

Digital Transformation Empowering Faculty Development via Virtual Teaching and Research Offices

Song Jiayin

Educational Administration
Universitas Pendidikan Indonesia
Bandung, Indonesia
jiayinsong619@gmail.com

Abstract

Under the strategic background of the comprehensive and in-depth digital transformation of higher education, virtual teaching and research offices, as a new type of teaching and academic community that breaks through the boundaries of time, space, and organization, have become a key innovative path for empowering the professional development of university faculty. This study focuses on two core dimensions of virtual teaching and research offices: their knowledge innovation mechanism and their actual operational efficiency for faculty development. Through a hybrid research method, it systematically explores how virtual teaching and research offices, through cross- institutional activities such as course co-construction, resource sharing, and collaborative research, construct a dynamic ecosystem for knowledge generation and transformation, thereby effectively improving faculty's digital literacy, teaching and research capabilities, and collaborative education effectiveness. The study aims to reveal the internal logic and key influencing factors of the successful operation of virtual teaching and research offices, providing a solid theoretical basis and operable practical guidelines for universities and education management departments to optimize digital faculty development models and build a sustainable new teaching and research ecosystem.

Keywords: Digital transformation; Teacher development; Virtual teaching and research room; Innovative mechanism; Operation efficiency

Introduction

Against the backdrop of a new round of technological revolution and industrial transformation, digital technologies such as artificial intelligence, big data, and cloud computing are profoundly reshaping the teaching models, organizational structures, and knowledge production mechanisms of higher education. International studies widely agree that digital transformation in higher education is not merely an upgrade of technological tools, but a systemic change involving educational governance, instructional collaboration, and faculty professional development models (Bond et al.,2020; UNESCO,2021). In this context, faculty development has been endowed with new connotations, with digital literacy, instructional innovation capacity, and cross-boundary collaborative competence increasingly recognized as core components of university teachers' professional competence (OECD, 2021).

In the Chinese context, educational digitalization has been elevated to a national strategy. The Ministry of Education has successively issued the Action Plan for Educational Digitalization and the Notice on Launching Pilot Programs for Virtual Teaching and Research Offices, explicitly calling for the reconstruction

of grassroots teaching organizations through digital technologies and the transformation of faculty development from fragmented and experience-based approaches toward collaborative and sustainable models (Ministry of Education, 2021; Ministry of Education, 2022). Driven by these policies, virtual teaching and research offices have emerged as a new form of teaching and academic organization that transcends temporal, spatial, and institutional boundaries, demonstrating positive effects in areas such as course co-construction, resource sharing, and collaborative teaching and research.

Despite the policy-driven proliferation of VTROs, existing studies have largely focused on descriptive accounts of practical experiences and case implementations. Systematic theoretical exploration and robust empirical evidence remain insufficient regarding the underlying mechanisms through which VTROs empower faculty development (Zhan et al., 2024; Zhang, 2023). Specifically, two critical gaps persist in the literature. First, while the potential for knowledge creation within communities of practice is acknowledged (Wenger-Trayner et al., 2022), the specific processes by which knowledge is generated, shared, and transformed within the digitally mediated environment of VTROs have not been adequately theorized or empirically investigated. Second, beyond anecdotal evidence, there is a lack of rigorous, large-scale quantitative assessment of VTROs' actual operational effectiveness in improving key faculty competencies, such as digital literacy and collaborative research skills. Therefore, it is necessary to conduct an indepth study that addresses these gaps by systematically examining the knowledge innovation mechanisms and operational effectiveness of VTROs from the perspective of digital transformation, in order to respond to the pressing need for the transformation of faculty development models in higher education.

To Systematically Reveal the Knowledge Innovation Mechanism of VTROs. The primary objective of this study is to examine how knowledge is generated, shared, transformed, and applied within VTROs. The research focuses on how individual teaching experiences are externalized, integrated, and reconstructed through collaborative activities such as course co-development, resource sharing, and joint research. Prior research suggests that while digital environments facilitate the externalization of tacit knowledge, effective knowledge innovation remains highly dependent on organizational design and interaction mechanisms (Nonaka & Takeuchi, 2021).

To Evaluate the Operational Effectiveness of VTROs in Faculty Development. Beyond mechanism analysis, this study aims to empirically assess the effectiveness of VTROs in promoting faculty professional development. Key outcome dimensions include digital literacy, instructional innovation capacity, and collaborative research competence. Although recent studies have demonstrated a positive relationship between participation in digital professional learning communities and instructional innovation (Koh & Kan, 2021), such relationships have not been sufficiently examined in the context of VTROs.

To Construct an Operable Model for Digital Faculty Development. Based on the combined analysis of mechanisms and outcomes, this study seeks to identify critical conditions for effective VTRO operation and to construct a replicable and scalable model of digital faculty development. The ultimate goal is to provide actionable recommendations for universities and policymakers.

Methodology

Literature Analysis and Theoretical Framework Construction

This study begins with a systematic review of literature published between 2020 and 2025, retrieved from Web of Science, Scopus, and CNKI databases, focusing on educational digital transformation, faculty development, virtual professional communities, and knowledge innovation (Bond et al., 2020; OECD, 2021).

Drawing upon communities of practice theory ([Wenger-Trayner et al., 2022](#)) and organizational knowledge creation theory, an integrated analytical framework is developed to guide the study.

Questionnaire Survey and Quantitative Analysis

A structured questionnaire is designed and administered to university faculty members participating in VTROs. The survey measures participation patterns, perceived changes in digital competence, instructional practices, and research collaboration. Reliability and validity tests, descriptive statistics, and multiple regression analyses are employed to examine relationships between VTRO participation and faculty development outcomes ([Hair et al., 2022](#)).

Interviews and Case Studies

To complement quantitative findings, in-depth interviews and case studies are conducted with selected representative VTROs. Interviewees include faculty participants, organizational coordinators, and technical support staff. Qualitative data are analyzed using coding and thematic analysis to uncover how organizational governance, technological infrastructure, and collaborative culture facilitate or constrain knowledge innovation ([Zhang, 2023](#)).

Results and Discussion

VTROs Promote Knowledge Innovation Through Structured Collaboration

The study is expected to find that VTROs function not merely as information-sharing platforms but as organizational communities that enable sustained knowledge innovation through structured collaboration. Within VTROs, individual teaching experiences and digital practices are continuously shared, debated, and reconstructed, resulting in collective professional knowledge ([Wenger-Trayner et al., 2022](#)).

This finding can be interpreted through the lens of [Nonaka and Takeuchi's \(2021\)](#) SECI model. The VTRO environment is expected to facilitate: (1) Socialization, by enabling faculty from different institutions to share tacit experiences through virtual observations and informal discussions; (2)

Externalization, through structured dialogues during course codevelopment, where tacit knowledge is articulated into explicit concepts like shared teaching plans and design principles; (3) Combination, by systematically integrating these diverse explicit knowledge fragments into more comprehensive teaching manuals or cross-institutional curricula; and (4) Internalization, as faculty members apply this newly combined knowledge to their own teaching contexts, thereby enriching their personal tacit knowledge base. The effectiveness of this cycle, however, is likely contingent on the quality of digital tools and the design of collaborative tasks. For instance, platforms lacking functionalities for synchronous co-editing or asynchronous threaded discussions may hinder the externalization and combination phases.

VTRO Participation Significantly Enhances Faculty Digital Competence

The findings are anticipated to show that sustained participation in VTROs leads to significant improvement in faculty digital literacy, instructional design capacity, and collaborative research skills. Such development is gradual and cumulative, distinguishing VTRO-based development from short-term training programs ([Koh & Kan, 2021](#)).

This expected outcome challenges the traditional, episodic model of faculty development, which often relies on one-off workshops. The ongoing, situated learning within a VTRO allows for the practical application and iterative refinement of new skills. For example, engaging in cross-institutional resource sharing exposes faculty to a wider array of digital tools and pedagogical strategies than they would encounter within their own institution. Collaborative lesson study activities within the VTRO provide a platform for receiving continuous peer feedback, thereby honing instructional design skills. The discussion will need to

delve into the nuances of this development: Are improvements uniform across all competency dimensions? Does the intensity and type of VTRO activity (e.g., research-focused vs. teaching-focused) moderate these outcomes? Preliminary analysis suggests that faculty heavily involved in joint research projects may show greater gains in collaborative research competence, while those focused on course co-construction may demonstrate more pronounced improvements in instructional design and digital literacy.

Operational Effectiveness Depends on Governance and Incentive Structures

The study further expects to demonstrate that VTRO effectiveness is strongly influenced by organizational governance, clear goal orientation, and incentive mechanisms. VTROs lacking institutional support and clear operational rules tend to exhibit weaker knowledge innovation and faculty development outcomes (OECD, 2021).

This finding underscores the socio-technical nature of VTROs. Their success is not solely a function of the technology platform but is deeply embedded in the organizational context. "Governance" here encompasses more than just rules; it includes leadership styles (e.g., distributed vs. top-down), decision-making processes, and conflict resolution mechanisms. "Incentive structures" are critical because faculty participation requires significant time and effort beyond their regular duties. Universities that formally recognize VTRO contributions in workload calculations, promotion criteria, and performance evaluations are likely to see higher levels of sustained engagement and, consequently, more positive outcomes. Conversely, VTROs that operate purely on a voluntary, goodwill basis risk participant burnout and gradual disintegration. The discussion will also consider the role of institutional support, such as providing dedicated technical support staff, offering training on virtual collaboration, and protecting faculty time for these activities. Without such systemic alignment, VTROs may remain peripheral innovations rather than becoming a mainstream model for faculty development.

Conclusion

This research proposal outlines a systematic investigation into the knowledge innovation mechanisms and operational effectiveness of VTROs in empowering university faculty development. The study is expected to yield three key findings: (1) VTROs act as structured collaborative platforms that facilitate a dynamic SECI knowledge creation process; (2) sustained participation in VTROs leads to significant and cumulative improvements in faculty's digital literacy, instructional innovation, and collaborative research capacities, distinguishing it from short-term training interventions; and (3) the operational effectiveness of VTROs is critically dependent on a supportive ecosystem encompassing clear governance structures, formal incentive mechanisms, and robust institutional support. These findings aim to provide a nuanced understanding of how digital transformation can fundamentally reshape faculty professional growth.

This study, while comprehensive in its mixed-methods approach, is not without limitations. First, the cross-sectional nature of the planned survey will capture data at a single point in time, which may not fully reflect the long-term, developmental trajectory of faculty within VTROs. A longitudinal study would be beneficial for future research to track changes over time. Second, the reliance on self-reported measures for competency development may introduce response bias. Future studies could complement this with more objective measures, such as analysis of teaching artifacts, peer evaluations, or student outcome data. Third, the case studies, while providing depth, may be context-specific, potentially limiting the generalizability of the findings to all types of VTROs across different disciplines or institutional types.

Based on the proposed study's scope and anticipated findings, several avenues for future research are recommended. First, longitudinal studies should be conducted to trace the long-term impact of VTRO

participation on faculty career trajectories and on tangible measures of student learning. Second, comparative studies across different countries and cultural contexts would be valuable to understand how varying educational policies and digital infrastructures influence VTRO models and outcomes. Third, future research could delve deeper into the "black box" of knowledge innovation by employing social network analysis to map the flow of information and expertise within VTROs, identifying key brokers and interaction patterns that optimize knowledge creation. Finally, intervention studies could be designed to test the efficacy of specific governance models or incentive structures, providing causal evidence for best practices in designing and sustaining effective VTROs.

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