

Research on the Transformation of University Teaching Paradigm from the Perspective of Educational Digitalization and Educational Technology Integration

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Abstract: Driven by the dual strategies of digital economy and education powerhouse, educational digitalization has evolved from a tool-based supplement to a structural force reshaping the university teaching ecosystem. Taking the concept of “empowerment by data and intelligence” as the entry point, this paper focuses on the coupling relationship between educational technology and teaching paradigm. Only by embedding technology into the discourse system, knowledge production, and institutional arrangements of the teaching community can the paradigm shift from “digital teaching” to “teaching digitalization” be truly realized. The transformation framework constructed in this paper can provide an operable theoretical fulcrum and practical path for universities to formulate educational digitalization strategies, optimize educational technology governance, and improve teaching innovation effectiveness.

Keywords: Educational digitalization; Educational technology; Empowerment by data and intelligence; Teaching paradigm; University transformation

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1. Introduction

With the in-depth development of the global digital economy, data and intelligent technologies are accelerating their penetration into the education field, triggering chain changes in university teaching systems in multiple dimensions such as objectives, structure, process, and values. The report of the 20th National Congress of the Communist Party of China clearly proposed to “promote educational digitalization”, elevating it to a “national project” for building a high-quality education system. At the same time, emerging technology clusters such as generative artificial intelligence, learning analytics, and educational metaverse are rapidly iterating, providing realistic possibilities for solving the structural contradiction between scale and individualization in the traditional class teaching system. However, a large number of empirical studies show that the transformative effect of technology on teaching presents a significant “scissors gap”: on the one hand, investment in educational

technology continues to rise; on the other hand, the deep structure of classroom teaching remains stable, and the traditional paradigm of teacher dominance, textbook centrism, and standardized evaluation has not been fundamentally loosened. Thus, educational digitalization has entered the “deep water zone”, and its key contradiction has shifted from “whether there is technology” to “how to use technology to reshape teaching”. Based on this, this paper attempts to break through the narrow perspective of “tool-means”, place educational digitalization within the explanatory framework of complexity science, explore the co-evolution mechanism between technological elements and teaching paradigms, and provide new cognitive coordinates and action roadmaps for universities to achieve high-quality and connotative development.

2. Literature review

Foreign research has paid early attention to the symbiotic relationship between educational technology and teaching paradigm ^[1]. The early “media comparison research” paradigm regarded technology as an information transmission channel, and conclusions mostly showed “no significant difference”; subsequently, models such as “SAMR” and “TPACK” were proposed, emphasizing the redefinition of teaching tasks by technology and the re-integration of teachers’ knowledge structure. Domestic research has generally gone through three stages: “hardware construction and resource accumulation–platform promotion and blended teaching–data-driven and intelligent upgrading”, with research focus gradually shifting from “input-output” performance evaluation to the interpretation of “deep learning occurrence” mechanisms. However, existing achievements still show the following gaps: first, the review of the evolution logic of educational digitalization mostly stays at the policy or phenomenon level, lacking a historical institutional perspective that vertically connects “technology–institution-culture”; second, the instrumental rationality interpretation of the concept of “empowerment by data and intelligence” is excessive, while the value rationality examination is insufficient, which can easily lead to the concealment of technology alienation risks; third, transformation strategy research emphasizes macro suggestions, lacking meso-level operational frameworks for different disciplines and course types in universities ^[2]. Based on this, this paper attempts to use “empowerment by data and intelligence” as a theoretical lens to construct a teaching paradigm transformation model that takes into account both macro strategy and micro implementation. In today’s digital era, enterprises collect, store, and analyze vast amounts of commercial data to gain precise insights into market demands, consumer preferences, and competitor dynamics, providing robust support for decision-making. Data sources are diverse, encompassing internal transaction records, production data, customer relationship management data, as well as external market research data, social media data, and industry reports. After cleaning, transforming, and integrating, this data is stored in data warehouses or data lakes, laying the foundation for subsequent analysis ^[3].

3. Key problems faced by the transformation of university teaching paradigm

3.1. The “fragmentation” dilemma of underlying infrastructure

Although the “Educational New Infrastructure” strategy has been advanced for many years, systems such as teaching, academic affairs, student affairs, personnel, and finance within universities are often built by different vendors in different periods, with significant differences in data standards, interface protocols, and field semantics, forming isolated “data islands”. On the one hand, learning behavior data is locked inside the LMS and cannot be cross-validated with data from libraries, laboratories, and second-classroom scenarios; on the other

hand, classroom teaching data lacks blood labels with scientific research data and employment data, causing algorithm models to be trained only based on “incomplete samples”, amplifying recommendation bias and prediction errors. More seriously, some universities ignore the low-latency collaboration between edge computing nodes and cloud platforms when chasing “smart classroom” hardware indicators, causing stuttering in the transmission of high-definition video, XR courseware, and other multimodal resources, which in turn suppresses teachers’ willingness to use educational technology in depth [4]. System fragmentation not only increases the cost of data governance but also causes “teaching digital transformation” to be alienated into “repeated recording on multiple platforms”, ultimately deviating from the original intention of learner-centered values.

3.2. The “last mile” obstruction of technology adoption

Existing teacher training mostly stays at the level of “tool operation”, ignoring the systematic supply of data thinking, algorithm ethics, and learning science theory, resulting in a deformed structure of digital literacy of “a very few at the top, a gap in the middle, and a huge base at the bottom”. Young teachers can quickly master platform functions but lack the “meaning-shaping” ability to transform data into teaching decisions; senior professors have profound subject knowledge but “cannot understand, trust, or use” learning analytics dashboards, and then develop a psychology of “technology stigmatization”, retreating to traditional PPT “cramming education”. When the element of “people” cannot evolve in sync with technology, even the most advanced smart classrooms can only become “high-pixel blackboards” [5]. Designing a commercial decision-making model based on digital and intelligent technologies involves the comprehensive application of big data analytics, artificial intelligence, machine learning, and other techniques to construct data-driven decision algorithms, enabling in-depth mining and analysis of business data. During the development process, agile methodologies are employed to ensure rapid iteration and optimization of the model, adapting to evolving market demands and corporate decision-making requirements.

3.3. The “transparency” crisis of teaching decision-making

With the landing of adaptive learning platforms on campus, algorithms begin to replace teachers in making key decisions such as “learning path recommendation–resource push–risk warning”. However, most vendors refuse to disclose feature weights and model structures on the grounds of “trade secrets”, causing teachers, students, and managers to fall into “black box” anxiety at the same time: teachers cannot judge whether recommendation results imply discrimination in gender, region, or academic origin; students cannot understand why they are labeled as “low-achievement” by the system, generating self-fulfilling prophecies; managers lack traceable audit logs when facing algorithmic accidents and can only “extinguish the fire after the fact”. In addition, some platforms use deep reinforcement learning to continuously capture students’ attention curves and extend online time through infinite scrolling and gamified badges, forming a paradoxical conflict with the goal of “deep learning”. When technological rationality overrides educational rationality, teaching paradigm transformation may slide into the trap of “algorithmic colonization”, damaging the fundamental mission of universities to cultivate virtue and educate people.

3.4. The “low-level cycle” trap of resource supply

Driven by the “Golden Course” construction policy, universities have launched projects such as micro-courses, MOOCs, and virtual simulation experiments. However, constrained by the performance orientation of “emphasizing application, neglecting operation”, a large number of resources show the characteristics of

“homogeneous copying–low-level cycle”: on the one hand, MOOCs in the same discipline across different universities are highly similar in knowledge structure, case selection, and visual style, resulting in the phenomenon of “thousand courses, one face”; on the other hand, existing resources are mostly presented in the form of “knowledge point slicing”, lacking “complex tasks–ill-structured problems” situations for high-order thinking, causing students to remain in surface learning even in “smart” environments. More severely, teachers often directly use existing resources from platforms in actual teaching, giving up secondary creation based on school-based learning situations, making classrooms a “pre-cooked food” heating scene and inhibiting teachers’ teaching design imagination and subject education creativity. The coexistence of “involution” and “inertia” in the resource supply side makes it difficult for educational technology to trigger a real paradigm revolution.

3.5. The “deep structure” resistance of organizational transformation

Teaching paradigm transformation involves not only the updating of technology but also touches the “deep structure” of university institutions and culture. Current performance evaluation, professional title review, and course payment distribution still focus on core indicators such as “classroom hours, research papers, and project funds”, leading teachers to invest a lot of time in digital teaching design without institutional recognition, creating a reverse incentive of “high cost, low return”. At the same time, grassroots teaching organizations (departments, teaching and research offices) have long followed the vertical differentiation logic of “discipline—major—course”, lacking the cultural soil for interdisciplinary collaborative innovation, making it difficult for new teaching forms such as project-based learning and cross-domain course groups to take root. The deeper resistance comes from the value conflict between “academic standard” and “student development standard”: some teachers regard educational technology as a “performative tool”, worrying that live streaming and recording will weaken the teacher’s “knowledge authority” identity in the classroom, thus resisting deep hybrid teaching reform in the name of “maintaining academic dignity”. The superposition of institutional friction and cultural inertia makes the process of technology embedding into teaching present a paradox of “surface excitement, solid core”, hindering the institutional rooting of the new paradigm.

4. Optimization strategies for the transformation of university teaching paradigm

4.1. Build an integrated architecture of “cloud—edge—end—middle platform” to break data silos

First, at the school level, a special working group for “educational data middle platform” should be established to uniformly formulate data standards, interface specifications, and blood label systems, and to encapsulate and micro-service transform existing systems such as academic affairs, student affairs, scientific research, and libraries, achieving a smooth transition of “existing systems remain unchanged, incremental data interoperable”. Second, introduce “edge cloud” nodes to cache high-frequency interactive data nearby and transmit it back to the cloud through low-latency links, alleviating the stuttering problem of high-definition video and multimodal resource transmission. Third, build a dual architecture of “real-time data lake–offline data warehouse”: the former is used for stream computing and immediate early warning, and the latter supports complex modeling and longitudinal tracking, opening up a full-link data closed loop of “pre-class—during-class—after-class”. Finally, provide teachers and students with a “low-code” data dashboard, where teachers can generate classroom behavior heat maps with one click, and students can view the mastery of their personal knowledge graph in real time, lowering the threshold for data use in a visual way, making data truly “flow” and “live”, and providing a credible

base for intelligent decision-making.

4.2. Build a dual-wheel drive mechanism of “digital literacy advancement—teaching ability reconstruction” to bridge the teacher gap

Universities should jointly develop a “digital literacy pyramid” certification system with the National University Teaching Development Network (CHED), incorporating data interpretation, algorithm ethics, learning science, and instructional design into layered micro-certifications: the base layer focuses on “tool operation”, the middle layer emphasizes “data decision-making”, and the top layer highlights “ethical creation”, and it is hard-linked with professional title evaluation, position assessment, and performance distribution, forming a closed loop of “training—certification—promotion”. For senior professors, adopt a “shadow partner” mechanism: educational technology backbones serve as “shadow partners”, one-on-one assisting them in transforming cutting-edge subject knowledge into computable, stimulative, and interactive digital resources, lowering the psychological threshold for technology adoption. For young teachers, establish an incubation fund for “data-driven instructional innovation”, encouraging them to carry out “small-grain, fast-iteration” teaching experiments based on learning analytics, and provide A/B testing platforms and AI audit reports on teaching behavior, helping them complete the identity transition from “tool users” to “instructional designers” in “learning by doing”. Through institutional incentives and personalized support, the overall improvement and echelon connection of teachers’ digital literacy are achieved.

4.3. Establish a three-dimensional governance system of “algorithm transparency—ethical audit—risk circuit breaker” to resolve black-box anxiety

Universities should require educational technology vendors to provide “explainability reports”, disclosing at least feature importance rankings, training data distributions, and potential bias test results, and sign “algorithm ethics commitment letters”. A “educational algorithm ethics committee” should be established on campus, composed of law, education, artificial intelligence, and student representatives, to conduct pre-review and regular review of high-risk algorithms; introduce a dual filing system of “model card–data card” to ensure that algorithm versions, training sets, and test indicators are traceable and can be rolled back. At the same time, develop an “algorithm risk circuit breaker” plug-in: when the system detects abnormal labels, it automatically suspends the service and triggers a manual review process. Open a compulsory “algorithm literacy” module for teachers and students, and through case teaching, simulation exercises, ethical debates, etc., improve their ability to identify and question algorithmic bias, let “technology transparency” and “human awakening” resonate at the same frequency, and ensure that teaching decisions return to educational rationality.

4.4. Implement a trinity ecology of “resource crowdfunding—creation incentive—quality co-creation” to break content homogeneity

Universities can build a “educational resource DAO” platform, encouraging teachers, students, and industry experts to jointly develop project-based course packages for complex tasks in a “crowdfunding” way: teachers provide subject frameworks, students contribute real needs, and enterprises introduce industry cases. The platform records contributions based on blockchain and distributes later copyright revenue, achieving a sustainable cycle of “co-creation—sharing—co-governance”. Set up a “resource creation incentive fund”, and give continuous dividends to original task scenarios, experimental scenes, and interactive scripts recognized by student voting and peer review, motivating teachers to shift from “applying for projects” to “operating ecology”.

Introduce a “resource quality co-creation” mechanism: before MOOCs and virtual simulation experiments go online, a “user experience officer” team composed of students, graduates, and employers conducts immersive testing, generating a “resource health report” from dimensions such as learning goal achievement, emotional experience peak, and vocational competency added value, and serves as the core basis for subsequent iterations and fund allocation. Through market-style competition and ecological collaboration, promote resource supply to move from “homogeneous copying” to “high-order creation”.

4.5. Reshape the synergistic mechanism of “institution—culture—leadership” to dissolve deep organizational resistance

First, revise the “Teacher Teaching Performance Assessment Measures”, incorporate “digital instructional design, learning data analysis, and student higher-order ability added value” into core indicators, with weights not lower than traditional classroom hours and papers, and implement a dual-track evaluation of “masterpiece influence”: teachers can submit a deep hybrid course as a “teaching masterpiece”, and its student ability added value data, peer citation times, and social openness serve as influence evidence, opening up an equivalent channel between “teaching academia” and “research academia”. Second, establish a permanent body of “interdisciplinary teaching community”, break down administrative barriers between colleges and departments, and encourage teachers to jointly develop cross-field project courses such as “artificial intelligence—ethics” and “big data—public policy” through mechanisms such as “course group bidding—credit mutual recognition—performance sharing”, cultivating a collaborative innovation culture. Third, implement the “teaching leadership improvement plan”: school leaders, deans, and professional heads need to regularly complete the “educational digitalization strategy workshop”, practice resource allocation, risk governance, and quality improvement strategies on real data sand tables, and include transformation effectiveness in the cadre KPI, forming a virtuous ecology of “top leader personally grasps, middle level collaboratively pushes, grassroots is willing to change”. Finally, create a “teaching paradigm transformation culture festival”, and through ritual activities such as student work exhibitions, teacher lecture competitions, and algorithmic ethics debates, continuously strengthen the value consensus of “student development standard”, let institutional innovation and cultural immersion go in the same direction, and ultimately achieve deep structural change from “external promotion” to “internal consciousness”.

5. Conclusion

The transformation of university teaching paradigms under the background of educational digitalization is a systemic change involving cognitive frameworks, organizational structures, and cultural mindsets. The “empowerment by data and intelligence” four-helix framework proposed in this paper not only reveals the synergy mechanism among platforms, data, algorithms, and scenarios but also provides an operable theoretical model for solving the problem of “high technology input—low teaching transformation”. Future research can further combine complex adaptive system theory, develop teaching policy “sandboxes” based on multi-agent simulation, and rehearse the long-term effects of different technology intervention schemes in virtual environments; at the same time, strengthen interdisciplinary research on ethical risks of educational digitalization, build a collaborative governance network of “law—technology—education”, and ensure that technology always serves the all-round development of people. Only in this way can universities achieve a paradigm leap from “following” to “running alongside” and even “leading” in the digital wave, and contribute higher education wisdom and strength to building a learning-powerful country and a digital China.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Chen W, Tang Z, Bai J, 2025, The Application of Blockchain Technology in Multimodal Educational Resources. *Journal of Systems Science and Information*, 2025(1): 137–156.
- [2] Li D, Nik Azman N, 2025, Digital Financial Inclusion Promotes Economic Environment-Inclusive Growth in Underdeveloped Regions: Evidence from Gansu, China. *Chinese Journal of Urban and Environmental Studies*, 2025(1): 1–21.
- [3] Li Y, Li Q, Cao Z, et al., 2025, The Impact of Reproductive Traits on Psoriasis Risk Is Mediated by Education Attainment and Body Mass Index: A Mendelian Randomization Study. *Biomedical and Environmental Sciences*, 2025(3): 365–375.
- [4] Liu Z, 2023, A Multiple q-translation Formula and Its Implications. *Acta Mathematica Sinica, English Series*, 2023(12): 2338–2363.
- [5] Lian R, Zeng Q, 2023, An Overview of the Dynamic Framework in Earth-System Model and Its Well-Posedness. *Chinese Annals of Mathematics, Series B*, 2023(6): 803–818.

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