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The Logical Path, Implementation Route and Practical Principles for Optimizing Teaching Methods Driven by Embodied Cognition

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Abstract: The traditional teaching methods of ideological and political theory Courses (IPTC) excessively emphasize rational thinking and knowledge indoctrination, ignoring the educational role of physical participation and emotional experience, which leads to the disembodied dilemma where cognition is separated from practice in IPTC teaching. Embodied Cognition, a cognitive psychology trend advocating that cognition emerges from the dynamic interaction between the body and the environment, is adapted to the current changes in teaching environments triggered by digital technologies. Driving the optimization of IPTC teaching methods with this theory is supported by both theoretical and practical bases, which helps to break the disembodied dilemma and improve teaching methods. Based on the three characteristics of the current teaching field of IPTC—field extensibility, technology-enabledness, and subject interactivity—a "virtual-real double closed-loop" method system is constructed: the forward loop promotes the transformation of theoretical cognition through field adaptation, the reverse loop drives the iteration of teaching strategies through data feedback, and the collaboration of the two loops realizes the dynamic generation and continuous evolution of cognition. At the practical level, it is necessary to actively explore the boundaries of cognitive generation, grasp the dialectical unity of technological empowerment and value guidance, continuously strengthen the dominant position of IPTC teachers, and finally achieve the value goal of connotative development of IPTCs through Embodied Cognition-driven teaching method innovation.

Keywords: embodied cognition, ideological and political theory courses, teaching methods

1. Introduction

Information technology has reshaped the spatio-temporal boundaries of society and the human way of life. Through technology, humans have achieved a state of synchronous existence and real-time interaction of the body in both virtual and real environments—a state of being known as virtual-real embodied presence. How to shape and guide values under the condition of virtual-real embodied presence has become a contemporary issue for the construction of ideological and political theory Courses (IPTC). While technology gives rise to new problems, it also cultivates the means to solve them; the application of these means requires the guidance of a systematic theoretical framework. Embodied Cognition offers a theoretical reference for using technological means to promote the optimization of teaching methods. Optimizing teaching methods based on Embodied Cognition has a rich theoretical background and practical value, and it is of profound significance for strengthening teaching method innovation and promoting the connotative development of IPTCs. Development of IP courses.

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2. Main Content

2.1. The compatibility of embodied cognition in driving the optimization of teaching methods

Embodied Cognition is a theoretical paradigm that emphasizes the participatory and functional role of the body in cognitive generation, positing that cognition is a dynamic process formed through the real-time interaction of the body with the environment, rather than an abstract symbolic computation isolated in the brain. Compared to traditional cognitive psychology, Embodied Cognition, in its ontology, absorbs Merleau-Ponty's idea of "embodied subjectivity," holding that a person is in the world from the very beginning, and their subjectivity is formed through the interaction of the physical body with the world, during which cognition is formed, advocating for the unity of mind and body. In epistemology, it regards cognition as a form of action for an organism to adapt to the environment, emphasizing the analysis of the social practice process of cognition. In methodology, it shifts towards a dynamic analysis of cognitive dynamics, stressing the temporal dimension of cognitive behavior and the systemic nature of the cognitive process. Ultimately, the goal of IPTCs is to foster in students the formation of cognition regarding the Marxist worldview and methodology. As a revolutionary theoretical achievement in contemporary cognitive psychology, Embodied Cognition reveals the psychological mechanisms of cognitive formation at a micro-level, providing theoretical reference for innovating teaching methods. The compatibility of Embodied Cognition in driving the optimization of teaching methods is mainly manifested in its adaptability to the current teaching environment, its isomorphism with the guiding ideology of IPTCs, and its feasibility in resolving the disembodied dilemma. Recent research has demonstrated the synergistic relationship between embodied cognition and cognitive load theory, showing how their integration can optimize learning outcomes. This theoretical convergence provides additional support for applying embodied cognition principles to teaching method innovation.

2.1.1 The adaptability of embodied cognition to the current teaching environment of virtual-real embodied presence

Contemporary digital technology has shaped a human existence of virtual-real embodied presence, where individuals, mediated by technology, achieve a synchronous and interactive presence in both real and virtual worlds through a technological extension of bodily perception. The consensus in academia is that technological change has revolutionized the human mode of existence. International research trends in virtual education from 2015-2020 have highlighted this transformation (Chen & Yang, 2022), with philosopher David Chalmers believeing that virtual reality is a new form of existence and has proposed the concept of Plural Realism, which posits that the real world and the virtual world are parallel domains of existence, independent but potentially interactive: "reality is not singular, but plural. We may live in multiple realities at once" (Clark, 2008). Domestic scholars have also pointed out that current society is transitioning to a third stage where virtual and real spaces merge. The main feature of this stage is the gradual blurring and fusion of the boundaries between virtual and real spaces, with cyberspace increasingly becoming a new real space itself, and online social life becoming an integral part of daily real life, forming a new situation of spatial fusion (Dreyfus, 1991).

While reshaping the human mode of existence, technological change has profoundly altered the material basis of cognition, creating an educational environment of virtual-real embodied presence. Technology philosopher and phenomenologist Don Ihde noted that technology as a medium allows humans to achieve both embodied extension and disembodied presence; on one hand, it expands human perceptual abilities, and on the other, it makes deep immersion possible (Ministry of Education, 2022). Technological mediation has reconstructed the elements of cognitive generation: in the bodily dimension, it has expanded the functional boundaries of the biological body; in the environmental dimension, it has broken the spatio-temporal

limitations of the educational field; and in the action dimension, it has formed a virtual-real interactive cognitive loop. The reconstruction of cognitive elements resonates theoretically with the "body-world" mutual constitution revealed by Merleau-Ponty, demonstrating that the educational environment of virtual-real embodied presence is an ideal carrier for Embodied Cognition, and the two are highly compatible. Higher education aims to equip members of society with the ideological, moral, and political qualities required for social development, and IPTCs are the main channel for achieving this goal. Youth, the main subjects of higher education, exist embodiedly and synchronously in the dual fields of reality and virtuality, and their ideological shaping presents a duality of "real individual-virtual existence." IPTC teaching must actively intervene to achieve value guidance. Therefore, while IPTC teaching needs to maintain its function as the main channel of classroom instruction, it must also respond to the new teaching environment of virtual-real embodied presence, construct new teaching methods, and achieve spatio-temporal synchronization between teaching and the teaching environment.

2.1.2 The isomorphism between embodied cognition and the guiding ideology of iptc teaching

The "eight unifications" are the fundamental principles for the reform and innovation of Ideological and Political Theory Courses in the new era, which explicitly propose "persisting in the unification of theory and practice." This requires not only explaining theories accurately, thoroughly, and clearly but also guiding students to grasp theories in practice. The practical viewpoint is a prominent feature that distinguishes Marxism from other theories and is also a guiding ideology that IPTC teaching must follow. Embodied Cognition views cognitive formation as a dynamic process of real-time interaction between the subject, their body, and the environment, which is isomorphic with the guiding ideology of IPTC teaching in the three dimensions of cognitive source, cognitive process, and cognitive condition. In his Theses on Feuerbach, Marx pointed out that "The question whether objective truth can be attributed to human thinking is not a question of theory but is a practical question" (Macrine & Fugate, 2021).

Knowledge is obtained from practice, and its truthfulness can only be tested through practice. Embodied Cognition, in turn, emphasizes that cognition depends on experience, and experience originates from a body with perceptual and motor capabilities, which are rooted in a broader biological, psychological, and cultural context (Merleau-Ponty, 1942). Both oppose viewing cognition as a purely rational activity detached from practice. The practical foundation of the source of cognition determines that its generation depends on the dynamic interaction process between subject and object. The guiding ideology of IPTC teaching regards cognition as a unity of the reflection of the object and the construction of the subject; through practice, the subject not only cognizes the object but also transforms their own thoughts, promoting the generation and updating of cognitive schemas and the formation and internalization of cognition about objective things. Embodied Cognition likewise holds that cognitive construction depends on the experiential understanding that the subject gains from embodied interactions with the object. Both reveal that cognition detached from practice is like a tree without roots. The subject-object interaction does not occur in a vacuum but is always embedded in a specific social, historical, and cultural field. The guiding ideology of IPTC teaching advocates that teaching requires the creation of specific situations, and the mechanism of cognitive generation is rooted in the practical field of subject-object interaction. Embodied Cognition similarly believes that cognitive generation originates from embodied interactive behaviors in a specific field. Both emphasize that the external field is not only the space-time where the subject and object exist, but also the specific occasion where cognition occurs through subject-object interactive activities. The three-dimensional isomorphism between Embodied Cognition and the guiding ideology of IPTC teaching

provides a theoretical basis for optimizing teaching methods with Embodied Cognition.

2.1.3 The feasibility of embodied cognition in breaking the disembodied dilemma in teaching

Traditional mind-body dualism asserts that the mind and body are two separate entities, and humans achieve knowledge of things solely through the mind, i.e., reason. Influenced by mind-body dualism, the field of education has developed a disembodied teaching paradigm, which regards learning as a purely mental activity, ignoring physical participation and situational interaction, leading to a knowledge-indoctrination model where cognition and practice are disconnected, presenting three major flaws: first, it presupposes a mind-body opposition, where the body is merely a vessel for the mind, and learning is a purely intellectual activity; second, it advocates for context-free learning, where cognition is solely a mental activity; third, it views education as a mechanical transfer of knowledge, placing the learner in an absolutely passive position. Merleau-Ponty pointed out that human perception, the body, and the world form a unified whole, and human cognition of the world is formed through the interactive process between the body and the world (Merleau-Ponty, 1945). This led to the revolutionary theory of Embodied Cognition, which not only emphasizes the generative role of sensorimotor processes in cognition but also highlights the cognitive construction value of embodied interaction in specific contexts, transforming the learner into an active subject of knowledge discovery and production. Traditional IPTC teaching, influenced by disembodied methods, is prone to problems of utilitarianism, functionalism, and the hollowing out of ideology and morality, whereas embodied teaching methods emphasize physical participation. Through physical activities, students can more deeply comprehend ideological and moral principles and political qualities, making abstract ideological and political theories concrete and individual, and presenting value principles and norms in a sensory and situational manner, thereby achieving the unity of theory and practice, and the unity of values and knowledge (Mohsen & Alangari, 2024). Recent empirical studies have demonstrated the effectiveness of embodied approaches. For instance, research has shown that integrating gesture recognition with memory strategies can significantly improve learning performance and motor skills, highlighting the cognitive benefits of physical engagement in educational contexts. Embodied Cognition and the teaching methods derived from it can effectively break the current disembodied dilemma in IPTC teaching, which provides a practical basis for optimizing teaching methods with Embodied Cognition.

2.2 Main characteristics of IPTC teaching from the perspective of embodied cognition

The Fourth Industrial Revolution, represented by artificial intelligence technology, is reshaping human society with unprecedented depth and breadth, driving the digital transformation of society. The Outline of the Education Powerhouse Construction Plan (2024-2035) proposes to "implement the national education digitalization strategy (Shapiro, 2019) ", indicating that the digital transformation of education is already "in progress." The digital transformation of higher education for IPTCs is also inevitable: digital technology has promoted the structural reform and functional upgrading of higher education for IPTCs, reconstructed the environment on which it depends, and driven its comprehensive, systemic, and structural digital innovation (Taylor, 1985). Digital technology has created an educational environment of virtual-real embodied presence, leading to profound changes in the constituent elements of IPTC teaching, namely, the extension of educational space-time into a virtual-real composite, the upgrading of educational means to digital technology, and the restructuring of educational relationships toward subject interactivity, presenting three main characteristics: field extensibility, embodied immersion, and subject interactivity.

2.2.1 Field extensibility

Embodied Cognition emphasizes that the mind is rooted in the environment, and the mind, body, and environment form an organic cognitive whole.

Digital technology breaks the spatio-temporal boundaries of teaching, reconstructs the embodied interaction boundaries between the body and the environment, and makes it possible for cognitive generation to shift towards on-site participation, confirming from a practical level the mind-body-environment synergistic view of Embodied Cognition. Field Theory, proposed by French sociologist Pierre Bourdieu, is used to explain the dynamic relationship between social structures and individual practices. A field is "a network, or a configuration, of objective relations between positions" (Varela et al., 1991). The teaching field of IPTCs refers to the social space-time formed around the activities of disseminating and instilling mainstream ideology, which follows its inherent educational logic and value orientation. The contemporary digital technology revolution has brought about the extension of the IPTC teaching field, mainly manifested as horizontal extension at the real level, vertical expansion at the virtual level, and the interweaving and superposition of virtual and real fields.

First is the horizontal extension of the educational field at the real level. The traditional teaching field was almost confined to fixed places like classrooms and schools, with clear field boundaries: "'entering' means receiving education; 'leaving' means the suspension of educational activities" (Weisberg & Newcombe, 2017). The singular and fixed nature of the educational field cannot meet the educational goals of higher education in the new era, which is why General Secretary Xi Jinping pointed out that "the 'great ideological and political course' is something we must be good at using" (Wilson, 2002). The "great course" aims to break through traditional spatial limitations, achieve horizontal extension of the educational field at the real level, and extend the field from fixed places to the three-dimensional space of social life, thereby constructing a comprehensive educational pattern. On the one hand, it is necessary to adhere to the main position of school classroom education, hold fast to the main channel of IPTC teaching, and leverage the synergistic educational effect of the curriculum system and campus culture. On the other hand, it is necessary to open up a new front of social practice education, guiding students to strengthen the foundation of their ideals and beliefs through participation in social practice, and to realize the practical transformation from theoretical cognition to value identity.

Second is the vertical expansion of the educational field at the virtual level. The application of internet technology in the field of higher education has broken through the field boundaries of traditional higher education, constructing a virtual, dynamic, and audiovisual educational field (Yang, 2005). On the one hand, digital technologies represented by virtual reality have created a near-real virtual world. IPTC teaching can also use VR technology to build corresponding virtual scenes according to teaching needs, transforming abstract theoretical knowledge into vivid embodied experiences through immersive and interactive experiences. On the other hand, digital technologies represented by the internet and 5G have built a network world that is intertwined with the real physical world and presents a dialectical picture; the network has been upgraded from a tool and carrier used by teaching to the operational space-time and mode of existence for IPTC teaching.

Third is the interweaving and superposition of virtual and real fields. The real and virtual fields of education show a state of deep integration and interweaving. The virtual field is rooted in the reconstruction of elements from the real world; its subjects are real people, and its operational goals are anchored in real teaching tasks. The superposition of virtual and real fields can achieve relative spatio-temporal consistency between educational activities and educational content by bridging spatio-temporal gaps and barriers, and can influence people's cognition and decision-making in reality through embodied experiences, thereby shaping their values. The real person is the medium for the interaction between the virtual and real fields, and the embodied immersive experience brought about by technology is the basis for the interconnection and

interweaving of the virtual and the real.

2.2.2 Embodied immersion

The extension of the field simultaneously reconstructs the form of the educational experience. Embodied immersion refers to the process where contemporary digital technology and teaching activities, under the premise of achieving consistency between technological logic and educational goals, promote a shift in teaching activities from singular classroom indoctrination to an embodied interactive process of cognitive generation through the synergistic effect of virtual and real fields. This is specifically manifested in the use of extended reality technology to support individual virtual-real embodied presence, digital twin technology to achieve dynamic mapping of virtual-real dual environments, and big data technology to drive the dynamic adjustment of cognitive schemas.

First, extended reality technology supports individual virtual-real embodied presence. Extended Reality (XR) is a collective term that covers Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR) technologies, whose recent developments in educational contexts have been comprehensively analyzed (Al-Ansi et al., 2023), aiming to create immersive experiences that break or blur the boundaries between virtual and reality, supporting the embodied presence of real individuals in virtual and real fields. First, virtual reality technology can replicate real scenes. The digital scenes generated by VR technology, "as a visual representation of the content of higher education for IPTCs, are a true mapping of 'real scenes', carrying the tasks of transmitting ideas and values (Ye, 2015)". Students can achieve embodied presence in the virtual field by wearing VR equipment. Second, augmented reality technology can overlay virtual information onto the real environment, achieving a virtual-real superimposed presentation effect, enhancing students' understanding of abstract concepts or models, and realizing embodied presence in a virtual-real superimposed field. Third, mixed reality technology is a fusion of virtual reality and augmented reality, which can achieve dynamic interaction between virtual objects and the real environment. Creating intuitive and interactive teaching situations based on MR technology can subtly influence and infect students, promote the generation or sublimation of their emotions, and cause changes in their thoughts and behaviors (Ye, 2019), rising from emotional resonance to rational cognition.

Second, digital twin technology achieves dynamic mapping of virtual-real dual environments. A digital twin is a technology that links virtuality and reality, merges the abstract and the restorative, and integrates concepts and actual existence in the process of processing, transmitting, and storing data, aiming to duplicate rather than merely reproduce (Zhang, 2005). First, digital twin technology maps from real to virtual, enabling real-time insight into the ideological dynamics of the learners. By using multimodal perception, it transforms fragmented information into visual and quantifiable specific values, and performs dynamic simulation and calculation to dynamically grasp the changes in learners' thoughts, bridging the gap between teaching and learning. Second, digital twin technology maps from virtual to real, enabling dynamic adjustment of teaching management and decision-making. Digital twin technology mirrors the real world, and by analyzing the real-time changes of real-world variables in the twin mirror world, it provides adjustment suggestions for real-world teaching management and decision-making. Third, digital twin technology, combined with other technologies, creates a synergistic effect for immersion. Educators can place a story in a specific historical space-time according to the actual narrative, allowing a historical event to be presented panoramically and realistically across time and space, bringing an immersive experience to the learners (General Office of the Communist Party of China Central Committee & General Office of the State Council, 2019).

Third, big data technology drives the dynamic adjustment of cognitive schemas. Big data refers to the digital technology for collecting, storing, processing, and analyzing massive (Volume),

high-speed (Velocity), diverse (Variety), low-value-density (Value), and authentic (Veracity) 5V data through new computing architectures and algorithms. A cognitive schema is a dynamic cognitive structure formed by a subject through embodied practice, a thinking framework constructed through continuous interaction between the body and the environment. Based on the collection and analysis of multi-source heterogeneous data, cognitive schemas can be dynamically adjusted through two main paths: first, by using the multimodal perception and data collection capabilities of big data to capture cross-field behavioral data in real-time, generate personalized user cognitive profiles, and drive the design of adaptive learning plans. Second, by using the text sentiment analysis and natural language analysis functions of big data to grasp students' ideological dynamics in real-time in both virtual and real fields, converting their cognitive characteristics into quantifiable behavioral indicators, providing empirical evidence for teaching optimization, and promoting the generation and evolution of students' cognitive schemas through precise interventions and optimized cognitive correction mechanisms.

2.2.3 Subject interactivity

"Subject" refers to a real individual with agency and interactivity. Technology empowerment has caused changes in the relationships between teaching subjects. Digital technologies, represented by the internet, have reshaped the distribution pattern of discourse power by breaking the existing order in information transmission channels, thereby breaking the clear distinction between subject and object in the traditional education model (He et al., 2025). Subject interactivity is manifested in changes in the relationships between subjects, changes in the roles of subjects, and the broadening of pathways to achieve educational goals.

First, the relationship between subjects has changed from a clear subject-object distinction to intersubjectivity. Traditional higher education for IPTCs held that the educator is in the subject position in educational activities, while the learner is in the object position, exhibiting subjectivity only in certain educational situations (Radianti et al., 2020). The modern view of higher education for IPTCs holds that it is a process of two-way interaction between the educator and the learner, and both are subjects of education (Marks & Thomas, 2022). Technology empowerment has broken the original hierarchical structure, reshaping the relationship between "teaching and learning" and "subject and object" by building an open educational field. In this common educational field, educators and learners construct meaning and achieve educational goals through interaction and understanding, showing the characteristics of intersubjectivity.

Second, the roles of subjects have changed from a clear division of labor in teaching to interactive and mutually beneficial learning. Position determines function, and the change in the relationship between subjects brings about a change in their functional roles. The role division in traditional higher education for IPTCs was characterized by clear roles, explicit power, and distinct hierarchies (Hamilton et al., 2021). The educator's role was to organize educational interactions, transmit ideology and theory, clarify ideological doubts, and cultivate moral character. The learner's role was to participate in educational activities, receive theoretical indoctrination, provide feedback on the educational process, and embody the educational outcomes. Digital technology has broken the traditional division of roles in teaching. On the one hand, the discourse subject in education is no longer limited to the educator; learners can engage in equal dialogue and interaction with educators, achieving a shift in the discourse subject of higher education for IPTCs from a single subject to an integrated and pluralistic one (Chen et al., 2018). On the other hand, the boundaries between educational roles have been blurred. Learners participate in the production, narration, dissemination, and interaction of educational content, transforming from passive participants to active interactors, and from knowledge receivers to content co-creators. The educator's role has expanded from knowledge

indoctrination to field interaction, from a traditional knowledge authority to a designer and leader of educational activities, and from a one-way disseminator of knowledge to a facilitator of cognitive generation.

Third, the pathway to achieving educational goals has broadened from singular indoctrination to a combination of indoctrination as the primary method and diverse interaction. The formation of a Marxist worldview and methodology cannot be separated from necessary indoctrination, but this does not equate to "cramming" and certainly does not mean that indoctrination is the only way to achieve educational goals. The method of singular indoctrination carries the potential risk of stifling the learner's autonomy and creativity (Poupard et al., 2025). Intersubjectivity transforms the teacher-student relationship into one of equal dialogue that is mutually inspiring and promoting. The interaction between teachers and students plays a vital role in the process of cognitive formation; students can understand and master knowledge through situational experiences, deepen mutual understanding in the process of teacher-student interaction, and are encouraged to apply what they have learned (Lai et al., 2019). Therefore, with the change in the status and roles of subjects, the method of diverse interaction has become one of the viable pathways for achieving the educational goals of IPTC teaching.

2.3 The implementation path for optimizing teaching methods driven by embodied cognition

During his visit to Renmin University of China, General Secretary Xi Jinping emphasized: "Whether Ideological and Political Theory Courses can play their due role in fostering virtue through education depends on whether they are valued, whether they are adaptive, and whether they are well-executed". (Sharma et al., 2020). Optimizing teaching methods driven by Embodied Cognition is an active response to the question of "being adaptive" and, moreover, a methodological innovation to achieve the goal of "being well-executed." Embodied Cognition reveals that the real individual, spanning both virtual and real worlds, is the interactive medium and hub of the virtual and real fields. Therefore, to adapt to the cognitive characteristics of learners' virtual-real embodied presence, it is necessary to start from the intersection of virtual and real fields. Based on the three major characteristics of field extension, embodied immersion, and subject interactivity, a "virtual-real double closed-loop" method covering the entire teaching process is constructed (as shown in Figure 1): the forward closed-loop promotes the transformation of theoretical cognition through field adaptation, the reverse closed-loop relies on data feedback to achieve the iteration of teaching strategies, and the synergy of the two loops drives the dynamic generation and continuous evolution of cognition.

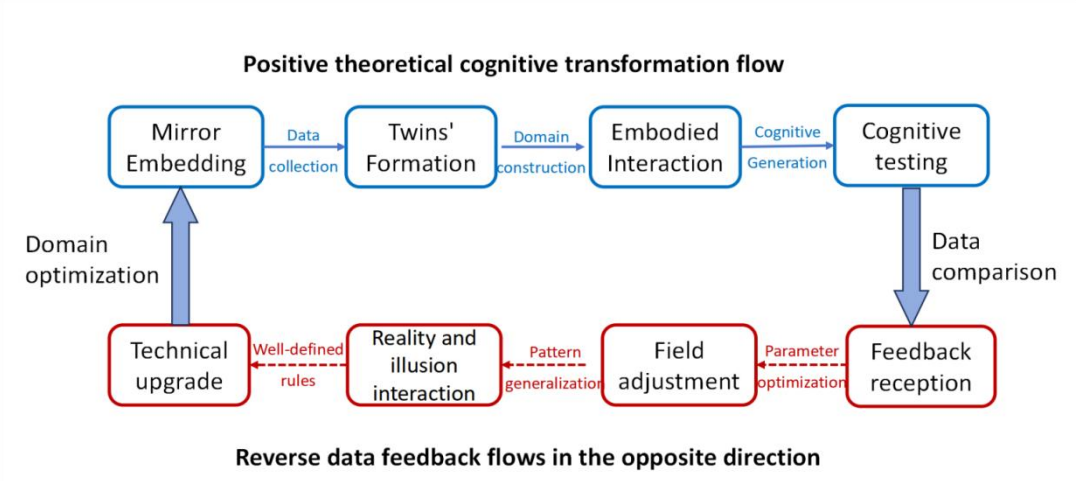

Figure 1 The "Virtual-Real Double Closed-Loop" Synergistic Mechanism for IPTC Teaching Driven by Embodied Cognition

2.3.1 The forward path of field extension from virtual shaping to cognitive transformation

Virtual shaping is the starting point of the forward path, with the expected goal of achieving field extension and promoting cognitive generation. "Mirror embedding—twin shaping—embodied interaction—cognitive verification" are the four stages of the forward path.

First, mirror embedding refers to using a real or actually occurring scene as a template, embedding within it to collect scene data and data of the subjects (youth) participating in the cognitive activities within that scene. It also involves identifying the environmental variables in this real scene that can influence the cognitive formation of youth, which will serve as the basic basis for generating the virtual field later. Mirror embedding requires the collection of scene data as the object and human data as the subject. The selection and data collection of object scenes mainly include two types. One is the recreation of historical scenes that carry red memories and have important educational value, such as the First National Congress of the CPC, the Zunyi Conference, etc. In this case, the focus should be on the objective authenticity of the mirror world and the educational methods of the elements within the scene. The other is the recreation of life scenes closely related to daily real life that require value guidance, such as online live streaming rooms, school bullying, etc. In this case, the focus should be on the cognitive influence mechanism on youth in this scene and the variables in the environment that affect cognition. The cognitive subjects are mainly university students. Through the analysis of student data, models are used to analyze the basic situation of the youth sample and the results of questionnaires and interviews, creating personality, character, and emotional profiles to generate a group characteristic database and an individual characteristic database, which serve as the basis for evaluating cognitive effects.

Second, twin shaping refers to using digital twin, artificial intelligence, virtual reality, and other technologies to incubate a corresponding virtual field based on the environmental elements and cognitive mechanisms collected and summarized in the mirror embedding stage. This serves as the specific virtual space-time for promoting students' cognitive formation. In a virtual field based on real historical events, learners can travel through time and space to immersively perceive the theoretical context, significantly enhancing their sense of embodiment and presence. At the same time, it can transform flat theoretical output into three-dimensional embodied perception, thereby effectively enhancing the appeal of the teaching narrative. In a virtual field based on daily real life, higher education for IPTCs extends into the space of daily life, making the theoretical narrative of higher education for IPTCs closer to reality and life, opening up a more vivid and lively narrative field, and enhancing the discursive power of the theoretical narrative of higher education for IPTCs (Weisberg & Newcombe, 2017). In the twin shaping stage, it is necessary to pre-set the cognitive goals that learners need to achieve and design the interactive tasks and links in the virtual field based on this.

Third, embodied interaction refers to the embodied cognitive process where learners interact with objects or characters in the virtual field through multiple senses, complete pre-set interactive tasks, and ultimately form the expected cognition. The core essence of Embodied Cognition is that the body plays a key role in the cognitive process; human cognition is formed through the internal connection between the body's movements, perceptions, experiences, and other embodied structures and cognitive schemas (Cook & Ellaway, 2015). During the process of embodied interaction in the virtual field, students project their original ways of thinking and values onto their interactive behaviors in the virtual field through bodily interaction. The virtual field, based on the pre-set cognitive goals, provides behavioral correction and value education to the students. In the process of continuous trial-and-error and adjustment, cognitive formation is promoted, and the expected teaching effect is achieved. The embodied interaction stage emphasizes learners' multi-sensory immersive

participation and behavioral interaction, leveraging the unique role of bodily perception in cognitive formation.

Fourth, cognitive verification refers to placing students who have completed the embodied interaction stage back into the real field to observe their actions and responses in reality, thereby verifying the cognitive formation effect of the previous stage and ensuring that students can apply what they have learned in the virtual field to reality, achieving the educational goal of the unity of knowledge and action. The purpose of this stage is to transform the state and behavior of the learners into a representation that a computer can understand and operate on through human-computer interaction technology, and to transform the computer's output into content that educators can understand. This stage uses the cognitive representation measurement method: first, to collect learners' voice interaction records for linguistic analysis. Second, to collect learners' movements, expressions, breathing, heart rate, EEG signals, etc., for morphological analysis. Third, to collect learners' position changes, displacements, and routes in the virtual field for spatial movement analysis. By integrating the above data, the effect of the learners' cognitive formation is evaluated, compared with the pre-test data collected in the mirror embedding stage, to verify the cognitive formation effect and the field shaping effect, and to summarize the cognitive patterns of youth in specific scenarios.

2.3.2 The reverse path of technological iteration from behavioral feedback to situational optimization

Behavioral feedback is the starting point of the reverse path, with the expected goal of achieving technological iteration and optimizing the virtual field. "Feedback reception—field adjustment—virtual-real fusion—technological upgrading" are the four stages of the reverse path.

First, feedback reception refers to sorting and filtering the data collected from the mirror embedding and cognitive verification stages of the forward path, as well as the pre- and post-test comparison data from these two stages, to obtain valid data as the basis for field adjustment. Multimodal perception technology collects and digitizes data, converting it into signals or symbolic content that can be processed and analyzed by a computer, ultimately establishing a feedback pool that spans both real and virtual fields, providing the raw input for subsequent field optimization and technological iteration.

Second, field adjustment refers to adding, removing, and adjusting the variables that affect cognitive formation in the virtual field based on the behavioral data and data analysis results collected from the forward path. This ensures the virtual field promotes the desired cognitive formation. According to immersion theory, achieving a state that promotes cognitive formation requires certain external conditions, which can be met by adjusting the parameters in the virtual field to optimize the effect of promoting cognitive formation. Based on real-time behavioral feedback from participants, the parameters of the virtual field, such as task difficulty and role interaction rules, are dynamically adjusted. Using Reinforcement Learning (RL) methods to detect users' special cognitive states, combined with feedback information such as the learners' needs and evaluations, as well as the system requirements and suggestions from administrators, the situational experience system is adjusted as a whole. After the field adjustment is completed, the data on the youth's actions and responses in reality, collected in the cognitive verification stage of the forward path, is mapped to the new virtual field to generate digital humans for simulated operation, thereby re-validating their behavioral patterns.

Third, virtual-real fusion refers to using the simulation results from the previous stage to correct and improve the cognitive patterns summarized in the forward path, and forming real-world action guidelines based on these patterns. These guidelines are presented to students in real-time through augmented reality technology to intervene in their real-world decision-making, ensuring it aligns with the expected educational goals. The virtual-real

interaction is reflected in two aspects: first, the influence of the virtual on the real, where cognitive patterns are transformed into action guidelines that exist in the real field through augmented reality, guiding students' behavioral decisions. Second, the correction of the virtual by the real, where the behavioral consequences of students guided by the cognitive patterns are fed back in real-time to the virtual field as data, serving as an important basis for further correcting and improving the cognitive patterns.

Fourth, technological upgrading refers to using machine learning as the core support technology to summarize the cognitive formation patterns of students in specific scenarios and the scene-shaping patterns that promote cognitive formation, based on the data collected in all stages. This leads to the deepening of cognitive patterns and the improvement of the virtual field. On the one hand, through Supervised Learning (SL), an emotion-behavior-cognition association model for students is established to improve data collection accuracy and enhance the predictive ability of the virtual field. On the other hand, through Unsupervised Learning (UL), the hidden associations between field elements and interactive participants, as well as among field elements themselves, are mined to assist in the automated iteration of the virtual field, reducing the manual workload.

2.3.3 The synergistic path of virtual-real double closed-loop teaching optimization for promoting cognitive formation

The forward path from real to virtual aims to construct a virtual field to generate and test cognition; the reverse path from virtual back to real aims to optimize the virtual field and summarize cognitive formation patterns. The forward path completes the process of testing theory through practice, while the reverse path achieves the summarization of patterns from practice to theory. The real individual, as a medium, connects the interaction between the virtual and real fields, and the principles of embodied cognition run through the entire process. (As shown in Figure 2)

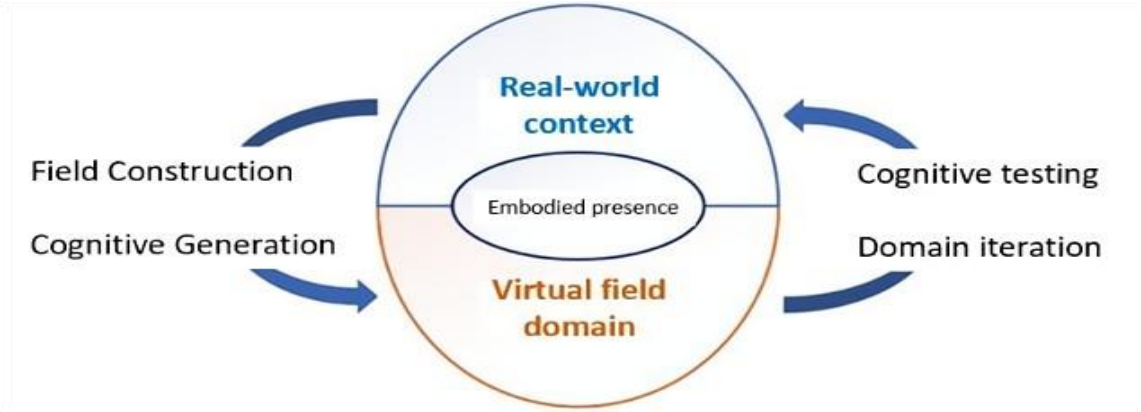

Figure 2 The Virtual-Real Interaction Relationship under the "Virtual-Real Double Closed-Loop" Synergistic Mechanism

In the short term, the dual closed-loop teaching optimization path can accomplish the teaching tasks of extending the educational field and intervening in student cognition. In terms of extending the educational field, the mirror embedding stage of the forward path collects real scene data and youth behavioral data as the basic elements for generating the virtual field. In the twin shaping stage, digital twin technology is used to generate a virtual field corresponding to the real one, thus extending educational activities from the real to the virtual and expanding the coverage of teaching. In terms of student cognitive intervention, the embodied interaction stage of the forward loop allows students to use their bodily perceptions to participate in the process of cognitive formation, completing value-based behavioral correction through interaction. The reverse loop receives feedback data from the

operation of the forward loop to make simultaneous adjustments to the virtual scene, improving the precision of cognitive intervention. In the virtual-real fusion stage, it directly transforms cognitive patterns into real-world action guidelines, further strengthening cognitive formation.

In the long term, the dual closed-loop teaching optimization path can achieve the teaching tasks of iterating the virtual field and guiding core values. In terms of iterating the virtual field, the reverse loop comprehensively uses all the data generated during the operation of the dual-loop path. On the one hand, it makes real-time adjustments during the operation of the virtual field, optimizing task difficulty and interaction logic to make the field more aligned with long-term educational goals. On the other hand, after one cycle of the dual-loop path, it uses machine learning to mine the hidden associations between field elements and between students and field elements, assisting in the manual adjustment of the virtual scene and promoting the iterative upgrading of the virtual field. In terms of value guidance, through the virtual-real interaction of the dual loops, mainstream ideology and values are presented in a scenario-based manner in the virtual field. Through students' embodied interaction, these values are disseminated into their daily social lives through content-based embodied metaphors and image schema extensions (Martinez-Maldonado et al., 2021), achieving value guidance in daily life. During the operation of the dual closed loops, the data accumulated by the forward path and the technological upgrades of the reverse path provide mutual feedback, gradually forming a closed loop of "field extension—cognitive generation—value guidance," which is conducive to the systematization and long-term effectiveness of value guidance.

2.4 Practical principles for optimizing teaching methods driven by embodied cognition

Technological change has brought about the extension of the teaching field, opening up a new spatio-temporal domain for educational activities in a virtual-real embodied context. It is urgent to establish the principles for IPTC teaching activities in this new field, and the educational laws within this new field still require unremitting exploration. To actively integrate into the new field opened up by technology, IPTC teaching methods should adhere to the following practical strategies.

2.4.1 Exploring the boundary line of fusion between technology and teaching methods

Optimizing teaching methods driven by Embodied Cognition means integrating technology into the IPTC classroom. Therefore, it is essential to follow the logic of both technology operation and higher education for IPTCs, actively seek the boundary of fusion between the two, and establish a clear boundary line for technology-innovated teaching methods through exploratory practice.

First, actively explore the cognitive boundary line of "conversion distortion" between the virtual and the real. Distortion originally refers to the deformation of a waveform during signal transmission, amplification, or processing in electronic information engineering, resulting in an output signal that is inconsistent with the original signal, i.e., an inconsistency between input and output. "Conversion distortion" refers to the inconsistency between the virtual field and its corresponding reality due to technical constraints during the conversion process. Embodied Cognition emphasizes the fundamental role of the environment in the cognitive process. Only a virtual field that objectively and truthfully reflects the real world can lead to the formation of correct and required cognition; a virtual field that distorts the real world is not conducive to the formation of correct cognition. Therefore, during the process of field extension, the boundary line of fusion between technology and method should be explored in the following ways. First, technology must be continuously improved, and a variety of immersive technologies must be used comprehensively to strive for an objective and true reflection of reality. Second, the boundary between virtual and real must be clearly defined by setting up warning signs and activity norms in the virtual field to prevent students from confusing virtuality with reality. Third, natural language processing systems

and multimodal perception systems should be used to identify interactive behaviors and dialogue content to guard against the risk of historical nihilism. Finally, manual oversight must be strengthened by establishing a college-level review and operation mechanism; the virtual field can only be put into use after being approved by college faculty, and if there is a cognitive risk in the virtual field, its use must be immediately suspended.

Second, actively explore the boundary line between technology and teaching principles. Principles are the fundamental guidelines for methods. The influx of a large amount of technology into the classroom, while providing learners with extreme sensory enjoyment and visual stimulation, may cause them to lose their value connection with higher education for IPTCs (Larmuseau et al., 2020). The particularity of IPTCs lies in the distinct value orientation and ideological characteristics of their content. Technology must serve the systematicness of theoretical interpretation and the continuity of academic exposition, preventing the form of technology from alienating the subject status of the content. In curriculum design, theory should come first, and it should be reviewed whether the technology can accurately convey the theoretical connotation. In teaching activities, a standard for the time ratio between technology presentation and theoretical explanation should be set to appropriately control the balance between the two. In teaching evaluation, a three-dimensional evaluation system of knowledge, value, and behavior should be established to test the degree of students' theoretical internalization. In teacher training, teachers' digital literacy should be enhanced to exert human dominance and regulation over technology. In terms of long-term mechanisms, a negative list for technology application should be formulated to prevent technology from eroding the value core, and a three-level teaching supervision system involving the college, the university, and higher authorities should be constructed to control the teaching quality after the optimization of teaching methods with Embodied Cognition.

2.4.2 Anchoring the balance point of tension between technological rationality and value rationality

The Western Marxist Herbert Marcuse pointed out that technology is not neutral but carries ideological characteristics. The phenomenon of technological alienation in modern society is the direct result of the disorderly expansion of technological rationality suppressing value rationality. In IPTC teaching, technology is both the material condition for methodological innovation and carries the potential risk of alienating value rationality. When technological rationality swallows value rationality and becomes the dominant force, "the educator is transformed into an executor of technical procedures and a processor of data information, playing the role of a tool in the educational process, making it difficult to engage in more meaningful educational practices with ideological guidance, and their agency and creativity are suppressed (Skulmowski & Rey, 2018)." As a special educational activity, the inherent ideological nature of IPTC teaching dictates that value rationality must hold the primary and dominant position.

Technology permeates both the virtual and real worlds and also serves as the material basis for the interconnection between the virtual and real fields. The disorderly expansion of technological rationality originates from the interaction within and between the virtual and real fields, and the human being is the mediating existence through which this interaction occurs. Therefore, the human becomes the key to restraining technological rationality and promoting value rationality, serving as the balance point between technological rationality and value rationality. The human body and its activities span the virtual and real fields. On the one hand, educators need to adhere to a human-centered approach, avoiding the tendency to digitize and flatten individuals. When shaping the field, they must adhere to the fundamental principle of fostering virtue through education and actively select the elements presented in the field and their forms of expression. On the other hand, participants in the

field need to be clear about the principle that virtual and real are different, actively establishing virtual-real boundaries through embodied actions and habits, being vigilant against the weakening of self-subjectivity by fragmented experiences, and avoiding becoming passive objects of the technical system in the virtual field.

2.4.3 Continuously strengthening the teacher's dominant role in the new field

In the practice of optimizing teaching methods driven by Embodied Cognition, there is a risk of technology overstepping its role and replacing the teacher's dominant position, thereby dissolving the subjectivity of IPTC teaching. The complementary relationship between technology and education not only fails to achieve better synergy, but instead, the subjectivity of technology becomes prominent, and the subjectivity of higher education for IPTCs faces an unprecedented crisis (Liu et al., 2023). Although technology has led to a shift in the teacher-student relationship towards intersubjectivity, there is still a primary-secondary distinction between teachers and students. General Secretary Xi Jinping emphasized that "teaching is inseparable from the teacher's leading role (Akram & Li, 2024)." The teacher is the key intermediary connecting mainstream ideology with young students and plays a guiding and enlightening role in teaching. In the teaching process of IPTCs, which emphasizes value guidance and ideological education, the teacher must be in the dominant position.

First, update educational concepts to strengthen the teacher's authoritative guidance. Thought is the guide to action, and the social reality of virtual-real embodied presence has spurred corresponding changes in educational concepts. Teachers should first enhance their digital literacy, mastering tools such as virtual simulation and human-computer interaction, to avoid being swept away by technological logic and to maintain a dominant position in the application of technology. Second, deepen embodied practice to enhance teachers' teaching capabilities. Embodied Cognition emphasizes the important role of bodily practice in the formation of values, which relies on the creation of specific fields. As the creator and user of the educational field, the teacher must, on the one hand, lead the creation of the field, pre-design teaching goals, control the technical tools, and clarify the rules of embodiment. On the other hand, they must lead the reflection on behavior. After the embodied practice, through questioning and discussion, they should guide students to deepen their bodily experiences into value cognition, promptly answer questions about values, and correct cognitive biases. Third, improve the work system to optimize the teacher's dominant mechanism. In the dual closed-loop teaching optimization path, the teacher is not only a transmitter of knowledge and a guide of values but should also be a formulator of ethical norms and a participant in the operation of technology. On the one hand, teachers need to participate in technology risk governance activities, defining the scope of data collection to avoid excessive monitoring that infringes on privacy. On the other hand, before and after the teaching process, teachers should collaborate with the technology development team to evaluate the teaching effectiveness of the virtual field and adjust the technical plan in a timely manner. During the teaching process, they should play a role in value gatekeeping, selecting appropriate technical tools to assist in teaching, and preventing instrumental rationality from squeezing out the teacher's dominant position.

3. Summary

This paper explores how Embodied Cognition theory can optimize teaching methods in ideological and political theory Courses (IPTC) in universities to address profound changes in the digital-era educational environment. It first elaborates on the compatibility between Embodied Cognition and IPTC teaching, highlighting advantages in adapting to virtual-real embodied presence environments, aligning with Marxist practical perspectives, and resolving disembodied dilemmas. The paper then analyzes three major characteristics of IPTC teaching

driven by digital technology: field extensibility, embodied immersion, and subject interactivity.

The core contribution lies in constructing a "virtual-real double closed-loop" teaching optimization path: the forward loop achieves cognitive generation and verification from reality to virtuality through four stages—mirror embedding, twin shaping, embodied interaction, and cognitive verification; the reverse loop completes field optimization and pattern summarization from virtuality to reality through feedback reception, field adjustment, virtual-real fusion, and technological upgrading. The two loops work synergistically to promote dynamic generation and continuous evolution of cognition.

At the practical level, the paper proposes three principles: exploring boundaries between technology and teaching fusion to prevent virtual-real conversion distortion; balancing technological and value rationality to ensure value orientation dominance; and strengthening teachers' leading roles to maintain guidance and gatekeeping functions in technological environments. This research provides a systematic theoretical framework and operational practical solutions for IPTC reform in the digital age.

Conflict of Interest

The authors declare that they have no conflicts of interest to this work.

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