of symbiotic relationship strength is the most prominent, indicating that collaborative education is key to improving the quality of ideological and political education in universities.

Future research can further expand the sample scope, deeply exploring differences among different types of universities and students of various majors, as well as issues like the balance mechanism between digital technology and educational ethics, providing more comprehensive and in-depth theoretical support and practical guidance for advancing the deep development of digitalization in university ideological and political education.

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