A Study on Teachers' Cognitive Structure and Optimization of Teaching Strategies Under the Transformation of Educational Informatization

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ABSTRACT Educational informatization is reshaping the teaching ecosystem by embedding artificial intelligence, big data, and networked communication technologies into instructional scenarios. For technology-rich and engineering-oriented education, including courses supported by sensing systems, wireless networks, and electromagnetic communication infrastructure, teachers' cognitive adaptation directly affects the effective integration of digital tools. Based on cognitive load theory, constructivism, and technology integration theory, this study examines how educational informatization transforms teachers' cognitive structure and teaching strategies. The analysis shows that technology embedding reorganizes teachers' knowledge systems, data-supported feedback reshapes reflective cognition, and collaborative digital platforms promote cognitive flexibility. Artificial intelligence further changes professional judgment by shifting instructional decision-making from experience-based intuition toward data-supported reasoning. The study clarifies the internal mechanism linking cognitive structure, instructional decision-making, cognitive load management, and teaching-effectiveness improvement. It also proposes optimization strategies for informatized instructional design, technology-integrated classroom behavior, and the coordinated development of digital literacy and professional teaching competence. The findings provide theoretical reference and practical guidance for teacher professional development and digital teaching-quality improvement.

INDEX TERMS educational informatization, teacher cognitive structure, teaching strategy, technology integration, digital engineering education

I. INTRODUCTION

THE rapid development of digital technology has propelled education into a stage of in-depth informatization transformation. The penetration of technology has extended from the instrumental level to the cognitive and structural levels, triggering fundamental changes in teachers' roles, knowledge acquisition, and classroom decision-making logic [1]. Against this backdrop, the adaptive reconstruction of teachers' cognitive structure has become a key variable affecting teaching quality. Existing studies mostly focus on the application and operation of technology, lacking a systematic explanation of the internal mechanism by which informatization transformation influences teachers at the cognitive level and further acts on teaching behaviors. Teachers' cognitive structure not only restricts the understanding and integration of technical tools but also profoundly affects the generation logic and implementation effect of teaching strategies. Clarifying the correlation between the two is an important prerequisite for promoting informatized teaching from technical application to professional deepening[2]. Therefore, examining cognitive structure in the context of educational informatization transformation and exploring its evolution law and influence path on the optimization of teaching strategies holds important theoretical value and practical significance.

II. THEORETICAL EXAMINATION OF EDUCATIONAL INFORMATIZATION TRANSFORMATION AND TEACHERS' COGNITIVE STRUCTURE

A. CONNOTATION DEFINITION AND EVOLUTION LOGIC OF EDUCATIONAL INFORMATIZATION TRANSFORMATION

Educational informatization transformation refers to the overall process of systematically embedding digital technology into the whole process of education and teaching to promote fundamental changes in educational concepts, organizational methods, and learning patterns. From the perspective of historical evolution, educational informatization has gone through three stages: computer-assisted instruction, Internet-supported learning, and in-depth empowerment of education by artificial intelligence. Each stage is accompanied by a significant leap in the depth of technology and the degree of educational integration. At present, a new generation of digital technologies represented by big data, cloud computing, and artificial intelligence has extended educational scenarios from physical spaces to virtual spaces, transformed learning activities from static reception to dynamic generation, and shifted educational evaluation from empirical judgment to databased evidence. In this transformation, informatization is no longer just an auxiliary tool for teaching but a core driving force reshaping the structure of the educational ecosystem, exerting a profound impact on the logic of teaching organization, the form of teacher-student relationships, and the way of curriculum implementation. At the same time, the informatization transformation has also led to a fundamental adjustment in teachers' professional positioning—from one-way disseminators of knowledge to designers of learning environments, and ultimately to collaborative facilitators in an intelligent ecosystem. Unlike the pre-planned 'Learning Designer' role in Stage 2, the 'Collaborative Facilitator' in Stage 3 relies on AI-generated evidence to perform dynamic, real-time intervention and human-machine collaborative orchestration—thus imposing more complex requirements on teachers' cognitive adaptability and professional literacy. Understanding the connotation and evolution context of educational informatization transformation is an important theoretical premise for an in-depth discussion of changes in teachers' cognitive structure [3].

B. THEORETICAL BASIS AND CORE ELEMENTS OF TEACHERS' COGNITIVE STRUCTURE

Teachers' cognitive structure refers to an internal framework system formed by teachers through long-term teaching practice to organize and represent knowledge and experience related to teaching, serving as a deep psychological basis for instructional decision-making and behavior generation. From the perspective of theoretical origin, the concept of cognitive structure was first proposed by Ausubel in meaningful learning theory, emphasizing the decisive role of existing knowledge organization in the acquisition of new knowledge. It was further developed through Piaget's schema theory and Vygotsky's social constructivism, gradually extending to the field of teachers' professional knowledge. In research on teachers' professional development, Shulman's Pedagogical Content Knowledge (PCK) regards the integration of subject knowledge and pedagogical knowledge as the core of teachers' professional cognition, profoundly influencing subsequent research paradigms and understandings of teachers' cognitive structure [4]. In terms of core elements, teachers' cognitive structure usually encompasses four dimensions: subject content knowledge, pedagogical knowledge, learner knowledge, and contextual knowledge. These elements are interwoven and dynamically integrated, together forming the cognitive basis for teachers to understand teaching situations, generate teaching plans, and adjust teaching behaviors. In the context of informatization, the Technological Pedagogical Content Knowledge (TPACK) framework further incorporates technological knowledge into teachers' cognitive structure system, substantially expanding the boundaries of teachers' cognition. Understanding the above theoretical basis and core elements helps clarify the internal action paths through which informatization transformation impacts teachers' cognitive structure.

C. RECONSTRUCTION MECHANISM OF TEACHERS' COGNITIVE STRUCTURE IN THE INFORMATIZED ENVIRONMENT

The informatized environment does not merely provide external instrumental support for teaching but fundamentally changes teachers' cognitive ways of acquiring knowledge, processing information, and generating understanding, thus triggering a systematic reconstruction of teachers' cognitive structure [5]. This reconstruction process unfolds mainly through three mechanisms:

First, the technology-driven knowledge expansion mechanism. The wide application of digital tools enables teachers to break through their original knowledge boundaries, access and integrate interdisciplinary and cross-field teaching resources. The original knowledge organization framework expands and updates through continuous collision with new information.

Second, the data-supported reflective feedback mechanism. Big data analysis systems provide teachers with quantifiable data on teaching behaviors and learning outcomes, allowing them to examine their teaching cognition supported by data evidence and promote self-correction and refinement of cognitive structure.

Third, the collaborative interactive social construction mechanism. Digital teaching research platforms facilitate cross-temporal experience sharing and professional dialogue among teachers, enabling individual cognitive structures to be continuously enriched through exchanges and collisions of collective wisdom. These three mechanisms are nested and synergistic, jointly driving teachers' cognitive structure from a relatively stable static state to an adaptive cognitive framework, laying a mechanistic foundation for teachers to form more integrated and flexible professional cognitive abilities in informatized contexts.

III. MULTI-DIMENSIONAL IMPACTS OF EDUCATIONAL INFORMATIZATION TRANSFORMATION ON TEACHERS' COGNITIVE STRUCTURE

A. REORGANIZATION EFFECT OF TECHNOLOGY EMBEDDING ON TEACHERS' KNOWLEDGE SYSTEM

The deep embedding of technology fundamentally changes the composition logic and organization mode of teachers' knowledge system. In traditional teaching contexts, teachers' knowledge system is mainly composed of subject con-

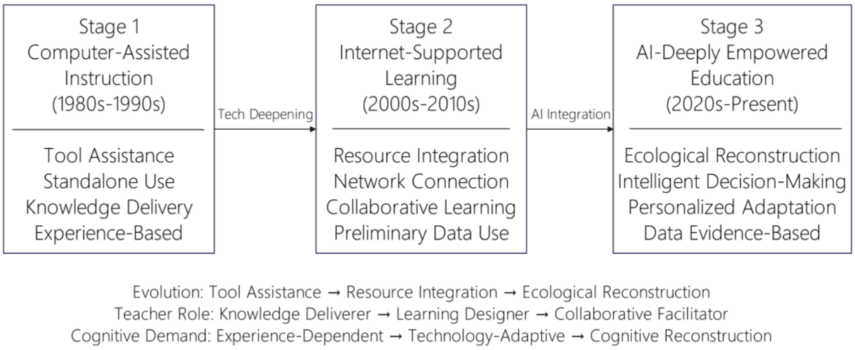

FIGURE 1. Evolution Stages of Educational Informatization Transformation

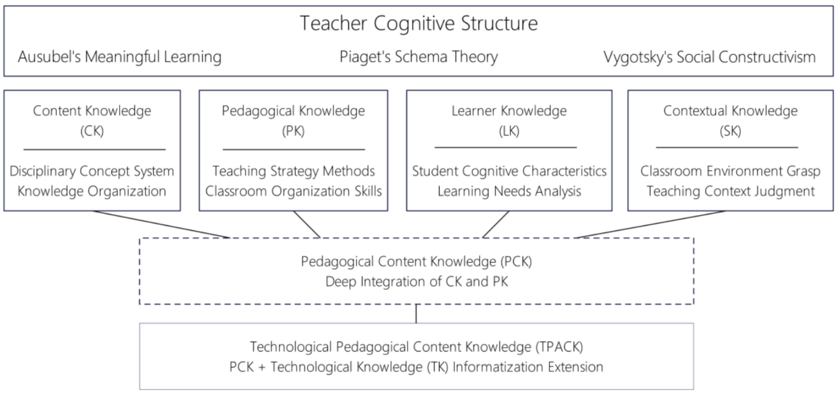

FIGURE 2. Core Elements Framework of Teacher Cognitive Structure

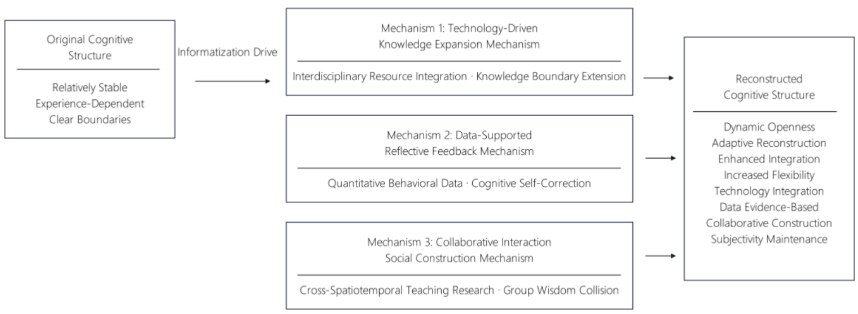

FIGURE 3. Reconstruction Mechanism of Teacher Cognitive Structure in Informatization Environment

tent knowledge and classroom experience, with knowledge acquisition and renewal relying primarily on personal study and in-school teaching research. With the comprehensive penetration of digital technology into educational scenarios, teachers are required to deeply integrate technological knowledge with subject teaching knowledge to form an integrated knowledge structure represented by the TPACK framework. This integration process produces a significant reorganization effect on teachers' original knowledge system [6].

On the other hand, real-time information flows and cross-platform resources provided by technical tools continuously challenge teachers' inherent cognition of the authority of subject knowledge, forcing them to update their knowledge stock with a more open attitude while blurring and integrating the boundaries between subject knowledge and educational technology knowledge. For example, when a history teacher uses a dynamic digital archive to reconstruct a historical scene, the subject matter (historical facts) and the technology (data visualization) become cognitively inseparable, as the tool itself shapes the pedagogical interpretation of the content.

It is worth noting that the reorganization effect of technology embedding does not occur naturally but depends on teachers' active integration willingness and continuous learning ability at the cognitive level. Therefore, the quality of knowledge system reorganization varies significantly among individual teachers, resulting in a more complex hierarchical pattern in the development of teachers' professional knowledge under informatization.

B. REGULATORY EFFECT OF DIGITAL TOOLS ON TEACHERS' COGNITIVE LOAD

Cognitive load theory holds that the total amount of cognitive resources individuals mobilize when processing information is limited. When task complexity exceeds cognitive capacity, learning efficiency and decision-making quality decline significantly. The introduction of digital tools exerts a dual regulatory effect on teachers' cognitive load management, with the direction of effect depending on the matching relationship between the rationality of technical design and teachers' technical proficiency.

In terms of load reduction, intelligent lesson preparation tools, automated evaluation systems, and data visualization platforms effectively share teachers' repetitive cognitive tasks such as resource retrieval, homework grading, and learning situation analysis, allowing them to focus limited cognitive resources on higher-order instructional design and classroom interaction decision-making [7]. In terms of load increase, when teachers face unfamiliar digital platforms or need to coordinate multiple tools in parallel, extrinsic cognitive load often rises significantly, leading to distracted teaching attention or even technical anxiety.

Thus, the net regulatory effect of digital tools on cognitive load is governed by an 'Efficiency Threshold': the positive effect of load reduction only manifests when teachers' technical proficiency exceeds the cognitive baseline required to operate the platform. If the extrinsic load of tool manipulation remains below this threshold, the intelligent system effectively shared repetitive tasks; otherwise, the cognitive benefits are invalidated by technical anxiety. This net effect is closely related to the usability design of tools, the accumulation of teachers' technical literacy, and the school's technical support system. In practice, reasonably assessing the matching degree between tool selection and teachers' cognitive abilities and gradually optimizing the introduction rhythm and training mechanism of digital tools are key to achieving the positive regulatory effect of digital tools.

C. CULTIVATION OF TEACHERS' COGNITIVE FLEXIBILITY IN THE INFORMATIZED ENVIRONMENT

Cognitive flexibility refers to individuals' ability to flexibly switch cognitive perspectives, integrate diverse knowledge frameworks, and generate adaptive response strategies in complex and changing situations, representing a higher-order component of teachers' professional cognition. The informatized environment exerts a positive cultivation effect on the development of teachers' cognitive flexibility at multiple levels [8]. Digital learning platforms break the temporal and spatial limitations of traditional teaching research, enabling teachers to frequently access teaching cases and theories from different disciplinary backgrounds, teaching styles, and cultural contexts. The continuous stimulation of diverse perspectives helps break rigid cognitive stereotypes and prompts teachers to exhibit greater cognitive resilience when responding to diverse teaching situations. Meanwhile, AI-assisted tools provide real-time feedback and dynamic suggestions, driving teachers to conduct frequent cognitive assessments and plan adjustments in instructional decision-making, forming iterative thinking habits based on data over long-term practice and further improving the efficiency of cognitive switching and integration depth.

In addition, interdisciplinary collaboration and inter-school exchanges in the digital teaching research environment provide teachers with abundant opportunities for cognitive collision, promoting the flexible transfer and integrated application of knowledge across multiple disciplinary frameworks. The improvement of cognitive flexibility enables teachers to adjust teaching ideas in a timely manner in rapidly changing informatized classrooms and respond to students' immediate learning needs in a more adaptive way, thereby effectively supporting high-quality classroom interaction and the occurrence of deep learning.

D. PROFOUND CHANGES IN TEACHERS' PROFESSIONAL COGNITION DUE TO AI INTERVENTION

The in-depth intervention of artificial intelligence has brought about profound changes in teachers' professional cognition beyond instrumental application. At the level of knowledge production, the wide application of generative AI tools has changed the way teachers acquire professional knowledge [9]. Teachers' roles have gradually shifted from independent constructors of knowledge to human-machine collaborative integrators of knowledge. This transformation has a substantial impact on teachers' original sense of knowledge authority and professional autonomy cognition, prompting them to re-examine their professional value and core strengths.

At the level of instructional decision-making, AI-driven learning situation analysis systems and teaching behavior feedback platforms provide teachers with refined data support, shifting teaching judgment from vague evaluation relying on intuition and experience to precise reasoning based on data evidence chains, thus forming a new data-driven decision-making logic at the cognitive level. At the level of professional development, AI systems can conduct multi-dimensional quantitative analysis of teachers' classroom behaviors and generate personalized improvement suggestions. This precise external cognitive mirroring effectively compensates for blind spots in teachers' self-reflection, promoting self-renewal of professional cognition to a higher level.

However, AI intervention also brings new cognitive risks—over-reliance on algorithmic judgments may weaken teachers' independent teaching thinking, leading to the inertiation of professional cognition and the decline of subjectivity. Therefore, it is necessary to maintain the dominant position of teachers' cognition by implementing a 'Metacognitive Audit' protocol in human-machine collaboration. This involves teachers intentionally cross-referencing AI-generated logic against pedagogical intuition and empirical classroom data, thereby establishing a 'Human-in-theloop' decision-making model that prevents the erosion of professional subjectivity and cognitive inertia.

IV. INTERNAL CORRELATION BETWEEN TEACHERS' COGNITIVE STRUCTURE AND TEACHING STRATEGIES

A. MECHANISM OF COGNITIVE STRUCTURE INFLUENCING INSTRUCTIONAL DECISION-MAKING

Instructional decision-making is a complex cognitive process in which teachers judge and select teaching objectives, content, methods, and evaluation methods in specific teaching situations. Cognitive structure is the internal driving mechanism of this process. Teachers' existing knowledge organization framework and experiential schemas determine their perception of teaching situations, interpretation of problems, and weighing logic of alternative solutions. Thus, the quality and level of cognitive structure directly restrict the rationality and effectiveness of instructional decision-making [10].

From the perspective of action paths, cognitive structure influences instructional decision-making in three key links:

In the situation perception link, teachers with rich cognitive structures can quickly identify key teaching clues from complex classroom information, while teachers with weak cognitive structures may produce one-sided or distorted interpretations of the same situation.

In the plan generation link, cognitive structure provides teachers with available knowledge resources and strategy reserves, determining the diversity and creativity of their instructional design plans.

In the plan evaluation link, teachers' metacognitive ability and critical reflective awareness further influence their self-examination and adjustment quality of generated plans.

It should be emphasized that the influence of cognitive structure on instructional decision-making is not unidirectional and linear but forms a dynamic feedback through continuous interaction with teaching practice —the accumulation of practical experience continuously enriches and revises cognitive structure, and the updated cognitive structure further improves the quality of subsequent instructional decision-making. The two jointly promote the maturity of teachers' professional cognition in a cyclic interaction.

B. COGNITIVE BASIS FOR TEACHING STRATEGY SELECTION IN INFORMATIZED CONTEXTS

The selection of teaching strategies is essentially a cognitive reasoning process, in which teachers select and combine the most appropriate teaching methods from the strategy knowledge base based on comprehensive judgments of student characteristics, learning objectives, and teaching situations. In informatized contexts, this cognitive reasoning process gains new supporting conditions while facing new complexity.

Digital learning analysis tools can provide teachers with quantitative learning situation data, including students' knowledge mastery status, learning behavior trajectories, and cognitive participation levels. This shifts the selection of teaching strategies from relying on empirical intuition to rational judgment based on data evidence, significantly improving the objectivity and accuracy of the cognitive basis. Meanwhile, the types of available teaching strategies in the informatized environment have expanded significantly, with emerging forms such as blended learning, flipped classrooms, game-based learning, and human-machine collaborative inquiry. When selecting strategies, teachers need to comprehensively consider multi-dimensional factors such as technical adaptability, students' cognitive readiness, and teaching objective orientation, imposing higher requirements on teachers' comprehensive cognitive analysis ability.

In addition, the selection of teaching strategies in informatized contexts is deeply influenced by teachers' cognitive beliefs about technology. Teachers with positive beliefs about technical effectiveness tend to actively integrate digital tools in strategy selection and can often form more innovative strategy combinations, while teachers with high technical anxiety may cognitively avoid complex technical strategies, leading to a limited scope of strategy selection [11].

C. SYNERGISTIC RELATIONSHIP BETWEEN COGNITIVE ADAPTABILITY AND TEACHING INNOVATION BEHAVIOR

Cognitive adaptability refers to teachers' ability to flexibly update cognitive schemas, adjust knowledge structures, and generate creative response strategies when facing new situations, new information, and new requirements. Teaching innovation behavior in informatized contexts depends on teachers' cognitive adaptability. These two elements share a mutually reinforcing relationship. Within this framework, cognitive flexibility (the ability to switch perspectives) serves as the foundation for broader cognitive adaptability (the ability to update entire schemas). High adaptability allows teachers to integrate emerging tools quickly, while successful innovation further drives the willingness to adapt.

Teachers with high cognitive adaptability can quickly complete cognitive integration when exposed to emerging technical tools, creatively matching technical possibilities with teaching objectives, thus spontaneously generating exploratory teaching innovation practices. The successful experience and reflective feedback brought by these innovative practices further strengthen teachers' cognitive adaptation willingness, forming a positive self-reinforcing cycle. Conversely, teachers with insufficient cognitive adaptability often experience cognitive resistance when facing knowledge shocks and role changes brought by informatization transformation, tending to adhere to traditional teaching models, resulting in insufficient motivation or stagnation of teaching innovation behavior.

It is worth noting that cognitive adaptability is not purely an innate individual trait but is gradually formed under the combined influence of the school's organizational environment and professional development ecosystem [12]. A supportive digital teaching research environment, a positive peer learning culture, and an effective technical training mechanism can all provide important external support for the development of teachers' cognitive adaptability, thereby enhancing the overall vitality of school-level teaching innovation and the effectiveness of informatization transformation.

D. COUPLING EFFECT BETWEEN TEACHERS' COGNITIVE ABILITY AND TEACHING EFFECTIVENESS

Teaching effectiveness is a core indicator measuring teachers' professional value, usually covering multiple dimensions such as classroom teaching quality, student learning outcomes, and teachers' professional satisfaction. There is no simple linear causal relationship between teachers' cognitive ability and teaching effectiveness but a complex coupling effect—the improvement of cognitive ability indirectly and profoundly affects the overall level of teaching effectiveness by influencing the quality of instructional decision-making, the depth of teacher-student interaction, and the flexibility of teaching adjustment.

In informatized contexts, this coupling relationship further extends to the dimension of technology integration: when teachers' cognitive ability is sufficient to support the in-depth integration of digital tools, the introduction of technology significantly enhances teaching effectiveness; when there is a large gap between cognitive ability and technical complexity, the introduction of tools may instead disperse cognitive resources, exerting a negative interference effect on teaching effectiveness.

In addition, teachers' metacognitive ability—i.e., the ability to monitor and regulate their own cognitive processes—plays a key regulatory role in the coupling between cognitive ability and teaching effectiveness. Teachers with high metacognitive levels can timely identify and correct cognitive blind spots during teaching, thus maintaining high stability of teaching effectiveness. The improvement of teachers' cognitive ability must be promoted in coordination with the cultivation of metacognition and the optimization of technical support mechanisms to form a positive coupling between cognitive ability and teaching effectiveness.

TABLE 1. Correspondence Between Dimensions of Teachers' Cognitive Ability and Indicators of Teaching Effectiveness

Dimension of Cognitive Ability	Core Performance	Corresponding Teaching Effectiveness Indicator
Knowledge Integration Ability	Cross-domain integration of diverse knowledge	Depth and breadth of teaching content
Instructional Decision-Making Ability	Situational judgment and plan generation	Classroom adaptability and flexibility
Cognitive Load Management	Task allocation and attention regulation	Teaching rhythm and concentration efficiency
Metacognitive Monitoring Ability	Self-reflection and cognitive correction	Quality of continuous teaching improvement
Technology Integration Cognition	Tool selection and digital application	Implementation effect of informatized teaching

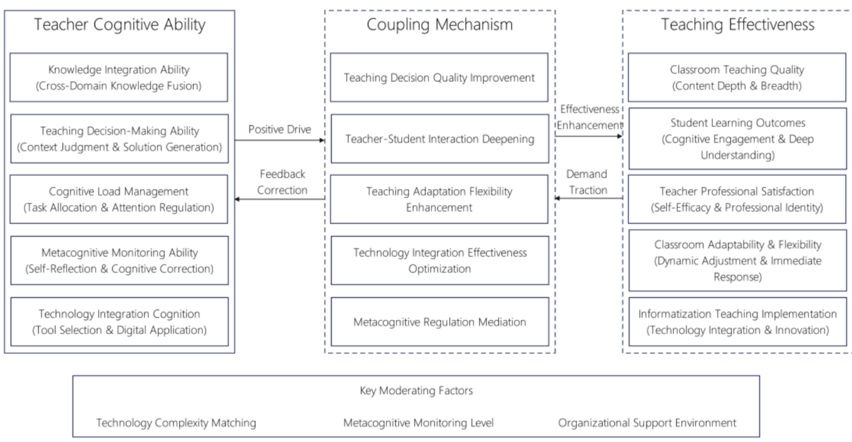

FIGURE 4. Coupling Relationship Between Teacher Cognitive Ability and Teaching Effectiveness

V. OPTIMIZATION AND RESHAPING OF TEACHERS' TEACHING BEHAVIORS IN EDUCATIONAL INFORMATIZATION CONTEXTS

A. OPTIMIZATION OF INFORMATIZED INSTRUCTIONAL DESIGN BASED ON COGNITIVE RECONSTRUCTION

Instructional design is the core link where teachers transform cognitive structure into actionable teaching actions, and its quality directly determines whether the results of cognitive reconstruction can be effectively transformed in classroom practice [13]. In informatized contexts, the optimization of instructional design must be premised on the systematic reconstruction of teachers' cognitive structure, organically integrating subject content knowledge, technical tool knowledge, and pedagogical knowledge to form an overall design framework that balances technical possibilities and learning objective orientation.

From the perspective of cognitive reconstruction, the optimization of informatized instructional design should focus on three levels:

At the objective level, leveraging the social construction mechanism (Mechanism 3) identified in Section 1.3, teachers need to go beyond mere knowledge transfer objectives through cross-temporal professional dialogue. By incorporating the cultivation of students' higher-order thinking and digital learning abilities into the objective system, teachers collectively complete a cognitive shift from "knowledge-centered" to "ability-centered" objective positioning, translating shared wisdom into actionable instructional goals., teachers collectively complete a cognitive shift from "knowledge-centered" to "ability-centered" objective positioning, translating shared wisdom into actionable instructional goals.

At the process level, teachers need to dynamically adjust the design of teaching activities based on learning situation data, shifting the teaching process from prescriptive to generative, reflecting the active adaptation of cognitive structure to situational changes.

At the evaluation level, teachers need to construct diversified learning evaluation schemes with the help of informatized tools, feeding evaluation data back into the continuous renewal of teaching cognition. In the practice of AI-enabled teaching research at Shanghai Xiangming Junior High School, AIGC tools are used to intelligently optimize teachers' preset teaching objectives, making objective setting more observable in the classroom. Specifically, by analyzing the "Extrinsic Cognitive Load" vs. "Germane Cognitive Load" ratios provided by AIGC tools, teachers at Xiangming redefined their schemas for lesson pacing. This allowed for a measurable shift where 85% of teachers successfully restructured their instructional designs to prioritize student inquiry over rote delivery, providing empirical evidence of cognitive transformation from experience-driven to data-supported models.

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B. TRANSFORMATION OF TEACHERS' TEACHING BEHAVIORS UNDER THE GUIDANCE OF TECHNOLOGY INTEGRATION

Teaching behaviors are the direct manifestation of teachers' cognitive structure at the level of classroom practice, and the depth and quality of technology integration determine the scope of this transformation [14]. Against the background of educational informatization, the transformation of teachers' teaching behaviors cannot remain at the superficial operation of digital tools but must form an integrated behavioral logic at the cognitive level with the cultivation of students' thinking as the core goal and technical tools as supporting means.

In terms of specific directions for teaching behavior transformation, the deepening of teacher-student interaction patterns is the core dimension—shifting from low-frequency and superficial memory-based Q&A to high-frequency and in-depth inquiry-based dialogue requires teachers to cognitively master the hierarchical logic of question design and the framework methods of guiding students' thinking.

Practical data from Xiangming Junior High School confirms this judgment. Through AI-assisted big data analysis of classroom behaviors, the school systematically tracks changes in the distribution of teachers' question types, sets the increase in the proportion of "creative questioning and answering" as a clear transformation goal, and promotes the shift of classrooms from "high-frequency superficial" to "high-frequency in-depth" teacher-student dialogue patterns, effectively activating students' higher-order thinking participation. This practice shows that the transformation of teaching behaviors driven by technology integration must be based on refined behavioral data analysis and guided by clear thinking cultivation goals to avoid formalistic technology application and achieve real cognitive transformation.

C. CLASSROOM TEACHING IMPROVEMENT FROM THE PERSPECTIVE OF COGNITIVE LOAD MANAGEMENT

The core of classroom teaching improvement is to enhance the depth of students' cognitive participation, which largely depends on teachers' effective management of the distribution of classroom cognitive load. In informatized classrooms, the introduction of technical tools and the expansion of interaction dimensions significantly increase classroom information density, imposing new management demands on the cognitive load of both teachers and students. Thus, teachers need to possess metacognitive regulation abilities to rationally allocate cognitive resources and optimize the sequence of cognitive tasks, ensuring that the use of technical tools does not squeeze the cognitive processing space of core teaching content.

Xiangming Junior High School provides teachers with quantifiable cognitive load reference data through real-time analysis by a big data platform for classroom teaching behaviors, enabling teachers to timely perceive students' participation status and attention distribution during classes and make immediate teaching adjustments accordingly, effectively avoiding reduced learning efficiency due to information overload. At the level of classroom structure design, it is important to distinguish between intrinsic and extrinsic cognitive load, and concentrate students' effective cognitive resources on the in-depth understanding of core concepts and active construction of higher-order thinking by optimizing teaching situation design and progressive question sequences. This requires teachers not only to be familiar with the functional logic of technical tools but also to internalize cognitive load management awareness as professional intuition in instructional design, thus achieving an effective balance between technical support and cognitive management [15].

D. SYNERGISTIC DEVELOPMENT OF DIGITAL LITERACY AND TEACHING PROFESSIONAL COMPETENCE

Digital literacy and teaching professional competence are not independent development dimensions but have a deep synergistic relationship—digital literacy provides a technical foundation for the informatization transfer of teaching professional competence, while teaching professional competence provides professional guidance for the effective use of digital tools. Their synergistic development together constitutes the dual-core driving force for teachers' professional growth in the information age.

In practice, the improvement of digital literacy should go beyond the training of simple tool operation skills and extend to the overall cultivation of data interpretation ability, algorithmic cognitive awareness, and critical thinking about technology, enabling teachers to maintain subjective judgment and professional reflection while using digital tools. In promoting AI-enabled teachers' professional development, Xiangming Junior High School adopts an evidence-based teaching research process of "individual reflection—teaching research group comments—data analysis report—comprehensive analysis", helping teachers gradually develop a data-driven mindset through the continuous application of digital tools and organically integrate the accumulation of digital literacy with the development of practical knowledge. After continuous research and training over multiple semesters, teachers have achieved significant improvements in three dimensions: strategic knowledge, situational knowledge, and reflective knowledge, fully verifying the feasibility and effectiveness of the synergistic development of digital literacy and teaching professional competence.

In the future, schools and educational administrative departments need to incorporate the systematic cultivation of teachers' digital literacy into the overall plan for professional development, establish a long-term development system based on real teaching practice and feedback mechanisms based on data evidence, and promote the continuous improvement of teachers' professional competence in the information age.

VI. CONCLUSION

The transformation of educational informatization is not merely a technological upgrade but a profound reshaping of teachers' cognitive ways and teaching logic. Technology embedding accelerates the reorganization of teachers' knowledge system, presenting new characteristics of cognitive load and cognitive flexibility; the in-depth intervention of artificial intelligence brings new challenges and opportunities to teachers' professional cognition. Cognitive structure is not static but evolves continuously in informatized practice, directly influencing the formation and implementation of instructional decision-making. When teachers' cognitive ability adapts to the needs of informatized teaching, teaching strategies become more targeted and innovative, and classroom effectiveness improves accordingly. In the future, teachers' professional development must take cognitive reconstruction as the internal driving force and the improvement of digital literacy as the external support, promoting teaching behaviors to be more adaptive, proactive, and creative. Only by synergistically cultivating technology integration and in-depth cognitive abilities can informatized teaching move from formal transformation to substantive improvement, injecting sustained momentum into the digital transformation of education.

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AUTHOR CONTRIBUTIONS

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