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Digital Competence Among English Teachers in Economically Underdeveloped Regions: Evidence from Guizhou, China

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Abstract. Guided by the European framework for the Digital Competence of Educators (DigCompEdu), this study examined the digital competence of 115 English teachers in Guizhou, an economically underdeveloped province in Southwest China. Descriptive statistics revealed a moderate level of digital competence among participants. Independent samples *t*-tests and the one-way ANOVA were conducted to examine differences across demographic and contextual variables. The results indicated that gender was the only significant differentiating factor, with male teachers reporting higher digital competence than female teachers. In contrast, educational background, teaching experience, and access to facilities and resources were not significantly associated with digital competence. These findings suggest that commonly identified predictors of teachers' digital competence may operate differently in economically disadvantaged contexts. The study contributes to digital competence literature by providing empirical evidence from an underexplored and underdeveloped region and highlights the importance of context-sensitive professional development strategies beyond demographic characteristics and infrastructure investment alone.

Keywords: digital competence; English teachers; DigCompEdu; educational digitalization; teacher professional development; underdeveloped regions

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1. Introduction

In the digital era, the integration of technology into education has become a global imperative. The Chinese government has taken active steps to promote educational digitalization. For instance, the Ministry of Education of the People's Republic of China (2021) proposed to implement the digital strategy for basic education and enrich high-quality digital teaching and learning resources. Within this context, English as a foreign language (EFL) teaching is particularly poised to

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benefit from digital technologies, given the subject's inherent need for authentic materials, interactive practice, and access to global resources (Lo, 2025; Mitrulescu & Negoescu, 2024). Digital technologies can provide a channel for addressing these needs.

Teachers' digital competence refers to the knowledge, skills, and attitudes required to integrate technology into teaching practices effectively (Redecker & Punie, 2017), which is widely recognized as a prerequisite for successful technology integration. A growing body of research has examined the factors influencing teachers' digital competence, including demographic characteristics such as gender, educational background, and teaching experience, and contextual factors such as access to facilities and resources (Moreira-Choez et al., 2024; Suzer & Koc, 2024; Tan et al., 2025). However, the vast majority of this research has been conducted in economically developed regions of China (Gao, 2022), and little is known about the state of English teachers' digital competence in underdeveloped regions where educational resources are often scarce, infrastructure may be inadequate, and teachers face unique challenges in adopting digital technologies.

Guizhou province, located in Southwest China, exemplifies an economically underdeveloped educational context. Despite being one of China's least developed provinces economically, Guizhou has been positioned as a national pilot zone for big data (National Development and Reform Commission et al., 2016), creating both opportunities and challenges for educational digitalization. Moreover, the province plans to establish a provincial-level shared computing platform for AI in education by 2027 (Department of Education of Guizhou Province, 2026). Meanwhile, Guizhou province has undergone significant educational restructuring in recent years with the consolidation of rural schools, leading to a reconfigured landscape of secondary education (Department of Education of Guizhou Province et al., 2024).

In the Chinese context, rural schools refer to schools located in remote villages and townships, whereas urban and suburban schools are situated in county seats and city areas where educational resources are generally more concentrated. As a result of school consolidation policies, many students who would previously have attended small rural schools are now enrolled in larger urban and suburban schools. This has increased student diversity in terms of academic achievement, socioeconomic background, and prior learning experiences, placing new demands on teachers to address heterogeneous learning needs and provide more differentiated instruction.

English teachers in Guizhou are increasingly expected to integrate digital technologies into their teaching practices. However, existing research on teachers' digital competence has primarily been conducted in economically developed regions and urban educational settings (Gao, 2022) where digital infrastructure, professional development opportunities, and institutional support are relatively accessible. Consequently, it remains unclear whether the determinants of teachers' digital competence identified in developed contexts operate similarly in disadvantaged educational settings. Moreover, although previous studies have

identified factors such as gender, educational background, teaching experience, and access to resources as potential determinants of teachers' digital competence, their findings remain inconsistent. Some studies have reported significant differences across these variables (Lucas et al., 2021; Schmölz et al., 2023; Suzer & Koc, 2024), whereas others have found weak or non-significant relationships (Cabero-Almenara et al., 2021; Gökbulut, 2021; Guillén-Gámez et al., 2022). These inconsistencies suggest that the factors influencing teachers' digital competence may be context dependent rather than universally applicable. These limitations restrict the generalizability of current knowledge and highlight the need for context-sensitive investigations.

Guided by the European framework for the Digital Competence of Educators (DigCompEdu) (Redecker & Punie, 2017), the present study examined the digital competence of English teachers in Guizhou and investigated whether gender, educational background, teaching experience, and access to facilities and resources differentiate teachers' competence levels. This study contributes to digital competence literature by providing empirical evidence from an economically underdeveloped context and by examining whether commonly identified predictors of digital competence remain relevant in resource-constrained educational environments.

Hence, the study addresses the following research questions:
RQ1: What is the level of digital competence among English teachers in an economically underdeveloped region?
RQ2: Are there significant differences in teachers' digital competence based on gender, educational background, teaching experience, and access to facilities and resources?

2. Literature Review

To provide a foundation for the present study, this literature review first examines the conceptualization of teachers' digital competence. Thereafter, it reviews the factors that may influence teachers' digital competence and finally, it discusses the characteristics of underdeveloped regions that form the context of this study.

2.1 Defining the Framework of Teachers' Digital Competence

The concept and structure of teachers' digital competence have evolved considerably over the past decade. First, teachers' digital competence is defined as the teacher's ability to use Information and Communication Technology (ICT) in pedagogy to influence students' learning strategies (Krumsvik, 2008). Other scholars have argued that teachers' digital competence requires teachers to possess the ability to search for, collect, and process information, and it should not be limited to the teacher level but should extend to the school's organizational and leadership structures (From, 2017; Tsankov & Damyanov, 2017). This is because effective technology integration depends not only on individual teachers' competencies but also on institutional support, strategic leadership, and school culture that promotes digital innovation.

Second, the European Union published the Digital Competence Framework for Citizens (DigComp), which provides a common framework for understanding and developing digital competence among citizens (Ferrari & Punie, 2013). Building upon this framework, DigCompEdu was later developed specifically for educators. While DigComp focuses on the digital competence of citizens in general, DigCompEdu extends the framework to the educational context by emphasizing teachers' professional and pedagogical use of digital technologies (Redecker & Punie, 2017). The framework, DigCompEdu, identifies six competence areas: professional engagement, digital resources, teaching and learning, assessment, empowering learners, and facilitating learners' digital competence (Redecker & Punie, 2017).

Specifically, the professional engagement dimension refers to teachers' use of digital technologies for communication, collaboration, and professional development. The dimension regarding digital resources concerns the selection, creation, and sharing of digital materials. The teaching and learning dimension focuses on the integration of technology into instructional practices. The assessment dimension involves the use of digital tools to monitor and evaluate student learning. The dimension of empowering learners emphasizes the use of technology to support inclusion, personalization, and active participation, and the dimension of facilitating learners' digital competence refers to helping students develop their own digital skills. Together, these dimensions reflect the knowledge, skills, and pedagogical practices required for the effective integration of digital technologies into teaching and learning.

This framework has been widely adopted and validated across educational contexts, including online higher education in Portugal (Santos & Pedro, 2024), teacher education in Hungary (Horváth et al., 2025), and higher education in China (Li et al., 2026). Previous studies have demonstrated its reliability and applicability in assessing educators' digital competence across diverse educational settings. Its widespread adoption can be attributed to its comprehensive coverage of both technical and pedagogical aspects of digital competence and its clear competence structure that supports teacher professional development and educational digitalization initiatives.

Beyond serving as an assessment framework, DigCompEdu provides a conceptual lens for understanding how teachers develop and apply digital competence in educational practice. The framework emphasizes that digital competence extends beyond technical skills and encompasses pedagogical integration, assessment, learner empowerment, and the development of students' own digital competence. Consequently, it provides an appropriate theoretical foundation for examining whether individual and contextual factors are associated with teachers' digital competence in underdeveloped educational environments.

2.2 Factors Influencing Teachers' Digital Competence

Research has examined several factors that may shape teachers' digital competence, but findings remain inconsistent across different contexts.

2.2.1 Gender

Studies on gender differences in digital competence have produced mixed results. Some research has indicated that male teachers tend to score higher in digital teaching competence (Aslan, 2021; Lucas et al., 2021; Suzer & Koc, 2024). One possible explanation is that males are often reported to have greater confidence in using digital technologies and are more likely to engage with technology-related activities, and this may contribute to higher self-reported levels of digital competence (Hargittai & Shafer, 2006).

However, other studies found no significant gender differences, with a narrow gender gap in digital skills (Cabero-Almenara et al., 2021; Diz-Otero et al., 2023; Zakharov et al., 2021). This narrow gap may reflect the increasing accessibility of digital technologies and professional development opportunities that have enabled both male and female teachers to develop similar levels of digital competence. It may also indicate that institutional support and training play a more important role than gender in shaping teachers' digital competence in certain educational contexts. These inconsistent findings suggest that gender effects may be context dependent and influenced by other variables such as cultural norms or professional experiences.

Taken together, previous findings regarding gender differences in teachers' digital competence remain inconclusive. While some studies suggest a male advantage, others report minimal or no gender differences. These inconsistencies indicate that the influence of gender may vary across educational and cultural contexts. Therefore, further investigation is needed in economically underdeveloped regions where contextual conditions differ substantially from those of developed settings.

2.2.2 Educational Background

The role of formal education in shaping digital competence is also debated. Teachers with higher education levels are more competent in digital technology use (Schmölz et al., 2023; Suzer & Koc, 2024). However, research has indicated that advanced degrees do not automatically guarantee stronger digital competence (Gökbulut, 2021). The quality and content of ongoing technology training within education programs may matter more than the degree level itself (Tondeur et al., 2016). Overall, existing evidence suggests that educational background alone may not guarantee higher levels of digital competence. The inconsistent findings imply that the quality and relevance of technology-related training may be more important than the academic qualifications themselves.

2.2.3 Teaching Experience

It is often assumed that younger teachers, sometimes called 'digital natives', possess higher digital competence due to growing up with technology and having greater exposure to digital devices from an early age (Cattaneo et al., 2022; Erol & Aydın, 2021). This assumption suggests that familiarity with technology naturally translates into stronger digital skills. However, evidence for this assumption is not conclusive. Some studies have found that experienced teachers perform equally well or even better in certain pedagogical applications of technology (Guillén-Gámez et al., 2022). One possible explanation is that while younger teachers may

be more familiar with digital tools, experienced teachers often possess stronger pedagogical knowledge and classroom management skills, enabling them to integrate technology more effectively into teaching. Therefore, the relationship between teaching experience and digital competence appears more complex than simple generational explanations suggest. Collectively, these findings challenge the assumption that younger teachers are inherently more digitally competent. The relationship between teaching experience and digital competence appears to be complex and context dependent.

2.2.4 Access to Facilities and Resources

Having adequate digital infrastructure and resources is widely considered necessary for developing digital competence (Cattaneo et al., 2022; Lucas et al., 2021). However, research suggests that resource provision alone is insufficient. In most countries, teachers use digital technology only for basic instructional activities, and they lack the skills to integrate digital devices. Effective digital education requires a careful adaptation of teaching methods rather than simply replicating traditional teaching practices on digital platforms (Organisation for Economic Co-operation and Development [OECD], 2025).

While access to devices and the internet is important, the selection of teaching resources and platforms together with the provision of pedagogical support and training is equally critical (Guillén-Gámez et al., 2022; OECD, 2025). Therefore, access to facilities and resources should be viewed as a necessary but insufficient condition for the development of digital competence. Pedagogical support and professional learning opportunities may play equally important roles.

2.3 The Context of Underdeveloped Regions

Most existing research on teachers' digital competence has been conducted in developed countries or well-resourced urban areas (Gao, 2022). Far less attention has been paid to underdeveloped regions where contextual conditions differ significantly (Guangzhou Municipal Education Bureau et al., 2025; Xiong et al., 2025). In economically disadvantaged areas, schools face unique challenges. Digital infrastructure may be unreliable, with limited internet connectivity and outdated equipment (Wickramathunga et al., 2024). Moreover, the ineffective implementation of national policies and the lack of vitality in school reform are important factors contributing to the insufficient development of teachers' digital literacy in economically underdeveloped regions (Huang & Zhang, 2024).

Findings from developed regions may not transfer directly, as the factors shaping digital competence operate differently in resource-constrained contexts. For example, teachers in developed regions may indeed benefit from lifelong technology exposure, but teachers in underdeveloped regions may have had limited access to technology (Suzer & Koc, 2024). Similarly, while resource availability strongly predicts competence in well-funded schools, simply providing devices may not improve teacher skills without accompanying training and support systems (OECD, 2025). Therefore, findings from mainstream research cannot be simply assumed to apply in underdeveloped regions. Context-specific investigations are needed to understand teachers' digital competence in these settings.

Drawing on the DigCompEdu framework, teachers' digital competence is conceptualized as a multidimensional construct influenced by both individual and contextual factors. Previous research has suggested that demographic characteristics, including gender, educational background, and teaching experience, may shape teachers' opportunities to acquire and apply digital competence. At the same time, contextual conditions such as access to facilities and resources may facilitate or constrain technology integration. However, findings across studies remain inconsistent, particularly across different educational and socioeconomic contexts. Therefore, examining these factors in an economically underdeveloped region may contribute to a greater understanding of the development of teachers' digital competence.

Based on the literature that was reviewed, this study proposed the following hypotheses:
H1: Gender significantly influences teachers' digital competence.
H2: Educational background significantly differentiates teachers' digital competence.
H3: Teaching experience is associated with differences in teachers' digital competence.
H4: Access to facilities and resources significantly differentiates teachers' digital competence.

3. Methodology

This section describes the methodology that was employed in the study. It presents the research context and the participants, the instrument used for data collection, and the procedures for data collection and data analysis.

3.1 Research Context and Participants

The study used a quantitative cross-sectional survey design to examine the digital competence of English teachers in an economically underdeveloped region and to compare competence levels across demographic and contextual groups. Specifically, the research was conducted in Guizhou, an economically underdeveloped province in Southwest China. In recent years, Guizhou has made substantial investments in educational digitalization while undergoing significant school consolidation, with many rural schools merging into urban and suburban schools (Department of Education of Guizhou Province et al., 2024).

A total of 115 Grade 11 English teachers were selected using a multi-stage sampling approach. In the first stage, purposive sampling was employed to select 16 public high schools from 6 cities in Guizhou province to ensure variation in geographical location and educational context. In the second stage, convenience and snowball sampling were used to recruit English teachers within the selected schools. Convenience sampling was adopted because participation depended on teachers' availability and willingness to participate, while snowball sampling enabled participating teachers to recommend other eligible English teachers. These procedures facilitated access to participants across multiple schools and provided a diverse sample of teachers from underdeveloped educational settings. Because of school consolidation, no rural schools were included.

The teacher sample included 22 males (19.1%) and 93 females (80.9%), with diverse teaching experience and educational backgrounds. The gender distribution reflected the composition of the English teaching workforce in the participating schools where female teachers substantially outnumbered male teachers. Therefore, the observed imbalance was not the result of intentional sampling but rather reflected the actual demographic characteristics of the target population.

3.2 Instruments

Teachers' digital competence was operationally defined as teachers' self-reported ability to use digital technologies for professional engagement, digital resource management, teaching and learning, assessment, learner empowerment, and the facilitation of students' digital competence, as conceptualized by DigCompEdu (Redecker & Punie, 2017). Concerning the demographic characteristics, gender was coded as male or female; educational background was categorized as bachelor's degree and master's degree; teaching experience was grouped into 1−10 years, 11−20 years, and more than 20 years; access to facilities and resources was measured based on teachers' self-reported frequency of digital facilities and teaching resources.

Accordingly, teachers' digital competence was measured using a scale adapted from DigCompEdu. The scale consisted of 28 items covering six dimensions: professional engagement, digital resources, teaching and learning, assessment, empowering learners, and facilitating learners' digital competence. Sample items included "I collaborate with colleagues through digital platforms to co-design instructional activities" and "I use digital technology to support student learning at different levels and speeds". Teachers rated each item on a 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The full scale is presented in Appendix 1. Given the relatively small sample size (N = 115), item analysis was considered more appropriate than factor analysis. Therefore, validity evidence was established through back-translation, expert review, item analysis, and internal consistency reliability.

First, the original English instrument was translated into Chinese and then back translated into English by an independent bilingual researcher. The original and back-translated versions were compared to ensure semantic equivalence. After minor revisions, the Chinese version was reviewed by three experts in the field of English education and two experienced high school English teachers to ensure clarity and contextual appropriateness. Second, item analysis was conducted to evaluate the quality and discriminatory power of individual scale items and to determine whether each item contributed effectively to the measurement of teachers' digital competence.

The critical ratio (CR) value reached statistical significance at $p < .05$, indicating that the item could effectively differentiate between high and low scorers. Corrected item-total correlation (CITC) ranged from 0.543 to 0.894, over the benchmark of 0.3 (DeVellis & Thorpe, 2021). Lastly, Cronbach's alpha coefficient for the overall scale was 0.976, with the six dimensions all exceeding the threshold

of 0.7 (Nunnally & Bernstein, 1994). The results indicated excellent validity and internal consistency.

3.3 Data Collection and Data Analysis

Data was collected from 10/10/2025 to 16/11/2025. Research permission was granted by the participating schools and the local education authorities. An informed consent form was signed by all participants. Teachers completed the questionnaires in 15–20 minutes. The initial responses were obtained from 121 teachers. After excluding invalid responses, 115 valid questionnaires remained (95.83% retention). Data was analyzed using SPSS 27.0.

Prior to hypothesis testing, assumptions of normality and homogeneity of variance were examined. Skewness (0.226) and kurtosis (0.447) values fell within acceptable ranges, supporting the use of parametric analyses (Kim, 2013). Effect sizes (Cohen's d and η^2) were reported alongside significance tests to evaluate the practical importance of observed differences. First, descriptive statistics were calculated. Second, *t*-tests and the one-way ANOVA examined differences in teachers' digital competence by demographic characteristics, including gender, educational background, teaching experience and access to facilities and resources. The results provided an in-depth understanding of what factors were associated with English teachers' digital competence in economically underdeveloped regions.

4. Results and Findings

This section presents the findings of the study in relation to the research questions. Section 4.1 addresses RQ1 by reporting the overall level of digital competence among English teachers in an economically underdeveloped region. Sections 4.2, 4.3, and 4.4 address RQ2 by examining whether teachers' digital competence differs according to gender, educational background, teaching experience, and access to facilities and resources.

4.1 Descriptive Statistics of Teachers' Digital Competence

Descriptive statistics revealed that English teachers in this sample reported a moderate level of digital competence overall (M = 3.17, SD = 0.88 on a 5-point scale). As shown in Table 1, among the six DigCompEdu dimensions, teachers scored highest in "digital resources" (M = 3.37, SD = 0.92) and lowest in "empowering learners" (M = 2.98, SD = 1.08). This suggested that while teachers have developed foundational skills in finding and using digital resources, they face greater challenges in using technology to address learner diversity, provide personalized support, and foster student skills and autonomy. This pattern indicated variation across different dimensions of teachers' digital competence, with stronger performance in digital resource use than in empowering learners.

Table 1: Descriptive statistics for teachers' digital competence dimensions

Dimensions	Mean *(M)*	Standard Deviation (*SD*)
Professional Engagement	3.36	0.85
Digital Resources	3.37	0.92
Teaching and Learning	3.18	1.00
Assessment	3.07	1.02
Empowering Learners	2.98	1.08
Facilitating Learners' Digital Competence	3.13	0.97
Overall Digital Competence	3.17	0.88

4.2 Gender Differences in Digital Competence

To examine whether male and female teachers differed in their digital competence, an independent sample *t*-test was conducted. The results revealed a significant gender difference. Male teachers reported significantly higher overall digital competence (M = 3.57, SD = 0.77) than their female counterparts (M = 3.08, SD = 0.88), t (113) = 2.38, p = .019, Cohen's d = 0.57. The effect size (d = 0.57) indicates a small to medium effect, suggesting that the gender difference is practically meaningful. The finding demonstrated that gender was the only demographic factor associated with differences in teachers' digital competence in the present sample. Therefore, H1 was supported.

4.3 Differences by Educational Background, Teaching Experience, and Resources

An independent samples *t*-test was conducted to examine whether teachers' digital competence differed by educational background and facilities. One-way ANOVA was used to compare teachers with various teaching experiences.

4.3.1 Educational Background

The initial category of associate degree was canceled, as no teacher belonged to this subgroup. It may be attributed to the minimum requirement for senior high school teachers in China (Ministry of Education of the People's Republic of China, 2021) in which senior high school teachers must have a bachelor's degree or above. Therefore, teachers were grouped into two categories: bachelor's degree (n = 102), and master's degree (n = 13). The independent samples *t*-test revealed no significant difference in digital competence between the two groups, t (113) = −1.52, p = .131. Teachers with a bachelor's degree (M = 3.12, SD = 0.88) and teachers with a master's degree (M = 3.52, SD = 0.86) reported similar levels of digital competence. As a result, H2 was not supported.

4.3.2 Teaching Experience

Teachers were divided into three groups based on years of teaching experience: 1–10 years (n = 46), 10–20 years (n = 40), and ≥20 years (n = 29). The one-way ANOVA showed no significant difference in digital competence among the three groups, F (2, 112) = 0.70, p = .498, η^2 = 0.01. As shown in Table 2, mean scores were comparable across all experience levels. Consequently, H3 was not supported.

Table 2: Digital competence by teaching experience

Teaching Experience	*n*	*M*	*SD*
1–10 years	46	3.29	0.89
10–20 years	40	3.07	0.84
≥20 years	29	3.14	0.92

4.3.3 Facilities and Resources

Teachers were asked whether they had adequate access to digital facilities and resources for teaching. Based on their responses, teachers were divided into two groups: those reporting adequate access (n = 102) and those reporting inadequate access (n = 13). The independent samples t-test revealed no significant difference in digital competence between teachers with adequate access (M = 3.19, SD = 0.88) and those with inadequate access (M = 3.52, SD = 0.94), t (113) = 0.61, p = .541, Cohen's d = 0.18. Therefore, H4 was not supported. Together, these results suggest that teachers' digital competence was relatively consistent across groups with different educational backgrounds, levels of teaching experience, and access to facilities and resources.

4.4 Summary of Findings

In summary, the results indicated that teachers in this sample reported a moderate level of digital competence across the six dimensions that were examined. Among the considered demographic variables, gender emerged as the only significant differentiating factor, with male teachers reporting higher levels of digital competence than female teachers. In contrast, no significant differences were identified with respect to educational background, teaching experience, or access to facilities and resources. These findings suggest that teachers' digital competence in economically underdeveloped regions may be shaped by factors beyond traditional demographic and contextual characteristics.

The relatively homogeneous levels of digital competence across most subgroups may also reflect the increasing availability of digital technologies and professional development opportunities in recent years. Overall, the findings indicate that gender remains a relevant factor in understanding variations in teachers' digital competence, whereas educational qualifications, teaching experience, and resource availability appear to play a less prominent role in this particular context. The discussion section explores the possible explanations and implications of these findings further.

5. Discussion

This section interprets the findings in view of the analysis results, which are discussed in three areas: the overall level of digital competence, the role of gender, and the (non-)effects of education, experience, and resources.

5.1 Moderate Digital Competence: Progress and Persistent Gaps

The finding that English teachers in Guizhou reported moderate levels of digital competence is both encouraging and cautionary. On the one hand, it suggests that policy investments in digital infrastructure and teacher training in the province may have contributed to this outcome, although the present study does not allow causal conclusions to be drawn. On the other hand, the moderate average

indicates substantial room for improvement, particularly the lowest scores in the "empowering learners" dimension, suggesting that teachers struggle to use technology to address learner diversity, provide personalized learning experiences, and promote active student engagement.

Recent empirical studies have also identified this dimension as one that needs to be focused on in teacher professional development (Runge et al., 2023), suggesting that even when teachers acquire basic digital skills, the pedagogical integration of technology to support differentiated instruction remains a commonly reported challenge across educational contexts. For underdeveloped regions such as Guizhou where classrooms often feature wide disparities in students' prior knowledge and access to technology outside school, there is a priority to strengthen teachers' capacity to use digital tools for inclusive and equitable learning.

From a DigCompEdu perspective, the pattern of results suggests that teachers have generally developed the capacity to access and use digital technologies, yet they encounter greater challenges when applying technology to support learner-centered and inclusive pedagogical practices. The contrast between the relatively stronger performance in digital resource use and the weaker performance in empowering learners indicates that technological adoption may have progressed more rapidly than pedagogical transformation. This finding implies that the development of digital competence should be understood not only as the acquisition of technological skills but also as the ability to translate those skills into meaningful learning experiences.

5.2 Gender Matters: Explaining the Male Advantage in Underdeveloped Contexts

A significant gender difference favoring male teachers was found in the study. While some studies in developed contexts have reported similar gender gaps (Aslan, 2021; Lucas et al., 2021; Suzer & Koc, 2024), others have found no differences or even female advantages (Cabero-Almenara et al., 2021; Diz-Otero et al., 2023; Zakharov et al., 2022).

In the context of an underdeveloped region, several explanations may account for this finding. First, gender role socialization may be more traditional in many cultural contexts, with technology use still coded as masculine (Voufo et al., 2025). Male teachers may have more opportunities and social encouragement to engage with technology, both personally and professionally. Second, male teachers in Guizhou may disproportionately take on technology-related roles in their schools, for example, maintaining equipment or leading digital initiatives, thereby accumulating more hands-on experience (Ghosh & Yadav, 2025).

Third, the possibility of self-report bias cannot be dismissed. Research consistently shows that men tend to overestimate their technological abilities compared to women who may be more modest in self-assessments (Hargittai & Shafer, 2006). Future research employing objective measures of digital competence or classroom observations would help clarify whether the gender gap reflects genuine skill differences or reporting patterns.

Overall, although the observed gender difference is statistically significant, caution is warranted when interpreting its practical meaning. The finding does not imply that male teachers are inherently more digitally competent than female teachers. Rather, it may reflect differences in access to technological responsibilities, professional experiences, institutional expectations, or self-perceptions of competence within the specific cultural and educational context examined in this study.

5.3 The (Non-)Role of Education, Experience, and Resources: Challenging Conventional Wisdom

Perhaps the most striking finding of this study is the absence of significant differences in digital competence based on educational background, teaching experience, and access to facilities and resources. These null findings contrast with assumptions that have been confirmed in the literature—that teachers with higher education levels have stronger digital skills (Schmölz et al., 2023; Suzer & Koc, 2024); that experienced teachers are inherently more digitally competent (Guillén-Gámez et al., 2022); and that providing hardware and infrastructure directly translates into enhanced competence (Cattaneo et al., 2022; Lucas et al., 2021).

Several explanations may account for these unexpected findings. First, the non-significance of educational background suggests that initial teacher education programs, whether at bachelor's or master's level, may not be sufficiently differentiating teachers' capabilities in regard to technology integration. This pattern has been documented across diverse cultural contexts (Jita & Thaanyane, 2025; Zhang et al., 2026). In underdeveloped regions, the teacher education institutions themselves may lack the resources and expertise. A master's degree does not guarantee higher digital competence if the program does not systematically integrate technology training.

Second, regarding teaching experience, contrary to the "digital native" assumption (Prensky, 2001), teaching experience did not differentiate teachers' digital competence. This may be explained by two factors. One explanation is that growing up in the digital era does not automatically equip teachers with deep technological knowledge or pedagogical integration skills (Kirschner & De Bruyckere, 2017). In other words, young teachers may be skilled at using technology for entertainment but not at translating their digital skills into effective teaching. Another factor is that professional development in underdeveloped regions may create a leveling effect, equipping teachers across all experience levels with similar foundational skills but without deeper technology integration (Abedi, 2024). These findings suggest that experience alone is not a reliable indicator of digital competence.

Third, and perhaps most importantly, the finding that access to facilities and resources did not differentiate teachers' digital competence challenges the "deficit model" that has long underpinned educational technology policy in developing regions. Although Guizhou has invested heavily in educational digitalization (Department of Education of Guizhou Province, 2025), the lack of a significant difference between the two groups suggests that resource provision is necessary but not sufficient. In this context, hardware appears to have been more widely

deployed than the pedagogical use of technology reflected in teachers' self-reported competence. It can be described as a lag in digital integration capacity behind widespread technological investment. This interpretation is supported by the dimension-level findings: teachers scored highest in "digital resources" (finding and using materials) but lowest in "empowering learners" (using technology to differentiate instruction and engage students actively). This finding implies that underdeveloped regions have been moving beyond a focus on infrastructure development and toward a more holistic approach centered on teacher professional development, pedagogical integration support, and contextualized digital resources.

More broadly, these findings contribute to ongoing global discussions regarding digital inequality in education. Early digital divide research primarily emphasized disparities in access to technological resources. However, contemporary scholarship increasingly highlights inequalities in digital skills, patterns of technology use, and the ability to transform access into meaningful educational outcomes (Van Deursen & Van Dijk, 2014). The present findings suggest that even in economically underdeveloped regions, differences in access alone may no longer adequately explain variations in teachers' digital competence. Instead, one important challenge appears to be transforming technological availability into effective pedagogical application. This observation aligns with recent arguments that educational digital inequality may increasingly be characterized by differences in meaningful use rather than simple access.

6. Implications

Based on the findings of this study, several theoretical, policy, and practical implications can be identified. These implications may help inform future research, educational policymaking, and professional development efforts related to teachers' digital competence in underdeveloped contexts.

6.1 Theoretical Implications

The present study contributes to the literature on teachers' digital competence in several ways. First, the findings extend the application of the DigCompEdu framework in economically underdeveloped EFL contexts. While teachers demonstrated relatively stronger competence in locating and using digital resources, they reported lower competence in empowering learners through technology. This pattern suggests that the development of digital competence may progress unevenly across different dimensions, with pedagogical application presenting greater challenges than technological access or resource use.

Second, the study contributes to broader discussions of digital inequality in education. Consistent with the notion of the second-level digital divide (Van Deursen & Van Dijk, 2014), the findings suggest that disparities in educational technology may increasingly relate to differences in meaningful use rather than access alone. Even in economically underdeveloped regions, improvements in infrastructure may not necessarily lead to equivalent improvements in pedagogical technology integration. This highlights the importance of examining digital competence as both a technological and a pedagogical phenomenon.

6.2 Policy Implications

The findings carry important implications for educational policy in underdeveloped regions. First, policymakers should avoid equating investments in infrastructure with improvements in teachers' digital competence. Although access to facilities and resources remains important, the findings suggest that hardware provision alone may not be sufficient to enhance teachers' ability to integrate technology effectively into teaching. Educational digitalization policies should, therefore, balance infrastructure investment with sustained support for teacher professional development.

Second, policies aimed at reducing gender disparities in digital competence should be considered. Rather than assuming that all teachers benefit equally from digital initiatives, policymakers may need to provide targeted support and professional learning opportunities that encourage broader participation in technology-related activities and leadership roles.

Finally, teacher education policies should promote the systematic integration of digital competence across both pre-service and in-service training programs. Such efforts may help to ensure that technology integration becomes a core component of teacher preparation rather than a supplementary skill.

6.3 Practical Implications

The findings also offer several practical implications for teacher educators, school leaders, and professional development providers. Given the relatively low scores in the dimension of empowering learners, professional development programs should place greater emphasis on learner-centered uses of technology, including differentiated instruction, personalized learning, and strategies for promoting student engagement.

In addition, training activities should move beyond technical skill acquisition and focus on practical classroom applications. Workshops, peer mentoring, lesson demonstrations, and collaborative learning communities may provide teachers with opportunities to translate technological knowledge into effective pedagogical practice. For English teachers in underdeveloped regions, professional development should be context-sensitive and responsive to local challenges. Examples include adapting digital resources for language learning, integrating mobile technologies into classroom activities, and using technology to support students with diverse levels of English proficiency and digital learning experience.

7. Limitations and Future Research

Several limitations should be acknowledged when interpreting the findings. First, the study relied on self-reported measures of digital competence. Although self-report instruments are widely used in digital competence research, they may be subject to social desirability bias and self-perception bias. Teachers may either overestimate or underestimate their actual competence and thus, self-reported competence does not necessarily reflect actual practices of classroom technology integration. Future studies should, therefore, incorporate classroom observations,

teaching artifacts, or performance-based assessments to obtain a more comprehensive evaluation of teachers' digital competence.

Second, the cross-sectional design limits the ability to draw causal conclusions regarding the relationships that were examined. The findings reflect associations at a single point in time and cannot determine the directionality of the observed relationships. Longitudinal studies are needed to examine how teachers' digital competence develop over time and how contextual factors influence its growth.

Third, the use of non-probability sampling, including purposive sampling for school selection and convenience snowball sampling for teacher recruitment, may have introduced selection bias. Teachers who were more willing to participate may have differed systematically from those who did not participate, potentially affecting the representativeness of the sample. Although participants were recruited from 16 schools across 6 cities in Guizhou province, the findings should be interpreted with caution and should not be assumed to represent all English teachers in the province or in other underdeveloped regions.

Fourth, the sample size (N = 115) was relatively modest, which may have reduced the statistical power to detect smaller effects. In particular, the relatively small number of male teachers (n = 22) warrants caution when interpreting the observed gender differences, as unequal group sizes may have influenced the stability of the estimates.

Finally, the study focused on a single economically underdeveloped province in China. The educational, cultural, and socioeconomic characteristics of Guizhou may differ from those of other underdeveloped regions both within and outside China. Therefore, the transferability of the findings to other contexts should be considered carefully.

Future research could adopt mixed methods designs that combine surveys with interviews, classroom observations, and document analysis to provide a more comprehensive understanding of teachers' digital competence. Longitudinal research may help to examine developmental trajectories and identify factors that contribute to changes in competence over time. In addition, comparative studies across different underdeveloped regions and educational systems would help clarify the contextual conditions shaping teachers' digital competence. Future studies could also employ larger probability-based samples and more advanced analytical approaches such as multilevel modeling or longitudinal structural equation modeling to investigate further the mechanisms underlying digital competence development.

8. Conclusion

This study examined the digital competence of English teachers in Guizhou, an underdeveloped province in China, and investigated whether commonly cited factors, including gender, educational background, teaching experience, and access to resources, differentiated their competence levels. The findings revealed a moderate level of digital competence overall and identified gender as the sole

significant differentiating factor, with male teachers reporting higher competence. The absence of differences by education, experience, and resources does not fully align with findings reported in some previous studies and highlights the importance of adopting context-sensitive approaches to understanding and fostering teachers' digital competence in underdeveloped regions.

Given that the findings are based on a sample of 115 English teachers from a single province, caution is warranted when generalizing the results to other educational contexts. Nevertheless, the study provides valuable insights into the development of digital competence in economically underdeveloped regions. The findings suggest that investments in digital infrastructure alone may not be sufficient to enhance teachers' digital competence and should be complemented by pedagogy-oriented capacity building and sustained professional development opportunities.

Conflict of Interest

The authors declare no conflict of interest.

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Appendix 1

QUESTIONNAIRE FOR ENGLISH TEACHERS' DIGITAL COMPETENCE

Dear Teachers,
The purpose of this questionnaire is to investigate the digital competence of English teachers in economically underdeveloped regions in order to understand better the current status of teachers' teaching with digital technology support and to provide a basis for future teacher training. This questionnaire is for academic research only. All data will be kept strictly confidential and will not be used for any commercial or administrative purposes. This questionnaire includes 6 dimensions and 28 questions. Please choose the option that best fits your actual teaching situation.

Part I: Basic Information
(The following information will only be used for data analysis and will not involve personal privacy)
1.Your gender:
- ☐ Male
- ☐ Female
2.Your educational background:
- ☐ College and below
- ☐ Bachelor's degree
- ☐ Graduate student and above
3.Your years of teaching experience:
- ☐ 1–10 years
- ☐ 11–20 years
- ☐ Over 20 years
4.Facilities and resources in your area:
- ☐ Adequate facilities and resources with ready access to digital teaching tools
- ☐ Inadequate facilities and resources with ready access to digital teaching tools

Part 2: Digital Competence Assessment for English Teachers
(Please select the option that applies to you after the following statements: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree)
1. I use digital tools (e.g., WeChat groups, DingDing) to communicate with parents about student learning.

1¨2¨3¨4¨5¨

2. I collaborate with colleagues through digital platforms to co-design instructional activities.

1¨2¨3¨4¨5¨

3. I use digital tools to manage classroom affairs (e.g., notifying lesson schedules, recording student performance).

1¨2¨3¨4¨5¨

4. I use online resources (e.g., teacher training websites, webinars) to enhance professional competence.

1¨2¨3¨4¨5¨

5. I participate in an online ELT community to share experiences with my peers.

1¨2¨3¨4¨5¨

6. I can find free or low-cost digital resources that are appropriate for my students' level of English.

1¨2¨3¨4¨5¨

7. I evaluate the quality of digital resources to make sure they meet local students' needs.

1¨2¨3¨4¨5¨

8. I use tools such as PPT and Seewo to create multimedia resources for the English classroom.

1¨2¨3¨4¨5¨

9. I manage and store teaching resources appropriately and comply with copyright regulations.

1¨2¨3¨4¨5¨

10. I design blended learning activities that combine online and offline activities.

1¨2¨3¨4¨5¨

11. I design teaching and learning activities that can be used offline when resources are limited.

1¨2¨3¨4¨5¨

12. I use tools such as projectors, videos, cell phones, or tablets to increase classroom interactivity.

1¨2¨3¨4¨5¨

13. I guide students in using digital tools (e.g., BoardMix) to learn collaboratively with their peers.

1¨2¨3¨4¨5¨

14. I recommend English apps for different students to support personalized learning.

1¨2¨3¨4¨5¨

15. I use digital tools (e.g., DingDing questionnaires) to create English tests or assignments.

1¨2¨3¨4¨5¨

16. I use digital tools to collect data on student learning.

1¨2¨3¨4¨5¨

17. I provide digital feedback (e.g., audio or video comments) to help students improve their learning.

1¨2¨3¨4¨5¨

18. I can adapt teaching strategies and assessment criteria to suit local student learning needs.

1¨2¨3¨4¨5¨

19. I encourage students to express themselves digitally (e.g., recording English speeches).

1¨2¨3¨4¨5¨

20. I use interactive tools (e.g., virtual whiteboards, online games) to increase classroom engagement.

1¨2¨3¨4¨5¨

21. I use digital technology to support student learning at different levels and speeds.

1¨2¨3¨4¨5¨

22. I use the web and technology to create ELL content that is relevant to students' lives (e.g., imitating live streaming).

1¨2¨3¨4¨5¨

23. I teach students how to use online dictionaries or grammar guides to enhance their learning.

1¨2¨3¨4¨5¨

24. I develop students' ability to evaluate resources and to search for reliable information.

1¨2¨3¨4¨5¨

25. I encourage students to interact and communicate cross-culturally on digital platforms.

1¨2¨3¨4¨5¨

26. I guide students in presenting learning outcomes through PPT or video.

1¨2¨3¨4¨5¨

27. I teach students how to cite and use online resources wisely and to develop copyright awareness.

1¨2¨3¨4¨5¨

28. I develop students' mastery of simple digital skills (e.g., file conversion).

1¨2¨3¨4¨5¨