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Development and Validation of a Digital Competency Evaluation Model for Teachers in the Faculty of Education at Higher Education Institutions in Yunnan Province, China

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Abstract

This study focuses on Yunnan Province, China, aiming to construct and validate a scientific, systematic, contextualized model for assessing the digital competency of teachers in the Faculties of Education within universities. The study followed the logic of "theoretical construction - tool development - empirical verification". First, based on literature analysis, a theoretical model covering five dimensions digital awareness, digital skills, digital application, digital ethics and responsibility, and professional development - was proposed and localized in light of the multi-ethnic and multi-geomorphic regional characteristics of Yunnan Province. Finally, an evaluation model was established using the Delphi expert consultation method, which included five first-level indicators, eleven second-level indicators, and twenty-two third-level indicators (specific observation points). Based on this, the "digital competency Assessment Questionnaire for Teachers of the School of Education, Yunnan University" (51 items in total) was developed. Subsequently, the content validity was ensured through expert review (IOC value ≥0.8 for all items). The finalized scale was then administered to a sample of 302 teachers from Faculties of Education in Yunnan universities, selected through stratified cluster sampling, and the empirical data were analyzed to verify the psychometric properties of the model.

The research result was found that: 1) the psychometric properties of the developed assessment tool were excellent, exhibiting high content validity (all items IOC ≥ 0.8), good item differentiation ($p<0.001$ for all items) and a clear five-factor structure (cumulative variance explained 62.105%) that is fully aligned with the theoretical model; 2) the overall reliability of the scale was extremely high (Cronbach's $\alpha = 0.961$) with sub-dimension α coefficients ranging from 0.840 to 0.972, indicating excellent internal consistency; 3) consequently, this study successfully constructed and validated a reliable, valid, and contextually sensitive assessment model and tool, providing a robust 'measuring rod' for the precise diagnosis and targeted support of digital competency development among faculty in the Faculties of Education within universities in the Yunnan Province.

Keywords: Digital competency, Evaluation model, University of education, University teachers

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Introduction

Since the 21st century, digital technologies represented by artificial intelligence, big data and cloud computing have been penetrating all areas of the economy and society at an unprecedented speed and breadth, and the education system is at the core of this profound transformation (UNESCO, 2022). The importance of digital competency assessment for educators is increasingly recognized in the field of educational research (Rodriguez-Garcia et al., 2019). Several teacher digital competency frameworks have been introduced at the international, European and national levels (Munoz-Repiso et al., 2020), while organizations such as the OECD have emphasized the strategic height of digital transformation in education (OECD, 2022). China has explicitly implemented the Education Digitalization strategy action in policies such as the Education Informatization 2.0 Action Plan. In this context, the success or failure of the digital transformation of higher education, which is a high ground for cultivating innovative talents, largely depends on the transformation and improvement of the digital capabilities of the teaching staff (Basilotta-Gómez-Pablos et al., 2022). Teachers' digital capabilities are an important "catalyst" for the digital transformation of education (Caena & Redecker, 2019). Research shows that teachers with high levels of digital competency can help students learn more efficiently in a digital environment (Caena & Redecker, 2019). For higher education institutions, their teachers have a special mission to cultivate future basic education teachers. Their digital capabilities not only affect their own teaching and research capabilities, but also profoundly influence the digital literacy foundation of future teachers through the transmission mechanism of "teachers training teachers" (Basantes-Andrade et al., 2020).

However, existing research and practice have shown that the assessment of teachers' digital competency faces challenges. First, most digital competency frameworks were originally designed for the compulsory education stage (Falloon, 2020), paying insufficient attention to the complexity, academic nature of higher education teaching and the professional role of teachers as researchers (Zhao et al., 2021). Secondly, the assessment often focuses on universal skills and neglects the need for adaptation to specific contexts such as regional and cultural ones. For example, in a multi-ethnic and frontier region like Yunnan Province, the digital competency framework for teachers in the Faculties of Education within universities should take into account unique issues such as how to use digital technology to promote ethnic educational equity and protect and develop ethnic cultures. Furthermore, the pandemic has accelerated the profound transformation of technology application and digitalization in global higher education (Krishnamurthy, 2020), and teaching methods have rapidly shifted from offline to online (Mishra et al., 2020). This "great online transformation" (Scherer et al., 2021) has shifted most higher education to online and hybrid teaching models (Zarei & Mohammadi, 2022), highlighting the importance of teachers' ability to use digital tools (OECD, 2022), And it forces teachers to rethink their role in teaching in a digital environment. Research shows that there is diversity in the readiness of teachers from different countries around the world to apply teaching technology (Scherer et al., 2021), and teachers still face challenges when implementing information and communication technology (ICT) in practice and transitioning to digital distance learning (Pozas & Letzel, 2021).

Therefore, drawing on the established core dimensions of digital literacy (Ilomäki et al., 2016; Oberländer et al., 2020), it is of great theoretical value and practical urgency to develop a teacher digital competency assessment model that is deeply integrated with China's higher education policies and the regional characteristics of Yunnan Province, and to conduct rigorous psychometric tests on it. In sum, a clear research gap remains: no existing instrument simultaneously accounts for the academic and research roles of higher-education teachers, the multi-ethnic and border characteristics of a frontier region such as Yunnan, and China's

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national digital-literacy policy within a single empirically validated model. Addressing this gap is precisely what makes the present study necessary. This study aims to respond directly to this demand. Its core objective is not to simply transplant the existing framework, but to "tailor" a set of scientific, reliable and operable "competency scales" for the teacher group in Yunnan's Faculties of Education through systematic model construction, tool development and empirical verification.

Objectives

The core objective of this study is to construct and validate a digital competency assessment model applicable to teachers in the Faculties of Education of universities in Yunnan Province. The specific objectives are broken down as follows:

1. To construct a multi-dimensional, multi-level, and actionable theoretical model of teachers' digital competency for the Faculties of Education of Yunnan universities, by integrating the core elements of authoritative international frameworks (DigCompEdu and the ISTE standards) and China's "Teacher Digital Literacy" standard with the individual–environment interaction perspective of social learning theory, while accounting for the particularity of higher education and the multi-ethnic, border characteristics of Yunnan Province.

2. To develop the theoretical model into a practical measurement tool with high content validity the "Digital Competency Assessment Scale for Teachers in Faculties of Education" through rigorous Delphi expert consultation, with multiple rounds of optimization and content-validity verification of the model's dimensions, observation points, and items to ensure its scientific quality and relevance to the target population.

3. To validate the model by conducting a sample survey of teachers in the Faculties of Education of Yunnan universities and analyzing the resulting empirical data — using item analysis, reliability testing, and validity testing to verify the internal consistency, structural validity, and content validity of the questionnaire and to establish a digital competency assessment model supported by empirical evidence.

Methodology

The study adopted a quantitative design and was carried out in phases to ensure the systematicness and scientific nature of the research process.

The 1st Step: Theoretical origin and initial model construction

The core task of this stage is to lay the theoretical foundation and draft the model. The research team conducted a systematic review of relevant literature at home and abroad, with a focus on the following aspects: 1) International mainstream frameworks: such as the EU's DigCompEdu (emphasizing six areas including professional engagement of educators, teaching and learning, and student empowerment) and the US ISTE standards for educators (focusing on roles such as learners, leaders, and citizens). 2) Chinese national Standard: The industry standard "Teacher Digital Literacy" issued by the Ministry of Education of China in 2022 has significant local guiding value in its five-dimensional structure of digital awareness, knowledge and skills, digital application, social responsibility, and professional development. 3) Related theory: The social learning theory emphasizes the interaction among individual cognition, behavior and environment, which provides a theoretical perspective for understanding how teachers' digital capabilities develop under the influence of internal and external factors. Based on this, we have initially constructed a five-dimensional theoretical model: Digital awareness (value recognition, risk awareness, intrinsic motivation), digital technology (tool knowledge and operational skills), digital teaching application (technology integration in design, implementation, and evaluation), digital ethics and responsibility

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(security, privacy, rule of law, cultural sensitivity), professional development (using technology for self-directed learning, collaborative research and innovation). Based on this, a theoretical model covering five dimensions digital awareness, digital skills, digital application, digital ethics and responsibility, and professional development - was initially constructed.

The 2nd Step: Delphi Expert Consultation to refine the model

To ensure the scientific nature of the model and its suitability in the context of Yunnan Institute of Education, we formed a consultation group consisting of 20 experts. The composition of the expert group was diverse and authoritative, including: professors in the field of educational technology (6 people), deans or teaching directors of higher education institutions (4 people), experts in ethnic education research (3 people), provincial-level or above teaching masters or winners of information technology teaching competitions in Yunnan Province (5 front-line practice experts), and scholars in higher education policy research (2 people). Experts were selected according to the following inclusion criteria: (a) holding a senior professional title or an equivalent position of standing in their field; (b) at least ten years of experience in higher education, educational technology, ethnic education, or education policy; and (c) direct familiarity with the higher-education context of Yunnan Province. Two rounds of Delphi consultation were strictly implemented. In the first round, the experts were provided with a preliminary model and a detailed description, and were asked to rate, on a five-point scale, the importance, clarity, and relevance of each dimension and indicator, and to provide open-ended opinions on "how to reflect the characteristics of the role of teachers in the education institute of Yunnan's multi-ethnic and border areas". Based on the feedback from the first round, the model was revised, for example, by strengthening "ethical awareness of cross-cultural digital communication" in "Digital Ethics and Responsibility" and adding relevant expressions such as "teaching design ability using digital technology to display or incorporate local ethnic cultural elements" in "Digital teaching Applications". In the second round, the revised model and the statistical summary of the first round were fed back to the experts for re-evaluation. Consensus was operationally defined as the point at which an indicator obtained a high mean importance rating together with a low coefficient of variation across experts and attracted no further substantive revisions; indicators that did not meet these criteria were revised or removed. After two rounds, experts reached a high degree of consensus and finally determined the evaluation index system consisting of 5 first-level indicators, 11 second-level indicators, and 22 observation points.

The 3rd Step: Questionnaire development and structure design

Based on the final determined index system, specific Likert 5-point scoring items were written (1= completely inconsistent, 5= completely consistent). The initial scale consists of 51 items. To ensure the authenticity of the answers, the questionnaire instructions emphasize answering based on the "real situation", and the item descriptions strive to be specific and contextualized.

The 4th Step: Formal survey and data collection

The formal survey was conducted using stratified cluster sampling. First, stratify by type of institution (public/private). Then, within each layer, randomly cluster and select all full-time teachers from the Faculties of Education (or teacher-education colleges) of 1-2 universities as the subjects of the survey. The target population comprised full-time teachers in the Faculties of Education of universities in Yunnan Province. With respect to sample-size adequacy, the recommended minimum subject-to-item ratio for factor analysis is at least 5:1; for the 51-item scale this implies a minimum of about 255 respondents. The 302 valid questionnaires obtained therefore exceeded this requirement, and the high value of the sampling adequacy index (KMO = 0.960) confirmed that the sample size was sufficient for the planned analyses. The formal scale was distributed through a professional online questionnaire platform. Informed consent and screening questions are set at the front end of the questionnaire.

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The study was conducted in accordance with the principles of the Declaration of Helsinki and received approval from the research ethics committee of the host institution; all participants provided informed consent before participating, and their responses were collected and stored anonymously. The survey period was four weeks, during which the recovery rate was increased through reminders and other means, and 302 valid questionnaires were retrieved.

The 5th Step: Data Analysis and Model validation

Data analysis was conducted using statistical software. Item analysis: The critical ratio method was used to test the discrimination of each item. Content validity: Tested by the IOC values derived from expert review. Structural validity: Tested by KMO and Bartlett spherical tests, as well as exploratory factor analysis. Reliability analysis: Cronbach's alpha coefficients were calculated for the total scale and for each dimension.

Results

For the 1st objective "model construction" : A multi-dimensional, multi-level, and operational theoretical model of teachers' digital competency was successfully constructed and localized, which includes 5 first-level dimensions, 11 second-level indicators, and 22 observation points. The study successfully integrated the international framework (DigCompEdu, ISTE), the Chinese industry standard (Ministry of Education of the People's Republic of China, 2022), and the perspective of social learning theory, and through Delphi expert consultation, deeply integrated the characteristics of Yunnan Province's multi-ethnic and border areas and the professional mission of the Education Institute to "cultivate future teachers" into the model. The definitive model consists of five core dimensions: From intrinsic value-driven Digital Awareness, to fundamental Digital Skills, to comprehensive Digital Application, and regulated by Digital Ethics and Responsibility, ultimately pointing to the continuous growth and influence of Professional Development. This achieves a theoretical integration of global consensus, national standards and regional characteristics, forming a specific and actionable system of assessment indicators.

For the 2nd objective, "tool development" : successfully developed the "digital competency Assessment Questionnaire for Teachers of the School of Education, Yunnan University" with high content validity. Based on the above theoretical model, an initial scale consisting of 51 items was developed. The indicators and items were repeatedly optimized and validated through rigorous two rounds of Delphi expert consultations. The results of the expert content validity Index (IOC) test showed that the IOC value of all items was ≥0.8, indicating that the final evaluation questionnaire (51 questions in total) had excellent content validity. The development process of the tool ensured its scientific nature and was well adapted to the characteristics of the teaching staff at Yunnan Institute of Education.

For the 3rd objective, "model establishment" : a numerical assessment model with excellent psychometric attributes and supported by validity and reliability tests was successfully established through large sample empirical data verification. Systematic statistical tests of 302 retrieved valid questionnaires are as follows: Content validity and discrimination: The critical ratio (CR) analysis for all 51 items reached an extremely significant level ($p<0.001$), indicating good discrimination for the items and further supporting the content validity of the tool. Structural validity: Exploratory factor analysis (EFA) indicated that the data were well-suited for factor analysis (KMO=0.960, Bartlett's sphericity test $p<0.001$). The analysis extracted five common factors with eigenvalues greater than 1, and the cumulative variance interpretation rate was 62.105%. The component matrix after the pivot clearly shows that all items belong to five factors respectively and correspond exactly to the five dimensions of the theoretical presupposition, digital application, digital awareness, professional development, digital ethics and responsibility, and digital skills, strongly confirming that the

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model has good construct validity. Reliability analysis: The Cronbach α coefficient of the total scale is 0.961. The alpha coefficients for each dimension were: digital awareness 0.930, digital skills 0.840, digital application 0.972, digital ethics and responsibility 0.857, Professional development 0.909. All the reliability coefficients indicated that the scale had extremely high internal consistency and stability. The sampling-adequacy and factor-analysis indices are summarized in Table 2, and the reliability coefficients for the total scale and each dimension are presented in Table 3. In the rotated component matrix, every item loaded most strongly on its theoretically intended factor, confirming the five-dimensional structure. In conclusion, the empirical data fully support the reliability and validity of the theoretical model, marking the formal establishment of the assessment model.

Table 1 Digital Competency Assessment Model

Primary Indicator	Secondary Indicator	Tertiary Indicator
Digital Awareness	Digital Cognition and Understanding	Digital-Related Concepts
		Digital Norms and Policies
	Digital Emotions and Attitudes	Digital Ethical Sentiments
		Digital Critical Thinking
		Confidence in Digital Technology Application
Digital Skills	Digital Technology Knowledge and Skills	Mastery and Application of Digital Tools
Digital Application	Digital Teaching	Digital Instructional Design
		Implementation of Digital Teaching
	Digital Resources	Selection and Use of Digital Resources
		Creation of Digital Resources
	Digital Collaboration and Communication	Digital Communication and Collaboration
		Construction of Learning Communities
		Academic Exchange and Dissemination
	Digital Education Exploration and Innovation	Data-Driven Teaching and Decision-Making
		Digital Teaching Research and Innovation
Digital Ethics and Responsibility	Digital Security and Privacy Protection	Maintenance of Digital Security
	Digital Ethics and Norms	Ethical Application of Technology
		Digital Citizenship Literacy
Professional Development	Empowering Students	Digital Learning Ability
		Cultivation of Students' Digital Competency
	Teacher Professional Growth	Digital Learning and Professional Development
		Digital Leadership

Table 2 Sampling Adequacy and Exploratory Factor Analysis Results

Index	Value
Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy	0.960
Bartlett's test of sphericity	$p < 0.001$
Number of factors extracted (eigenvalue > 1)	5
Cumulative variance explained	62.105%

Table 3 Reliability Coefficients (Cronbach's α) by Dimension

Dimension	Cronbach's α
Digital awareness	0.930
Digital skills	0.840
Digital application	0.972
Digital ethics and responsibility	0.857
Professional development	0.909
Total scale	**0.961**

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Discussions

This study, through theoretical construction and empirical testing, systematically responded to the pre-set research objectives and successfully developed and validated an assessment model that was both scientific and contextually appropriate.

For the 1st "model construction objective", this study did not simply transplant the international framework DigCompEdu or the Chinese standard (Ministry of Education of the People's Republic of China, 2022), but achieved a localized innovation with a theoretical foundation. Guided by the perspective of the "individual - behavior - environment" interaction in social learning theory, through Delphi expert consultation, we deeply integrated key contextual elements such as the higher education ecosystem in Yunnan Province's multi-ethnic and border areas and the professional mission of the Institute of Education to "cultivate future teachers" into the model metrics. This is in line with the idea advocated by Caena & Redecker (2019) of aligning the teacher competency framework with specific challenges. The final established five-dimensional structure of "digital awareness - digital skills - digital application - digital ethics and responsibility - professional development" also corroborates the concept proposed by Ilomaki et al. (2016) that digital competency is the boundary of integrating knowledge, skills and attitudes, providing a new theoretical lens for understanding the digital competency of teachers in specific regional Universitiesand universities.

For the 2nd "tool development objective", this study followed a strict scale development paradigm. The initial items based on the theoretical model were optimized and verified for content validity through multiple rounds of Delphi expert consultation (IOC≥0.8) to ensure the scientific nature and suitability for the target group of the items in the "digital competency Assessment Questionnaire for Teachers of the School of Education, Yunnan University". This process fills the gap pointed out by Zhao et al. (2021) that existing assessment tools are insufficiently adapted in the context of higher education.

For the 3rd "model establishment objective", this study validated the reliability of the model using empirical data from 302 teachers through systematic psychometric analysis. The excellent reliability coefficient (total scale α=0.961) and the clear five-factor structure (cumulative interpretation variance 62.105%) suggest that the model is an internally consistent and structurally stable measurement tool. The results of the exploratory factor analysis strongly supported the theoretical conception, transforming the model from a theoretical hypothesis to an actionable framework supported by empirical data. This rigorous validation process responds to Lin & Johnson (2021) 's call for direct research applicable to specific situations and provides a methodological reference for regional teacher competence assessment.

In a practical sense, this model and its scales can be directly applied to multiple aspects of teacher professional development: as a self-assessment tool to facilitate teacher reflection; As an institutional diagnostic tool to identify the shortcomings of group capabilities; It can also provide a data base for regional policy-making. Subsequent studies could use this model to conduct status quo analysis, which may reveal characteristics such as "strong technology, weak application, and need to enhance ethical awareness", will help to shift teacher training from mere skill practice to the cultivation of higher-order abilities that are deeply integrated with ethical practice.

Beyond confirming prior frameworks, the present model is theoretically distinct from both DigCompEdu and the Ministry of Education of China's "Teacher Digital Literacy" (2022) standard in three respects. First, whereas DigCompEdu was developed primarily for the European general-education context and the national standard is pitched at all Chinese teachers, the present model is explicitly tailored to the dual role of higher-education teacher educators—who are simultaneously researchers and trainers of future teachers. Second, unlike either

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reference framework, it embeds the multi-ethnic and border characteristics of Yunnan Province directly into its indicators (for example, cross-cultural digital communication ethics and the use of digital tools to present local ethnic cultural elements). Third, it is not only a conceptual framework but an empirically validated measurement instrument. These distinctions extend, rather than replicate, the work of Caena & Redecker (2019) and Zhao et al. (2021), and they explain why a context-specific model was required rather than a direct adoption of an existing one.

The model also carries specific implications for educational equity in multi-ethnic and border communities. Because indicators relating to cross-cultural communication and the digital presentation of ethnic cultural content are built into the instrument, the tool can help institutions identify whether teachers are equipped to use digital technology in ways that widen, rather than narrow, access for students from ethnic-minority backgrounds. In practical terms, diagnosing weaknesses on these indicators can guide targeted professional development that supports inclusive teaching, the preservation and digital dissemination of local ethnic cultures, and more equitable educational outcomes across Yunnan's diverse student population.

Conclusion and suggestions

Limitations of the Study

Several limitations should be acknowledged. First, the structural validity of the model was established through exploratory factor analysis (EFA) only; confirmatory factor analysis (CFA) on an independent sample was not conducted, so the factor structure should be cross-validated in future work before strong claims of measurement invariance are made. Second, the sample (n = 302) was drawn from a limited number of institutions within a single province, which constrains the generalizability of the findings to other regions and educational systems. Third, the data were based on teacher self-report, which may be subject to social-desirability and common-method bias. Finally, the study is cross-sectional and therefore cannot capture how teachers' digital competency develops over time. These limitations point directly to the future-research directions outlined below.

Conclusion

To sum up, this study systematically completed the development of the digital competency assessment model for teachers in education Universitiesof Yunnan universities. By integrating international perspectives, national norms and local context, the study constructed a theoretical model with five dimensions and multi-level indicators, and based on this, developed an assessment questionnaire with good content validity. Through empirical analysis of 302 valid samples, the study confirmed that the model had excellent discrimination, structural validity and internal consistency reliability, marking the successful establishment of the model.

The core contribution of this study lies in providing a scientific, reliable and contextualized digital competency "yardstick" for the group of teachers in higher education Universitiesin Yunnan Province, a specific multi-ethnic border area. The model not only enriches the theory of teacher competency evaluation in the context of the digital transformation of higher education, but also lays a solid tool foundation for the subsequent precise diagnosis of teacher competency status, assessment of development needs, and formulation of effective intervention strategies.

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Suggestions

1. Recommendations for policy and practice

1.1 Policy recommendations. Based on the research result of the 1st objective: The model constructed in this study successfully integrates the international framework, national standards and the local context of Yunnan, providing a systematic analytical tool for evaluating the digital competency of teachers in local Universitiesand universities. Therefore, it is recommended that educational administrative departments and university administrators in Yunnan Province adopt or refer to this model as the theoretical framework for formulating university-level standards for the development of digital literacy of teachers. The flexible approach of "core standards + professional modules" can be adopted, with the five first-level dimensions of this model, digital awareness, digital skills, digital application, digital ethics and responsibility, and professional development as the core, and local adjustments can be made in combination with the educational levels and disciplinary and professional characteristics of different institutions to form standardized school-level standards to promote the "standardized" development of teachers' digital literacy.

1.2 Practice recommendations. Based on the 2nd tool development and the 3rd model objective: The "digital competency Assessment Questionnaire for Teachers of Yunnan University School of Education" developed by this research institute has been proven to have good reliability and validity. It is recommended to use it as a core diagnostic tool and embed it into the teacher professional development support system. Specifically, a closed-loop improvement path of "diagnosis - planning - intervention - internalization" can be implemented. First, use the questionnaire to conduct a baseline diagnosis of teachers' digital abilities, generate personal ability profiles, and precisely identify their strengths and weaknesses in each dimension. Secondly, based on the diagnosis results, personalized "learning, application, research, creation" training programs are developed for teachers at different stages of development and with different competency profiles. For example, for teachers who are weak in the "digital application" dimension, the focus should be on organizing practical workshops on topics such as blended curriculum design and data-driven teaching, rather than repetitive basic skills training.

2. Recommendations for future research

The focus of this study is on the development and validation of the model, laying the groundwork for more in-depth and extensive research in the future. In light of the current research trends and limitations in the field, we propose the following future research directions:

2.1 It is recommended to conduct dynamic tracking and stage model research. Future research should conduct longitudinal tracking to explore the dynamic development trajectory and key transition nodes of teachers' digital competency from "technological adaptation" to "teaching innovation" and even "ethical leadership".

2.2 It is suggested that the evaluation results of this model be correlated with classroom teaching behavior data, online teaching platform interaction data, student academic growth data, etc., to shift the evaluation from summative to developmental and truly empower teachers' professional growth.

2.3 It can be applied to the group of university teachers in other multi-ethnic regions in China or along the Belt and Road Initiative to conduct cross-regional and cross-cultural comparative studies.

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New knowledge and the effects on society and communities

This study contributes new knowledge in two main ways. Theoretically, it produces the first empirically validated digital-competency model that integrates international frameworks (DigCompEdu, ISTE), China's national "Teacher Digital Literacy" standard, and social learning theory while embedding the multi-ethnic, border characteristics of Yunnan Province. It thereby reframes teacher digital competency as a context-dependent construct rather than a universal checklist, adding a regionally grounded perspective to the literature on teacher educators in higher education.

For society and local communities, the validated instrument offers a practical "measuring rod" with direct benefits. At the institutional level it enables evidence-based diagnosis of teachers' strengths and weaknesses and the design of targeted professional development. At the regional level it gives education authorities in Yunnan a common reference for policy-making and for monitoring the digital transformation of higher education. Most importantly, because the model explicitly values cross-cultural and ethnic-cultural dimensions, its adoption can help protect and digitally disseminate local ethnic cultures and promote more equitable, inclusive education for students in multi-ethnic and frontier communities effects that extend beyond the university to the wider society it serves.

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