Research on the Dilemma Diagnosis and Strategy Design of the Role Transformation of University Teachers under the Background of Educational Digital Transformation

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Abstract. Focusing on the role transformation of university teachers in the context of digital transformation of education, a "Four-Stages Double-Bridges" model was constructed as an analytical framework to address the current challenges faced by teachers, such as cognitive ambiguity, insufficient abilities, and lack of support. It divides the process into four stages: contact/exploitation, conflict/struggle, adaptation/integration, and innovation/leadership, identifying two critical support mechanisms—the "empowerment support bridge" and "innovation incentive bridge." Through mixed-methods diagnosis, it reveals stage-specific challenges: cognitive ambiguity, ability gaps, path dependence, and systemic constraints, rooted in insufficient support structures. The study advocates dual-strategy construction: early-stage value guidance and skill-building to overcome "unwilling/unable to change" barriers, and late-stage ecosystem cultivation and institutional reform to address "unmotivated/unable to innovate" stagnation. By integrating theoretical modeling with practical interventions, this framework offers a dynamic pathway for universities to systematically empower teaching staff during digital transformation, balancing individual development with organizational system evolution.

Keywords: University teachers, Role transformation, "Four-Stages Double-Bridges" model, Diagnosis of dilemmas, Strategy design

1 Introduction

Rapid advances in artificial intelligence, the Internet of Things, and data-driven systems are accelerating changes in production, communication, and knowledge creation. In education, this shift is moving teaching beyond an industrial paradigm of standardization toward a paradigm of digital intelligence characterized by adaptive learning, personalized support, and higher-order capability development. Within this transition, teachers are no longer merely transmitters of knowledge; they become the decisive agents who determine whether digital transformation improves learning quality or remains superficial.

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In higher education, this transformation is especially urgent. Industrial upgrading and the digital economy are reshaping occupational structures and competency requirements, while conventional teaching models centered on knowledge delivery and skill drills increasingly fail to match the needs of intelligent industries and complex service sectors[1]. Although digital platforms, virtual simulation, and learning analytics provide new possibilities, their educational value depends on teachers`capacity to interpret, integrate, and redesign teaching practices. Digital transformation is therefore not simply a matter of using new tools. It entails cognitive adjustment, capability reconstruction, and professional identity transition.

1.1 New Role Orientation of University Teachers

Digitally intelligent teaching is reshaping the role of university teachers in three major ways.

1.1.1 The Role Focus Shifts from Knowledge Imparter to Learning Designer.

As basic content becomes increasingly available through digital resources, teachers' value lies less in repeating information and more in designing authentic learning tasks, integrating knowledge with skills and literacy goals, and linking classroom learning with real work contexts [2].

1.1.2 The Teaching Stance Changes from Classroom Leader to Learning Guide.

When foundational knowledge can be learned before class through platforms and online resources, classroom time can be reoriented toward discussion, diagnosis of difficulties, inquiry, and problem solving. Teachers need to interpret learning data, identify student differences, and organize deeper learning activities rather than simply deliver content.

1.1.3 The Working Mode Expands from Independent Executor to Teaching Collaborator.

Digital transformation weakens the boundaries among classroom, laboratory, and industry settings. Teachers must increasingly collaborate with engineers, enterprise mentors, and cross-disciplinary colleagues to co-develop projects, update learning resources, and build authentic digital learning environments.

1.2 Practical Dilemmas in Role Transformation

Despite broad policy support, actual implementation often lags behind expectations. In many universities, teachers face at least three interrelated dilemmas.

1.2.1 Cognitive and Conceptual Level.

Some teachers still understand digital transformation mainly as the informatization of teaching methods. They regard digital tools as supplements rather than as drivers of

pedagogical and role change. This limited value recognition often produces identity anxiety, especially when the transition challenges the authority of the teacher-centered classroom [3].

1.2.2 Ability and Literacy Level.

Teachers are required not only to operate digital tools but also to redesign teaching, interpret data, organize blended learning, and support higher-order capability development. Many recognize the need to change but lack clear pathways for doing so effectively.

1.2.3 Mechanism and Environment.

Support and incentives are often fragmented. Training tends to be generic and episodic, while evaluation systems still privilege contact hours, research papers, and traditional performance metrics. As a result, teachers perceive high costs and uncertain returns in digital innovation, which weakens sustained engagement [4].

These dilemmas suggest that teacher transformation cannot be adequately explained either by technology adoption alone or by generic teacher development theories. Existing stage models describe growth trajectories, and the Technology Acceptance Model explains initial adoption intention, but neither fully captures the specific tensions of digital role transformation in higher education: the interplay among role identity, teaching redesign, organizational support, and long-term innovation. To address this gap, this study proposes a Four-Stages Double-Bridges model that links teacher development stages with two key support mechanisms for crossing critical transition points.

2 The Construction of "Four-Stages Double-Bridges" Model

Transformation dilemmas are interconnected and co-evolve as teachers adopt technologies, enact new roles, and adapt to environments. To analyze internal dynamics and key obstacles, this study proposes a Four-Stages Double-Bridges model that specifies stage characteristics, cross-stage bottlenecks, and support mechanisms.

2.1 Theoretical Basis and Logic of Model Construction

The model integrates four perspectives.

2.1.1 Development Stage Theory.

It helps explain why teacher concerns shift over time, from self-survival to task performance and then to student impact. This perspective supports the view that digital role transformation is gradual and stage-specific rather than immediate[5].

2.1.2 Technology Acceptance Model.

Technology explain why early transformation depends on perceived usefulness, perceived ease of use, and coordinated knowledge of technology, pedagogy, and content[6]. However, these frameworks mainly explain entry into digital practice, not sustained role reconstruction.

2.1.3 Transition Theory.

It highlights that professional change depends on situation, self, support, and coping strategy. This is particularly relevant because digital transformation involves not only new tools but also redefinition of professional identity[7].

2.1.4 Activity Theory and Higher Education System View.

It further suggests that teaching is a system involving subjects, tools, rules, communities, and division of labor[8]. Digital technologies disturb this system and generate contradictions that cannot be resolved through individual effort alone.

2.2 Four Stages of Role Transformation

The model identifies four dynamic stages.

2.2.1 Stage 1: Contact and Exploration.

Teachers begin to use platforms or simulation tools because of policy requirements, peer influence, or institutional promotion. Technology use is shallow and fragmented, while traditional teaching remains dominant. The main barriers are start-up inertia and weak value recognition.

2.2.2 Stage 2: Conflict and Struggle.

As implementation deepens, teachers confront the gap between expectations and actual competence. They may fail to integrate data, organize project-based learning effectively, or connect digital and physical tasks. This stage is marked by frustration, efficacy loss, and role anxiety.

2.2.3 Stage 3: Adaptive Integration.

Some teachers gradually establish workable links between technology and disciplinary teaching. They begin to redesign parts of the learning process, use data to adjust instruction, and improve efficiency. However, this stage may also generate a new risk: stable routines can become fixed patterns, reducing motivation for further innovation.

2.2.4 Stage 4: Innovation Leadership.

A smaller group goes beyond effective use and starts creating new teaching models, digital projects, or institutional practices[9]. These teachers can influence peers and

shape reform culture, but they may also experience isolation if organizational support remains weak.

These stages are sequential in tendency but not mechanically linear. Teachers may pause, regress, or cycle between stages depending on experience, support, and institutional context.

2.3 Double Bridges as Dynamic Support Mechanisms

Stage progression is not automatic. The model therefore introduces two bridges that address the most critical discontinuities.

2.3.1 The Empowerment Support Bridge.

It helps teachers move from early exploration and conflict toward adaptive integration. Its core function is to reduce uncertainty, strengthen capability, and provide structured opportunities for guided practice. It addresses the twin barriers of "unwillingness to change" and "inability to change."

2.3.2 The Innovation Incentive Bridge.

It helps teachers move from adaptive integration to innovation leadership. Its core function is to connect individual experimentation with institutional recognition, collaboration, and long-term development opportunities, thereby shifting teachers from users of technology to creators and leaders of innovation.

Importantly, these two bridges are not a simple sequential replacement. The empowerment bridge should remain present in later stages as a background support system, while the innovation bridge should begin to operate before teachers fully reach the innovation stage. In other words, the two bridges are dynamically coordinated: early stages require stronger support and lighter incentives, whereas later stages require stronger incentives while retaining necessary support. This dynamic balance avoids two opposite risks-dependence created by excessive early-stage guidance and stagnation caused by insufficient later-stage recognition.

3 Stage-Specific Diagnosis of Transformation Dilemmas

To analyze how teachers experience these stages, the study combines questionnaires, semi-structured interviews, and classroom observation. The questionnaire identifies teachers' stage characteristics in role cognition, teaching design, technology integration, and support needs. Interviews capture concrete experiences of frustration, adaptation, and motivation. Classroom observation is used to verify whether self-reports are reflected in actual practice. The diagnosis shows clear stage-specific dilemmas.

3.1 In the Contact and Exploration Stage

Teachers use technology infrequently and mainly for surface-level functions. Digital tools are often treated as repositories or presentation devices rather than as catalysts of pedagogical change. The root problem is weak perceived value combined with comfort-zone inertia[10].

3.2 In the Conflict and Struggle Stage

Teachers attempt reform but lack stable competence in digital design, data interpretation, and classroom orchestration. Repeated technical or pedagogical failure can undermine confidence and intensify anxiety. The root cause is not merely lack of training, but the absence of sustained and practice-oriented support[11].

3.3 In the Adaptive Integration Stage

Teachers develop workable routines, yet these routines may become fixed and efficiency-oriented rather than innovation-oriented[12]. The major problem here is path dependence, reinforced by evaluation systems that reward stability more than experimentation.

3.4 In the Adaptive Integration Stage

Innovative teachers often struggle to diffuse their practices. Without organizational coordination, communities of practice, and meaningful recognition, innovation remains isolated and difficult to sustain.

Across all stages, the absence of the two bridges creates systemic risks. When the empowerment bridge is weak, teachers` curiosity often turns into frustration, leading to superficial use or withdrawal. When the innovation bridge is weak, institutions may achieve only limited integration rather than deep pedagogical transformation.

4 Strategy Design Through Co-Construction of the Double Bridges

Because the major dilemmas are structural rather than purely individual, strategy design should focus on building the two bridges across the whole transformation process.

4.1 Strengthening the Empowerment Support Bridge

The first task is value guidance. Universities should present digital transformation not as an additional burden but as a pathway to improving learning quality, disciplinary relevance, and talent cultivation. This requires strategic communication, visible

benchmark cases, and peer-led cultural influence so that teachers can see concrete educational value rather than abstract policy pressure.

The second task is capability scaffolding. Support should be differentiated by stage: introductory assistance for teachers in exploration, design-focused coaching for those in conflict, and embedded support for key teaching teams. Training should be modular, scenario-based, and closely tied to real teaching problems. Rapid-response technical and pedagogical support is essential, as are peer mentoring and communities for collaborative reflection.

4.2 Strengthening the Innovation Incentive Bridge

The innovation bridge requires both ecological cultivation and institutional reconstruction.

At the ecological level, universities should foster communities of innovation in which teachers jointly explore frontier teaching problems, conduct action research, and share reusable practices. Mechanisms for discovering, incubating, and diffusing successful innovations are necessary so that individual breakthroughs can become collective assets.

At the institutional level, evaluation and incentive systems must explicitly recognize digital teaching innovation. Promotion, workload calculation, and performance assessment should value curriculum redesign, digital resource development, data-informed teaching improvement, and representative teaching outputs. Dedicated reform funds, innovation awards, and leadership roles for teaching innovators can further sustain momentum.

Most importantly, bridge construction should avoid a rigid stage logic. Early-stage teachers also need motivating recognition, while advanced teachers still need professional support and collaborative infrastructure. Only when support and incentive are coordinated can universities prevent early withdrawal, mid-stage stagnation, and late-stage isolation.

5 Conclusion

This study proposes a Four-Stages Double-Bridges model to explain the digital role transformation of university teachers under the digital transformation of education. Compared with models that focus only on technology acceptance or general teacher growth, the proposed framework highlights three issues more explicitly: the staged nature of role reconstruction, the interaction between individual change and institutional conditions, and the need for two dynamically coordinated bridges—empowerment support and innovation incentives—to enable sustainable transformation.

The analysis shows that teachers' dilemmas differ by stage: hesitation in exploration, frustration in conflict, inertia in integration, and isolation in innovation leadership. These are not isolated individual problems but manifestations of structural gaps in support, evaluation, and organizational learning. Accordingly, universities should

move beyond one-off tool training and instead build a full-cycle mechanism that combines value guidance, differentiated capability support, innovation communities, and reformed incentives.

This study has limitations. The model still requires validation through larger samples, longitudinal tracking, and comparative analysis across institutions and disciplines. Future research should further test whether bridge interventions can improve stage transition, reduce burnout, and increase the diffusion of innovative teaching practices. Even so, the model offers a concise analytical framework and a practical basis for designing policies and institutional strategies for teacher transformation in the digital era.

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