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From "No Development Growth" to "Ecological Development": Reflection on the Paradigm of Digital Technology Assisting Education to De-Involution

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Abstract: This study first traces the anthropological origins of "involution" to clarify its core meaning as "growth without development." It then demonstrates that contemporary educational involution represents a systemic crisis where industrial-era educational paradigms, amplified by digital technologies, have become self-locking systems. The inherent logic of digital technologies—data quantification and efficiency supremacy—has exacerbated systemic refinement and internal resource depletion. The conclusion analysis suggests that genuine "de-involvement" requires paradigmatic reflection aligned with prevailing trends, necessitating coordinated efforts across philosophical, institutional, and technological dimensions. By transforming digital technologies' empowering potential into foundational drivers for paradigm shifts, we can construct a new educational ecosystem centered on "diversity and symbiosis," achieving a qualitative leap from "involution" to "de-involvement."
Keywords: involution; digital technology; education; paradigm; reflection

Introduction:

The educational anxiety stemming from the practical implementation of the 'Double Reduction' policy has not diminished; instead, it has shown new trends of spreading in certain regions and among specific groups. The current phenomenon of "digital involution" in education stems not from the inherent flaws of technology itself, but from the misguided use of digital tools to reinforce an outdated industrial-era educational paradigm that is becoming obsolete. This paradigm, characterized by standardization, scale expansion, and efficiency supremacy, once supported large-scale public education systems in the 20th century but has proven increasingly rigid and outdated in the knowledge-driven society and intelligent era of the 21st century. When technology is merely employed to enhance operational efficiency of existing systems rather than driving paradigm shifts, it inevitably leads to "digital involution" —where technological advancement intensifies competition while marginalizing the intrinsic value of education and holistic human development. Therefore, the crux of the issue lies not in whether technology should be utilized, but in determining which "development paradigm" should guide its educational application[1].

To conduct an in-depth analysis of the aforementioned issues, this study first examines the historical formation and consolidation of industrial education paradigms, revealing their structural connections with contemporary educational challenges. Secondly, employing anthropological theoretical frameworks, it conducts a cultural-institutional diagnosis of educational "involution" phenomena to clarify their underlying mechanisms. Finally, integrating analytical tools from philosophy of technology and institutional theory, the study explores pathways for transitioning from "efficiency optimization" to "paradigm reconstruction," aiming to establish a "new educational ecosystem" centered on human connectivity, creativity, and growth. This approach not only emphasizes technological instrumental rationality but also prioritizes value rationality; it critically addresses existing challenges while actively seeking actionable transformation strategies.

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1 Theoretical Anchor Point of Involvement

1.1 Geertz's Classic Model: Internal Refinement Under System Expansion Constraints

American anthropologist Clifford Geertz was the first to systematically apply the concept of "involution" to socio-economic analysis. Through empirical research on colonial-era Indonesia, he revealed its core mechanisms[2]. Geertz particularly emphasized that rice cultivation could consistently maintain marginal labor productivity—meaning increased labor input did not lead to significant per capita income decline. This phenomenon of "growth without development" refers to systems expanding in physical output quantity while stagnating in labor efficiency and living standards[3]. Systems continuously self-replicate, refine, and complicate within existing frameworks without achieving fundamental structural leaps. Geertz's model provides the foundational framework and key insights into involution: when constrained by external boundaries, systems shift toward internal self-replication, refinement, and complexity, ultimately forming a growth pattern characterized by "no breakthrough."

1.2 Huang Zongzhi's Creative Transformation: From Ecological Models to Socioeconomic Structures

Historian Huang Zongzhi creatively applied Geertz's concept of "involution" to the study of China's economic history. Through comparative research, he found that "capitalist farms" employing wage labor and aiming for profit maximization would cease labor input when the marginal return on labor fell below market wages. In contrast, "smallholder family farms" dependent on household labor exhibited a starkly different logic: unable to "fire" family members, smallholders, driven by survival pressures, pushed labor input far beyond the point of diminishing marginal returns until the marginal return on labor fell below market wages or even below the level required for household subsistence. Huang Zongzhi summarized this unique growth pattern as "involutionary growth" or "over-density." Its essence lies in driving total output expansion through "super-dense labor input rather than productivity gains." Whether it was the poor farmers in the North China Plain investing far more labor per unit of land than reasonable levels, or the smallholders in the Yangtze River Delta shifting from rice cultivation to more labor-intensive cotton and sericulture, the common feature was that the average wage per unit of working day declined, yet household annual income remained stable or increased slightly due to mobilizing and utilizing more auxiliary labor. Huang Zongzhi incisively characterized this phenomenon as "growth without development" [4], meaning total output and total value increased, but labor productivity did not improve, living standards showed no substantial improvement, and the economic structure underwent no qualitative transformation.

1.3 Universal Analysis of Involvement in Internal Competition

By examining the theoretical discussions between Geertz and Huang Zongzhi, we can explore an alternative perspective to develop a more universally applicable analytical framework for "involution." This framework comprises three interconnected and logically progressive core criteria for evaluation, enabling the analysis of whether various fields have fallen into a state of involution.

External Lock-in. This constitutes the structural prerequisite for involution. Systems face insurmountable external constraints that prevent them from expanding into new domains, acquiring fresh resources, or achieving paradigm shifts in technology and institutions to secure growth opportunities[5]. Such lock-ins may manifest physically (e.g., land boundaries in Gertz's model), institutionally (e.g., rigid social structures, policy barriers, or singular evaluation systems), technologically (e.g., lack of disruptive innovation), or cognitively (e.g., entrenched success criteria and developmental paths)[6]. Internal Complexity Surge. The system's energy and resources fail to expand outward but instead become trapped within, leading to endless refinement and complexity in structural frameworks and operational rules. However, this complexity yields no fundamental functional innovation or substantial efficiency gains—merely a form of "complexity for its own sake" internal friction. Diminishing Marginal Returns. This represents the core consequence and performance indicator of involution. As system participants (individuals or subunits) continuously increase inputs (time, effort, resources, emotional investment), the positive return rate steadily declines. The severe input-output imbalance creates an "inflation of effort," where individuals expend escalating resources while gaining diminishing relative status and tangible benefits, ultimately resulting in widespread fatigue, anxiety, and disillusionment.

These three criteria form a complete causal chain: 'externalities lock-in' serves as the structural root cause of system stagnation, compelling it to shift inward; 'surge in internal complexity' represents the concrete manifestation and pathways of energy transformation within constrained spaces; while 'diminishing marginal returns' provides empirical validation for this internalization process.

2. How Digital Technology Creates Educational "Involvement"

2.1 Core and Crisis of Industrial Education Paradigm

The underlying structure of modern education systems remains deeply rooted in industrial-era production logic. This paradigm exhibits three defining characteristics: First, standardized production. Through uniform curriculum standards, textbook systems, and evaluation criteria, it molds standardized "educational products" akin to factory assembly lines. Second, centralized management. Organized around age-based grouping, subject specialization, and classroom instruction, it emphasizes scale efficiency and centralized control. Third, screening mechanisms. Educational systems employ tiered examinations and selection processes to serve societal division of labor and talent screening needs. The

homogeneous output of industrial education paradigms creates irreconcilable tension with the innovative era's demand for diverse talents. Huang Zongzhi further points out that industrialized education models prioritize "computability" and "performance transparency," reducing educational goals to quantifiable metrics that contradict holistic human development[7]. If digital technologies continue to follow industrial logic, they will exacerbate "individualized learning" and "meaning poverty," trapping education in a vicious cycle of "forced autonomy" and "excessive competition[8]." Innovation requires versatile talents with critical thinking, creativity, collaborative skills, and interdisciplinary perspectives—qualities precisely challenging to cultivate through standardized industrial education paradigms[9][13-14].

2.2 The "Conspiracy" and "Enhancement" of Digital Technology

Digital technology was originally regarded as a powerful tool for addressing educational challenges. However, within the framework of industrial education paradigms, it has to some extent become an "accelerator" of involution. Based on the three evaluation criteria for involution mentioned above, we can clearly elucidate the underlying mechanisms.

Firstly, at the level of "externalities lock-in," digital technologies substantially reinforce the rigidity of singular developmental trajectories through algorithmic recommendations and personalized learning paths. The superficial "personalization" essentially constitutes localized optimization within predetermined frameworks. As French philosopher Bernard Stiegler observed in *Technology and Time*, digital technologies often serve as tools for reinforcing existing power structures rather than disruptive forces. However, the optimal pathways identified by intelligent recommendation algorithms represent local optima defined by established evaluation systems (such as the national college entrance examination), rather than pioneering truly diversified developmental possibilities [10][13-14].

Secondly, regarding the "surge in internal complexity," digital technologies have created unprecedented micro-level competition spaces. As Ma Wen noted, learning analytics tools and smart attendance systems break down learning processes into infinitely granular metrics (such as response speed and focus duration), leading to an exponential proliferation of competitive dimensions and forming a self-reinforcing acceleration cycle. [7] Panoramic surveillance systems enable unrestricted refinement of competition. While these infinitely segmented dimensions ostensibly enhance "efficiency," they ultimately trap both teachers and students in a vortex of micro-level competition.

Thirdly, at the level of "diminishing marginal returns," there exists a significant imbalance between massive educational investments and substantive skill development. Students and families invest substantial time, money, and emotional resources, yet the returns increasingly manifest as mastery of exam-taking techniques rather than the cultivation of core competencies such as critical thinking, creativity, and stress resilience. The "involutionary growth" phenomenon described by Huang Zongzhi has resurfaced in education, where students become both exploiters and exploited. Trapped in endless self-improvement cycles, they exhaust themselves, and this involutionary competition ultimately stifles societal innovation.

Digital technology is therefore not a neutral tool. Without altering the industrial education paradigm, it systematically exacerbates educational involution by reinforcing external lock-in mechanisms, driving internal complexity, and causing diminishing marginal returns. To transform digital technology into a genuine enabler of educational innovation rather than an accelerator of involution, educational reform must fundamentally reconstruct its paradigm. Technology inherently embodies dual logics of empowerment and discipline. The current intensification of educational involution stems from the industrial-era education paradigm's "appropriation" and "taming" of technological resources.

3. Path to Breakthrough: Paradigm Revolution

Digital technology plays multifaceted roles in education. Under traditional paradigms, it risks becoming a catalyst for academic involution. The true breakthrough lies in achieving a systemic paradigm shift spanning philosophy, institutions, and technology. This transformation would steer technology from a "disciplinary tool" to an "ecological foundation," unleashing its long-suppressed empowering potential. The following outlines concrete pathways across three dimensions.

3.1 Philosophical Shift from "Instrumental Rationality" to "Value Rationality"

The profound philosophical roots of educational involution lie in the excessive expansion of instrumental rationality and the severe erosion of value rationality. Instrumental rationality focuses on conditions and means for achieving objectives, seeking effective and economical approaches to accomplish goals, while value rationality emphasizes the intrinsic value represented by actions and concerns the correctness and rationality of purposes. Max Weber's classic distinction of rational forms reveals the core dilemma of modernity: instrumental rationality obsesses over maximizing means efficiency and calculative approaches, yet neglects inquiries into life's ultimate meaning and values.[10] In education, this paradigm manifests as a utilitarian orientation that reduces education to mere human capital investment. As Gary Becker's "human capital theory" has reinforced and popularized, this approach leads to profound educational alienation—students are reduced to "raw materials" awaiting standardized processing in educational factories, while schools degenerate into "machines" fulfilling social screening and stratification functions. [11]Therefore, the primary task of paradigm revolution lies in guiding education back to its essential values, achieving a fundamental philosophical shift from "instrumental rationality" to "value rationality."

The intellectual foundation of this educational paradigm stems from Aristotle's concept of "practical wisdom," which

emphasizes making prudent and virtuous judgments in concrete contexts. It also derives from Kant's moral imperative that "human beings are ends in themselves and not means to an end," establishing the inviolability of human subjectivity and dignity in education. Furthermore, it is profoundly influenced by educator John Dewey's theory of "education as growth," which posits that the purpose of education lies in the continuous transformation and enrichment of individual experiences, with its value residing in the process itself rather than external utilitarian goals.[12] This educational philosophy transcends narrow utilitarianism focused on short-term utility and external gains, redefining education as a life journey of "becoming human" through value practices and meaning exploration within communities[13]. Such an approach provides philosophical guidance for addressing the issue of educational involution.

3.2 Institutional Level: Reconstruction from "Screening Machine" to "Empowering Ecosystem"

Bourdieu posits that traditional educational evaluation essentially constitutes a social reproduction process that institutionalizes and legitimizes the "cultural capital" of specific social strata[14]. Cultural capital encompasses cultural competencies internalized into individual cognitive frameworks, objectified cultural products, and institutionalized academic qualifications. At the institutional level, driving educational restructuring centers on breaking the path dependence of industrial education paradigms through evaluation system reforms and knowledge system openness. The latter requires adopting constructivism and sociocultural theories to transform closed, discipline-bound curricula into "project-based learning networks" focused on real-world problem-solving. Lev and Wenger's "situational learning theory" and "practical communities" [15][16]provide theoretical foundations for this approach, emphasizing that learning involves learners gradually constructing knowledge meaning through "legitimate marginal participation" within authentic social practice communities. This concept has been actively explored and validated in China's cutting-edge educational practices. For instance, multiple schools in Chengdu utilize the SEED platform to develop integrated teaching-evaluation systems emphasizing process-oriented assessments, shifting evaluation ecosystems from "quality certification" to "quality enhancement." Meanwhile, Jiangxi Normal University High School's Ganjiang Branch has introduced real-world research resources into basic education through its integrated "Qichuang Curriculum" system spanning preschool to high school levels, effectively alleviating educational anxiety at critical junctures—a vivid demonstration of institutional-level "empowerment ecosystem" construction. These practices demonstrate that institutional restructuring is not theoretical speculation but a feasible pathway grounded in solid practical foundations. These findings collectively validate the central thesis of the paradigm revolution: When educational systems transition from rigid structures serving hierarchical ranking to flexible ecosystems supporting diverse growth and meaning construction, digital technologies can transform from "disciplinary tools" exacerbating academic involution into "empowerment platforms" nurturing individuality. This profound institutional transformation not only provides practical breakthroughs for addressing educational involution but also lays practical foundations for reconstructing educational value rationality at the philosophical level.

3.3 Empowerment from "Discipline Tools" to "Ecological Foundation" at the Technical Level

The paradigm shift in technological education requires fundamental restructuring of educational technology's design philosophy and application ethics. Its theoretical foundations trace back to Lewis Mumford's critique of "megamachines" in *Technology and Civilization*—which exposed how technological systems become authoritarian forces suppressing life vitality[17]—and Ivan Illich's advocacy of "pleasure tools" in *The Joyful Tools*, emphasizing that technology should empower human autonomy and creativity rather than serving as instruments of control and discipline[18]. Current dominant educational technology applications represent an extension of "discipline-power dynamics" into the digital era, employing round-the-clock data monitoring and quantitative evaluations to place learners within persistent comparative frameworks, thereby reinforcing educational screening mechanisms. The concept of an "ecological foundation" leverages digital technologies as foundational support to foster educational environments characterized by biodiversity, systemic openness, and collaborative symbiosis, aiming to transform education from a standardized production system into an organic, generative, and interconnected ecosystem.

An ideal educational "ecological foundation" should encompass four interconnected core elements. First, connectivity: breaking down data and resource silos. While technological applications under the "disciplinary tool" model often create data barriers, the "ecological foundation" focuses on building interconnected networks. This enables seamless flow of students 'learning trajectories, project outcomes, and creative works across school, family, museum, and corporate environments. Such integration institutionally supports dismantling the diploma-driven society's monopoly on cultural capital, laying the groundwork for diversified evaluation systems. Second, diversity: fostering multiple intelligences and heterogeneous growth. The "ecological foundation" rejects uniform measurement standards for all students. Technology should serve dynamic identification of each learner's strengths in linguistic, logical, spatial, motor, and interpersonal intelligences rather than ranking systems, then recommend customized "ecological niches" – personalized development paths and resources that celebrate individual uniqueness. Third, generativity: stimulating emergent learning and innovation. This key distinction from preset teaching models utilizes generative AI as "thinking partners" instead of "answer machines," virtual laboratories with exploratory environments, and collaborative online platforms. Learning objectives aren't predetermined, shifting focus from knowledge consumption to creation to cultivate genuine innovation. Fourth, resilience: creating inclusive spaces that allow trial-and-error experimentation and gradual growth. The deceleration mechanisms derived from the "ecological foundation" manifest through

anonymized failure case repositories, process-oriented formative feedback systems, and proactive "digital silence" or "anti-pushing" mechanisms. Its core educational value lies in safeguarding essential exploration, confusion, and reflection time during learning processes, systematically evaluating "the ability to learn from failure" and the effort invested, rather than merely celebrating ultimate success. This approach fosters a safe, inclusive, and risk-supportive psychological environment.

The profound shift in technological paradigms—from pursuing efficiency in knowledge transmission to constructing immersive environments that support contextual learning—essentially marks a transition from "technological determinism" to "democratization of technological codes." Educational technology thus evolves into an "ecological foundation" that facilitates the diverse blossoming of life and promotes the free development of individuality.

4. Conclusion

The current educational "involution" phenomenon does not stem from the failure of individual efforts, but rather represents a systemic rigidity in the industrial-era educational paradigm exacerbated by digital technologies. Having fulfilled its historical mission of large-scale standardized knowledge dissemination, this paradigm now faces inherent contradictions between homogeneous output and the innovative era's urgent demand for diverse talents. The crux lies in whether we can guide technological design through civilizational visions to establish an educational ecosystem that is pluralistic, inclusive, resilient, and conducive to trial-and-error processes and slow growth. Within this ecological framework, the core purpose of technology application shifts from reinforcing "disciplinary control" to supporting "personalized development." As demonstrated by adaptive threshold learning models, artificial intelligence should serve as an "intelligent mentor" dynamically identifying individual competency thresholds and customizing personalized advancement paths. Concurrently, educational evaluation systems must transition from "screening rankings" to "empowering development," establishing diversified assessment mechanisms that validate students' project outcomes, artistic creations, social practices, and other "soft skills" with measurable societal value—thereby dismantling diploma-centric societies 'monopoly on cultural capital. Digital technologies provide unprecedented tools to realize Confucius' "teaching according to individual aptitude" and Aristotle's "practical wisdom," but their deeper value lies in liberating education from instrumental rationality to prioritize human cultivation. Ecological education aims to enable every learner to discover and develop their unique "ecological niche," achieving collective prosperity through "harmonious coexistence of diverse beauties" based on the principle of "each appreciating its own beauty." This reflects a profound respect for the value of individual life, an inclusive attitude toward diversified development, and trust in human creativity. It also represents an intrinsic requirement and inevitable path for achieving healthy and sustainable development in human civilization.

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