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From Digital Resources to Digital Care: The IPE-BOPPPS Framework for Teacher Digital Competency in Vocational Education

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Abstract

Digital transformation has become a central force in China's educational modernization; however, the growing dependence on technology in vocational classrooms continues to expose a persistent gap between technological integration and actual learning outcomes. This study argues that teacher digital competency should extend beyond technical proficiency to include a capacity for digital care—the ability to use technology to foster equity, engagement, and emotional connection. Drawing on Noddings' ethics of care and Tang's framework of digital care within teacher digital competency, the study develops the IPE-BOPPPS Integrated Framework, which integrates the Intention–Practice–Effect (IPE) cycle of ethical teaching with the structured pedagogical design of the BOPPPS model. Through multiple-case analysis of vocational teaching practices, five recurring digital care action patterns are identified and synthesized into a Teacher Digital Care Competency Model. The findings suggest that the framework offers a meaningful lens for understanding teachers' digital competence, learner engagement, and reflective professional growth, contributing to a more human-centered approach to digitalized vocational education.

Keywords

Digital Care; Teacher Digital Competency; BOPPPS Model; IPE Framework; Vocational Education

1. Introduction

Since the Ministry of Education launched the National Education Digitalization Strategy Action in 2022, followed by the Industry Standard for Teachers' Digital Literacy (2023) and the Outline for Building an Education Power (2024-2035), digital transformation has emerged as a national priority in China's pursuit of educational modernization. Within this agenda, higher vocational education plays a vital role due to its strong connection with industrial transformation and digital development (Liu, Pan, & Huang, 2025).

Defined in the European Commission's DigCompEdu framework, teachers' digital competence is recognized as a key driver of educational quality and innovation (Redecker, 2017). Yet the promise of digital transformation remains only partially fulfilled. As Selwyn (2016) cautions, technology alone cannot ensure equity or meaningful participation, which highlights the need for pedagogical approaches that are attentive to the human and social dimensions of learning. Within this context, affective factors such as motivation, confidence, and emotional experience play a crucial role in shaping vocational students' learning outcomes. Liu (2025) further emphasizes that

effective teaching in vocational education should integrate both cognitive and emotional dimensions to promote holistic student development. Taken together, these insights raise a growing concern about whether the ongoing drive for digitalization has overshadowed the moral and affective aspects of teaching, particularly the ethic of care.

To address this concern, Tang (2023) identifies digital care and support as a key dimension of teachers' digital competency, emphasizing equitable access, respect for individual differences, active participation, and effective use. However, existing conceptual frameworks have not fully incorporated this human-centered perspective on digital competence. Frameworks such as TPACK (Mishra & Koehler, 2006) conceptualize effective digital teaching as the integration of technological, pedagogical, and content knowledge, paying limited attention to the affective or moral dimensions of teaching practice. As a learner-centered and structured micro-teaching design tool, the BOPPPS model offers a natural framework for systematically embedding digital care strategies (Liu et al., 2025). Building on this insight, the present study develops the IPE-BOPPPS Integrated Framework, which links the ethics of care with structured pedagogy. By analyzing front-line vocational teaching cases, it seeks to operationalize digital care and refine it into a practical teacher digital competency model for vocational education.

1.1 Research Purpose and Questions

The purpose of this study is to explore how teachers in higher vocational education enact digital care through pedagogical design and classroom practice. By integrating ethical and instructional perspectives, it proposes an IPE-BOPPPS Integrated Framework to conceptually link caring intentions with effective digital teaching actions. Specifically, this paper seeks to answer the following questions:

- How can the concept of digital care be translated into digital teaching practices?
- What mechanisms link teachers' caring intentions, classroom actions, and students' reciprocal responses?
- How can a structured teaching model support teachers in embedding digital care consistently and sustainably?

2. Theoretical model: The "IPE-BOPPPS" Integrated Framework

The framework consists of three interconnected components that move from ethical foundations to pedagogical implementation (Figure 1). The Guiding Ring establishes the moral compass, the IPE Loop integrates these ethical principles into teaching processes, and the Practice Path translates them into concrete classroom actions. Together, they illustrate how digital teaching can become a caring and humanizing practice.

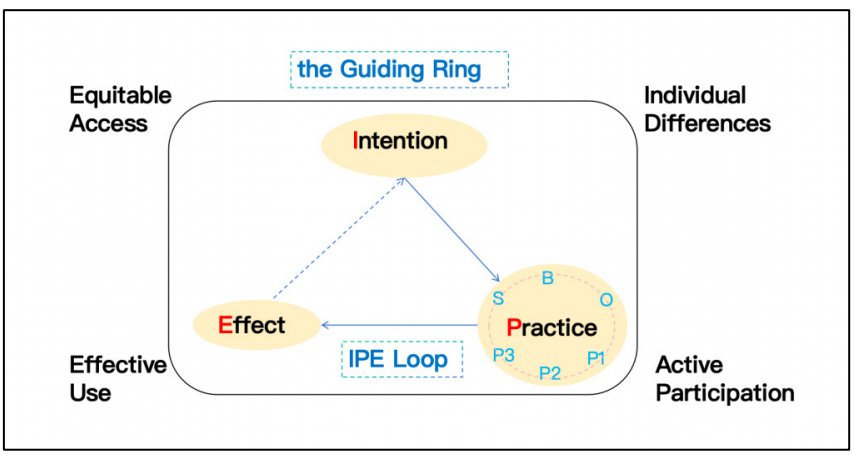

Figure 1. The "IPE Guiding Ring and BOPPPS Practice Path" Integrated Framework.

Surrounding the entire framework, the Guiding Ring provides the ethical foundation through four guiding principles—equitable access, individual differences, active participation, and effective use—originally articulated by Tang (2023). Viewed through the lens of Noddings' (2013) ethics of care, these principles are understood here as ethical conditions that nurture reciprocity and responsiveness in digital teaching. Individual Differences and Active Participation encourage teachers to engage deeply with learners, while Equitable Access and Effective Use establish the context in which reciprocity can flourish. Together, these principles form a pedagogical compass that orients

caring practices in digital environments and leads naturally to the next component, the IPE Loop.

At the center of the framework, the IPE Loop translates this ethical orientation into an interactive process from the teacher's perspective—the carer in Noddings' (2013) terms. Genuine care, according to Noddings, involves both the carer's attentive engagement and the cared-for's response. The IPE Loop captures this dynamic through three stages: Intention, Practice, and Effect. Intention refers to the teacher's effort to understand learners' needs and plan with empathy. Practice represents the observable actions that make this intention visible in classroom interactions. Effect reflects the reciprocity expressed by students—their engagement, emotions, and sense of belonging that indicate care has been received. Through reflection-in-action (Schön, 1983), teachers critically examine their ongoing practices, interpret the outcomes of their actions, and reconstruct their understanding to inform new intentions. In this way, the IPE Loop represents a continual process of inquiry and renewal—linking the ethical orientation of the Guiding Ring with its enactment in the Practice Path.

Finally, the Practice Path grounds this caring cycle in classroom practice. Using the six stages of the BOPPPS model—Bridge-in(B), Objectives(O), Pre-assessment(P1), Participatory Learning(P2), Post-assessment(P3), and Summary(S)—it offers a structured yet flexible approach to enacting digital care. Each stage represents a distinct caring act: Bridge-in builds emotional connection, while Participatory Learning enables reciprocity through collaboration. The Practice Path thus enacts the IPE Loop, turning caring intention into lived pedagogical action. It demonstrates how digital teaching can evolve from a technical process into a relational, human-centered practice.

3. Research Design

This study explores how teacher digital care is enacted in vocational classrooms through the lens of pedagogical discourse. A multiple-case qualitative design was employed, using textual analysis and coding of teaching materials to identify how caring intentions are expressed and realized in digital teaching practices. A total of 20 cases were selected from CNKI studies published between 2020 and 2025 that met the following criteria:

(1) They reported teaching practices in vocational or higher vocational education;

(2) They incorporated digital tools or AI-assisted instructional activities;

(3) They described teacher actions aligned with the stages of the BOPPPS model.

Cases covered fields like business, IT and Engineering. Each case was analyzed as an independent unit and later were coded in NVivo 15 using both deductive and inductive methods. Codes were based on the IPE model and BOPPPS stages, with new behaviors added during coding. This process revealed five recurring digital care action patterns, forming the basis of the Teacher Digital Care Competency Model. To ensure reliability, all cases were double-coded, and cross-case comparisons confirmed patterns across contexts. Coding decisions and examples were documented for transparency.

4. The Framework in Action: A Case-based Illustration

Analysis of the cases indicates that the IPE–BOPPPS framework provides a coherent and insightful explanation of the teacher digital care process.

4.1 Birth of Care: Expression of Teacher 'Intent'

The analysis shows that teachers' intention to implement digital care was a direct response to two key challenges in traditional teaching: "equity imbalance" and "insufficient efficacy." These intentions are deeply aligned with the principles embodied in the Guiding Ring, which guides the framework's approach to digital care.

4.1.1 Addressing Equity Imbalance: Towards Inclusive Educational Support

Teachers addressed equity imbalance in three aspects. First, unequal access to support: in traditional classrooms, instructors found it hard to give quick help in hands-on courses (Case 2). This often meant bolder students got more attention. Also, students with hearing or speaking difficulties faced communication problems, which caused their learning issues to build up (Case 14). Second, unequal participation opportunities: teachers often saw that even with interactive activities, a few excellent students dominated the sessions, a problem known as the "Matthew effect" (Case 18). This issue arose because there was limited "two-way communication" (Case 6) and not enough "interaction opportunities" (Case 14) in traditional classrooms. Third, unequal learning processes and resources: teachers identified problems that online learning often lacked proper supervision and feedback (Case 20), which put easily distracted students at a disadvantage (Case 2).

4.1.2 Optimizing Insufficient Efficacy: Towards Unified Knowledge and Action

Efficacy optimization focused on two issues. First, low participation efficacy: traditional teacher-centered models led to low student initiative. Methods were "monotonous, boring, with low participation" (Case 2) or "teacher-lecturing focused" (Case 6), causing waning interest (Case 20). Even interactive sessions remained superficial and procedural, with limited engagement in critical thinking (Case 18). Second, low practicality efficacy: especially in vocational settings, traditional teacher lecturing & textbook practice (Case 11) failed to meet skilled talent demands. Students preferred "actual operations" (Case 2), however, an overemphasis on abstract theoretical content, such as "tax law analysis" (Case 6) often intimidated them when it came to practical application. Critique of "results over process, knowledge over ability" evaluations (Case 3) revealed neglected student agency (Case 2).

4.2 The Enactment of Care: The BOPPPS Practice Path

The IPE-BOPPPS framework guided teachers in implementing their digital care intentions through a specific sequence of care-formatted BOPPPS.

4.2.1 Bridge-in & Objectives: Purpose Setting

The first core action pattern involves using digital tools to establish a lesson's purpose in ways that are authentic, immediate, and emotionally engaging. Teachers employed a range of strategies to achieve this. Some grounded learning in authentic professional contexts by sharing real-world materials, such as a teacher's payslip in a tax law course (Case 6) or a micro-video of a company's tax error to spark curiosity (Case 19). Others sought to foster affective and inspirational connections, using emotionally resonant media, for example, a short video of national surveyors summiting Mt. Everest in an engineering class (Case 16) or a clip from The Captain in a cabin crew training course (Case 13). At a more advanced level of digital integration, several teachers employed AI-powered digital humans to introduce complex project tasks, leveraging novelty and visual clarity to capture students' attention from the outset (Case 4).

Across these examples, digital tools served not only to attract attention but also to connect content with students' professional realities. Such designs exemplify the principle of Equitable Access, ensuring that all students—regardless of prior experience—begin the lesson with a shared and meaningful motivation to engage.

4.2.2 Pre-assessment: Data-informed Diagnostic Precision

During the early stages of BOPPPS, a common pattern for teachers is to adopt a diagnosis-intervention approach. They used tools like online quizzes and word clouds to quickly gather information about students' prior knowledge. The goal was to diagnose students' needs, not to judge them. This approach then allowed for accurate, evidence-based interventions.

For group-level intervention, teachers usually display the test data which helped educators understand common knowledge gaps across the class and therefore identify specific areas for focused teaching. The goal of this approach was to encourage meaningful discussion to find the best solutions for the whole group (Case 6), thereby promoting more equitable access to core knowledge.

For individualized intervention, many teachers used technology to tailor learning. This involved using a learning platform that provided personalized review materials for each student. These recommendations were based on predefined conditions set after diagnosing students' prior knowledge weaknesses (Case 1). Essentially, this strategy directly put into practice the principle of respecting individual differences.

4.2.3 Participatory Learning: Dual-field Construction for Deep Engagement

In this stage of BOPPPS, teachers strive to establish a "dual-field space" that brings together both "psychological safety" and "academic motivation." Together, these fields effectively address major barriers to engagement, such as students' fear of speaking out, often using an approach that seems contradictory.

(1) Building the Safety Field: Fostering Psychological Security

Teachers generally built the 'safety field' using anonymous features. Examples include temporary anonymous "bullet-screen" comments or non-attribution polling (Case 6, Case 20). Through these methods, students felt safer to make mistakes and contribute ideas without fear of judgment. This directly helps students meet their need for relatedness and autonomy, which are key aspects of Self-Determination Theory (Deci & Ryan, 2000). Ultimately, this promotes a more equitable and psychologically safe learning environment.

(2) Constructing the Incentive Field: Encouraging Student Motivation

The 'incentive field' was constructed using various motivational strategies. These included game-matches with team-based competition or utilizing random student selectors that offered points-rewards (Case 7). This approach directly helps students feel more competent, which is a key part of Self-Determination Theory (Deci & Ryan, 2000). As a result, students became more intrinsically motivated which encouraged them to share new ideas with peers and get involved actively.

4.2.4 Post-assessment: Evaluating Learning Through Authentic Outputs

In the final stage of the BOPPPS cycle, assessment shifted from testing rote memorization to evaluating students' ability to apply knowledge in authentic contexts. Teachers designed tasks that required students to produce real-world outputs—such as digital simulations, video presentations, or e-portfolios—using professional platforms. These authentic assessments not only demonstrated students' learning outcomes but also strengthened their professional competence and readiness for workplace challenges.

This authentic output took several forms:

(1) Work-based products aimed at consolidating capabilities. For example, live e-commerce students recorded 5-minute streaming videos and uploaded them to platforms (Case 2). Students in green manufacturing produced micro-videos to present research findings from diverse perspectives (government, enterprise, public) (Case 10).

(2) Report-based outputs focused on competency enhancement. Financial sharing students wrote expense reimbursement risk traceability reports after virtual operations (Case 11). Digital media students used AI tools (i.e., ChatGPT+Figma) to generate interface design references (Case 1).

The assessment emphasized value and growth rather than right-or-wrong judgments, embodying the principle of ensuring effective use. To enhance authenticity, teachers incorporated industry standards into the evaluation process; for example, enterprise mentors participated in scoring students' output reports during the post-assessment phase (Case 11).

4.2.5 Summary: Learning Showcase

In the final stage, this competency extends beyond content review to promote structured reflection on the learning process, enabling students to consolidate knowledge and acknowledge their own growth. In Case4 and Case16, teachers guided students to create digital mind maps or knowledge graphs to organize and present key ideas. On the institutional learning platform, some instructors showcased exemplary student summaries to encourage peer learning and provide diverse models of synthesis (Case 7).

At a more advanced level, teachers integrated AI tools to personalize reflection and feedback. For instance, AI assistants generated individual learning reports that visualized each student's learning path and offered targeted suggestions for improvement (Case 1). In other cases, ChatGPT functioned as a reflective partner, supporting students in articulating their thoughts for blog posts or e-portfolios (Case 8). Such digitally mediated reflection aligns with the principle of respecting individual differences, as it offers additional support to learners who may find reflective or metacognitive tasks more challenging.

4.3 The Appearance of Care: Varied Echoes of 'Effect'

Across cases, the Effect dimension captured diverse manifestations of student growth arising from care-oriented BOPPPS teaching. These effects extended beyond knowledge acquisition to include greater academic engagement, stronger confidence, improved collaboration, and enhanced digital literacy.

Academic engagement and performance improved across several courses. In live e-commerce teaching, 96.75% of students completed pre-study tasks, 86.36% joined pre-assessments, and over 80% participated in discussions (Case 2). Homework completion also rose markedly (Case 18), with students appreciating clear objectives and structured pre-study materials that supported self-regulated learning (Case 15). Confidence and collaboration likewise increased: engineering surveying students showed stronger enthusiasm and problem-solving ability (Case 16), while interactive learning boosted confidence in a Linux course (Case 17).

The Effect dimension also encompassed growth in digital literacy and critical engagement with technology. In a machine learning class, 90% of students reported that ChatGPT helped them overcome learning difficulties, especially in homework and discussions (Case 8). Yet only 60% expressed full trust in its responses, citing inaccuracies (70%) and limited reasoning depth (55%). These patterns suggest that care-oriented teaching can leverage AI tools while nurturing students' ability to critically evaluate technology.

4.4 The Movement Cycle of Care: From "Effect" To A New 'Intent'

Teachers continuously adjusted their intentions based on observed outcomes and student feedback, forming a clear feedback loop that reshaped their approach to digital care in line with the Guiding Ring's principles. For example, after using a machine learning model, one teacher noted students felt their innovative thinking had not improved much (average score for Q6 was only 3.8). This effect prompted a new intent to optimize teaching strategies for cultivating innovative abilities, aligning with the principle of active participation and ensuring the effective use of digital tools for deeper learning (Case 8). Similarly, when students pointed out ChatGPT's limitations, such as inaccuracy and lack of deep reasoning this crucial feedback directly guided the refinement of teaching methods and tool selection.

This reflected a renewed intent to foster effective use of digital resources by promoting critical evaluation and ensuring that all students, regardless of their starting point, could equitably access reliable and intellectually stimulating content (Case 8). These examples demonstrate how observed effects prompted teachers to modify their plans, continually reshaping their digital care practices to better embody the Guiding Ring's core principles.

5. Discussion: Developing a Teacher Digital Care Competence Model

Building on the preceding analysis, this study develops a practical model of teacher digital care competence for front-line educators (see Table 1). The model synthesizes insights from the case analyses and theoretical frameworks, identifying the core caring tasks and key action patterns teachers can enact at each stage of the BOPPPS model.

Table 1. The Teacher Digital Care Practice Model with BOPPPS

BOPPPS Stage	Core Care Tasks	Core Care Principles	Key Action Pattern/ Strategy	Typical Digital Tool Application
Bridge-in/ Objectives	Ignite Intrinsic Motivation & Establish Affective Connection	Equitable access	Purpose Setting	Industry trend videos; Mind mapping software
Pre-assessment	Diagnose Learning Gaps While Protecting Student Confidence	Individual differences	Data-Driven Precision Diagnosis	Anonymous online polls; Word clouds
Participatory Learning	Guarantee Expression Opportunities & Unlock Collaborative Potential	Equitable access, Active participation	"Dual-Field" Construction	Collaborative whiteboards; Breakout room tools; Gamification platforms
Post-assessment	Assess Authentic Competencies	Effective use	Evaluating Learning Through Authentic Outputs	Simulation software; Project management tools
Summary	Visualize Individual Growth	Individual Differences	Learning Showcase	E-portfolios; Blog/Vlog reflections

6. Conclusion and Implications

This study proposed and examined the IPE-BOPPPS framework, a practical model for understanding digital care in vocational education. The main contribution lies in the Teacher Digital Care Competency Model, which identifies core action patterns aligned with the stages of the BOPPPS model. It provides a clear and structured road-map for teachers and for the design of teacher training programs.

However, several limitations should be noted. First, this study is exploratory in nature, and the findings are based on a limited number of published cases rather than direct classroom observations. Second, as an exploratory and text-based analysis, this study did not directly measure the Effect of the proposed model, and the evidence reflects interpretations of existing cases rather than empirical validation. Third, the research drew on a modest dataset, which did not allow for comparative analysis across different types of institutions or teaching contexts. Finally, the action patterns identified in each BOPPPS stage may not be the only possible ones; further studies could reveal other meaningful variations.

In future work, more empirical studies in live classroom settings are needed to test and refine the framework, and to examine how well it applies across different educational levels and contexts. Moreover, while our model

highlights effective strategies, maintaining student engagement in digital learning environments over the long term remains an important challenge.

Despite these limitations, we believe that the IPE-BOPPPS framework represents an important step toward a more human-centered and effective approach to digital education. It provides both theoretical insight and practical guidance for promoting digital care in teaching and learning.

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