Education Insights

Article

Correlation between Digital Literacy and Teaching Efficacy among Teachers in Private Medical Colleges in Shandong Province

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Abstract: This study investigated the current status and relationship between digital literacy and teaching efficacy among teachers in private medical colleges in Shandong Province, with the aim of providing an empirical basis for targeted faculty development. A total of 345 full-time teachers from five private medical colleges were surveyed using an adapted DigCompEdu digital literacy scale and the Tschanen-Moran Teacher Efficacy Scale. Descriptive statistics, group difference testing, Pearson correlation analysis, and multiple linear regression were conducted using SPSS 27.0. The overall mean score for digital literacy was 3.57 ± 0.62, and the overall mean score for teaching efficacy was 3.78 ± 0.61, indicating moderate-to-high levels in both constructs. Within digital literacy, technical application scored highest (3.68 ± 0.72), whereas data literacy was relatively weak (3.45 ± 0.68). Within teaching efficacy, classroom management achieved the highest score (3.92 ± 0.65), while student engagement was lowest (3.68 ± 0.71). Digital literacy was significantly and positively correlated with teaching efficacy ($r = 0.68$, $p < 0.01$). Regression analyses further showed that all dimensions of digital literacy significantly predicted teaching efficacy, with instructional innovation ($\beta = 0.44$, $p < 0.001$) and technical application ($\beta = 0.38$, $p < 0.001$) exerting the strongest effects. Male teachers, those with 5–20 years of teaching experience, and professors reported higher scores. These findings highlight the need for systematic digital competence training, enhanced resource support, and incentive mechanisms to promote the coordinated improvement of digital literacy and teaching efficacy in private medical education.

Keywords: digital literacy; teacher self-efficacy; private medical colleges; medical education; digital competence framework; instructional innovation; faculty development

Received: 23 February 2026
Revised: 14 April 2026
Accepted: 26 April 2026
Published: 30 April 2026

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1 Introduction

With the rapid advancement of digital technologies such as artificial intelligence, big data, and virtual reality, medical education is undergoing a significant transition into a digital-intelligent phase. The introduction of industry standards for teacher digital literacy and strategic plans for medical education development has elevated the importance of enhancing teachers' digital competencies, providing a structured framework for the digital transformation of medical education. Private medical colleges, as pivotal institutions for cultivating primary healthcare professionals in China, currently play a critical role in this transformation. These colleges, numbering over 150 nationwide and enrolling a substantial number of students, face unique challenges compared to public institutions. Limited resource investment, imbalanced faculty structures, and insufficient technical support are among the primary obstacles hindering their progress. Teachers, as the central agents of educational digital transformation, play a decisive role in determining the success of these initiatives. Their digital literacy not only influences the quality of teaching but also affects their confidence and motivation to innovate pedagogically [1]. While existing research has identified a positive relationship between digital literacy and teaching efficacy, the mechanisms underlying this relationship remain

underexplored. Additionally, most studies have focused on broader national samples or higher vocational institutions, leaving a significant gap in understanding the specific context of private medical colleges. Addressing this gap requires a focused examination of how digital literacy develops within the unique institutional environments of private medical colleges and how it shapes teachers' perceptions of their instructional capabilities. A deeper understanding of these dynamics can provide actionable insights for designing faculty development strategies and supporting institutional digital transformation. This study, therefore, concentrates on the teacher population in private medical colleges within Shandong Province. It aims to systematically analyze the current status and characteristics of their digital literacy and teaching efficacy, explore variations across demographic factors, examine the correlation between these two constructs, and identify the predictive effects of different dimensions of digital literacy on teaching efficacy.

2 Methodology

2.1 Data Source

This study utilized a stratified random sampling approach to select full-time educators from five private medical colleges situated in Shandong Province as the primary subjects of investigation [1]. These institutions, distributed across the cities of Jinan, Qingdao, Weifang, Linyi, and Jining, include two private undergraduate colleges and three private higher vocational colleges. A total of 380 questionnaires were disseminated, with 345 valid responses collected, resulting in an effective response rate of 90.8%. The composition of the sample was deemed appropriate, with female educators representing 76.2% of the participants, reflecting the prevalent demographic trend in medical education where female teachers are more common. The age distribution of respondents was predominantly concentrated within the 30 to 49 age range, accounting for 69.6% of the sample. Furthermore, teaching experience was largely within the range of 5 to 20 years, comprising 63.7% of the participants. Professional titles were primarily categorized as assistant lecturers, lecturers, and associate professors, collectively making up 87.8% of the sample, indicating a balanced representation of academic ranks.

2.2 Instruments

Two standardized questionnaires were utilized in this study to assess key constructs. The first instrument was an adapted digital literacy scale designed to evaluate three critical dimensions: technical application, data literacy, and instructional innovation. These dimensions collectively provide a comprehensive framework for understanding digital proficiency in educational contexts [1]. The second instrument focused on teacher efficacy, encompassing classroom management, instructional strategies, and student engagement. Each item was measured using a five-point Likert scale, where higher scores reflected stronger proficiency or efficacy in the respective areas. These tools were selected based on their robust design and ability to effectively capture the targeted constructs, ensuring reliable and valid measurement outcomes suitable for diverse educational research applications [2, 3].

2.3 Measures

Digital literacy was evaluated through three distinct dimensions: technical application, data literacy, and instructional innovation, which were derived from a widely recognized educational framework. Teaching efficacy was examined across three key areas: classroom management efficacy, instructional strategy efficacy, and student engagement efficacy, aligning with established theoretical models. For each of these dimensions, the average score was calculated to provide a quantitative representation of the corresponding variable's level [4]. Higher average scores were indicative of more advanced digital literacy or greater teaching efficacy. Descriptive statistical tools, including measures such as mean and standard deviation, were employed to comprehensively summarize the sample's overall performance across these dimensions, offering a detailed understanding of the observed trends and variations within the dataset.

2.4 Data Analysis

The data were analyzed utilizing SPSS version 27.0 to ensure comprehensive statistical evaluation. Descriptive statistics were employed to provide a detailed overview of the levels of digital literacy and teaching efficacy within the sample population [5, 6]. To investigate variations across different demographic groups, independent-sample t-tests and one-way ANOVA were conducted, offering insights into potential disparities. Pearson correlation analysis was utilized to examine the strength and direction of relationships between digital literacy and teaching efficacy. Furthermore, multiple linear regression analysis was carried out to identify and quantify the extent to which specific dimensions of digital literacy could serve as predictors for teaching efficacy, thereby providing a deeper understanding of these interconnected variables.

3 Literature Review

Research on teachers' digital literacy has expanded considerably in recent years with the rapid development of educational technologies. Digital literacy is generally defined as the ability to effectively use digital tools, process information, and integrate technology into pedagogical practice. International frameworks emphasize multiple dimensions, including technical application, data literacy, and instructional innovation, all of which are considered essential competencies for modern educators. Teachers with higher digital literacy are more capable of designing interactive learning environments, improving instructional efficiency, and applying innovative teaching strategies. Teaching efficacy refers to teachers' beliefs in their ability to organize and execute teaching tasks [1, 7]. It is often classified into three domains: classroom management, instructional strategies, and student engagement. Research indicates that teaching efficacy significantly influences teachers' motivation, instructional behaviors, and classroom outcomes. These findings underscore the importance of fostering both digital literacy and teaching efficacy to enhance educational practices and outcomes.

The relationship between digital literacy and teaching efficacy has attracted growing scholarly attention. Studies have identified a positive correlation between the two, suggesting that digital competence enhances teachers' confidence in managing classrooms and implementing technology-enhanced pedagogy. However, most research has focused on public institutions, vocational colleges, or general university teachers. The unique contexts of private medical colleges, characterized by limited resources, uneven faculty development, and high demands for practice-oriented training, have rarely been examined. Additionally, while the overall association between digital literacy and teaching efficacy is well-established, fewer studies have explored how different dimensions of digital literacy influence specific domains of teaching efficacy. This gap highlights the need for targeted investigations into private medical colleges, where faculty face distinct challenges and opportunities. By analyzing digital literacy and teaching efficacy among full-time teachers in private medical colleges in Shandong Province, this study aims to provide a nuanced understanding of their relationship and offer practical insights for faculty development. Such research can inform strategies to enhance instructional capabilities and address the unique needs of educators in specialized academic environments.

4 Research Results

4.1 Descriptive Statistics

The findings presented in Table 1 reveal that the average score for digital literacy among educators in private medical institutions within Shandong Province stands at 3.57, while the average score for teaching efficacy is 3.78, both reflecting a performance level above the median. Analyzing the dimensions of digital literacy, the scores demonstrate a hierarchical pattern, with technical application achieving the highest average at 3.68, followed by instructional innovation at 3.58, and data literacy at 3.45. Similarly, the dimensions of teaching efficacy exhibit a structured trend, where classroom management

scores the highest at 3.92, instructional strategy follows at 3.75, and student engagement records an average of 3.68. These results underscore a disparity in the development of competencies among educators, suggesting that while certain areas exhibit strength, others may require targeted improvement to achieve balanced professional growth [8].

Table 1: Descriptive Statistics of Digital Literacy and Teaching Efficacy (N=345)

Variable	Mean	Std. Deviation
Technical Application	3.68	0.72
Data Literacy	3.45	0.68
Instructional Innovation	3.58	0.71
Digital Literacy Total	3.57	0.62
Classroom Management Efficacy	3.92	0.65
Instructional Strategy Efficacy	3.75	0.68
Student Engagement Efficacy	3.68	0.71
Teaching Efficacy Total	3.78	0.61

4.2 Analysis of Differences in Demographic Variables

The analysis reveals notable differences in digital literacy and teaching efficacy across various demographic groups. Male educators demonstrated higher overall scores in both digital literacy and teaching efficacy compared to their female counterparts. In terms of teaching experience, a distinct pattern emerged, characterized by higher scores among individuals with moderate experience, specifically those with 5 to 20 years in the profession, while those with either minimal or extensive experience exhibited comparatively lower scores. Regarding professional titles, individuals holding the rank of professor achieved the highest scores, surpassing those of associate professors and assistant lecturers or lecturers. Furthermore, associate professors outperformed assistant lecturers and lecturers in these measures. These results provide substantial support for the proposed hypotheses concerning demographic variations, highlighting the influence of gender, experience, and professional rank on digital literacy and teaching efficacy.

The statistical significance of these findings underscores the robustness of the observed patterns, with specific thresholds indicating meaningful differences across the analyzed groups.

4.3 Correlation Analysis

The analysis of Table 2 reveals that all dimensions of digital literacy exhibit a significant and positive relationship with all dimensions of teaching efficacy. This finding underscores the interconnected nature of these constructs, with the correlation coefficient between their total scores reaching a value of 0.68. Such a strong positive relationship provides robust support for the primary hypothesis, affirming the existence of a meaningful link between digital literacy and teaching efficacy. Among the various dimensions, the instructional innovation aspect emerges as particularly noteworthy, as it demonstrates the highest correlation with the overall teaching efficacy score, also at 0.68. This highlights the pivotal role of instructional innovation in bridging digital literacy with teaching efficacy, suggesting that the ability to innovate in instructional practices serves as a critical factor in enhancing teaching outcomes [9]. By emphasizing the importance of this dimension, the findings contribute to a deeper understanding of how digital literacy can be leveraged to improve teaching efficacy across diverse educational contexts.

Table 2: Correlation Coefficient Matrix of Digital Literacy and Teaching Efficacy (N=345)

	Classroom Management	Instructional Strategy	Student Engagement	Teaching Efficacy Total
Technical Application	0.62	0.58	0.55	0.65

Data Literacy	0.51	0.56	0.53	0.59
Instructional Innovation	0.58	0.62	0.65	0.68
Digital Literacy Total	0.62	0.63	0.61	0.68

4.4 Regression Analysis

A multiple linear regression analysis was performed using the total teaching efficacy score as the dependent variable and the three dimensions of digital literacy as independent variables. The analysis revealed a statistically significant regression equation, accounting for a substantial proportion of the variance in teaching efficacy. Each dimension of digital literacy demonstrated a meaningful positive influence on teaching efficacy, supporting the theoretical framework. Among these dimensions, instructional innovation emerged as the most impactful factor, showcasing its critical role in enhancing teaching outcomes. The technical application dimension also contributed significantly, highlighting the importance of practical technological integration in educational settings. Meanwhile, the data literacy dimension, although slightly less influential, still played a noteworthy role in shaping teaching efficacy. These findings underscore the multifaceted nature of digital literacy and its integral contribution to effective teaching practices.

4.5 Summary of Findings

1. The overall levels of digital literacy and teaching efficacy among teachers in private medical colleges in Shandong Province are satisfactory, but development across different dimensions is uneven. The overall digital literacy score and teaching efficacy score are both above the average level. However, development across digital literacy dimensions is unbalanced, with the technical application dimension demonstrating the highest performance and data literacy showing the lowest. A similar imbalance exists in teaching efficacy dimensions, where classroom management efficacy is the strongest and student engagement efficacy is the weakest. These findings highlight the need for targeted strategies to address these disparities and promote balanced development across all dimensions.
2. Digital literacy and teaching efficacy exhibit a significant positive correlation, indicating that they mutually reinforce and co-develop. This relationship can be analyzed from two perspectives: firstly, digital literacy provides the foundational capabilities necessary for forming teaching efficacy, enabling educators to effectively integrate technology into their instructional practices. Secondly, teaching efficacy acts as a critical psychological driver, motivating educators to further develop their digital literacy skills. This interplay underscores the importance of fostering both aspects simultaneously to achieve comprehensive professional growth.
3. Different dimensions of digital literacy exert varying predictive effects on teaching efficacy, with the instructional innovation dimension demonstrating the strongest influence. This suggests that enhancing the teaching efficacy of educators in private medical colleges requires prioritizing the cultivation of instructional innovation capabilities. Rather than focusing solely on basic digital skills training, institutions should emphasize advanced strategies that empower teachers to creatively integrate technology into their pedagogical approaches. Such efforts can lead to more impactful and transformative teaching practices, ultimately benefiting both educators and students.
4. Significant differences are observed in digital literacy and teaching efficacy among teachers based on factors such as gender, years of experience, and professional titles. These variations indicate that individual characteristics play a crucial role in shaping educators' competencies in these areas. Consequently, it is essential to implement differentiated and targeted enhancement strategies that address the unique needs of diverse teacher groups. By tailoring professional development programs to

accommodate these differences, institutions can ensure more equitable and effective improvements in digital literacy and teaching efficacy across their faculty.

5 Recommendations

5.1 Teacher Level: Foster Intrinsic Motivation and Engage in Continuous Learning

In response to the ongoing wave of digital-intelligent transformation, educators in private medical colleges must strengthen their capabilities through intrinsic motivation and external empowerment. At the individual level, teachers should adopt a lifelong learning mindset, actively explore the integration of emerging digital technologies into their teaching practices, and develop critical thinking skills to evaluate the benefits and limitations of these technologies. Continuous application and refinement of digital skills through practical teaching experiences are essential for sustained growth. At the organizational level, institutions should implement systematic training programs to build educators' theoretical and practical expertise in medical education technology [10, 11]. Platforms such as academic conferences and teaching salons can facilitate peer learning and the exchange of innovative practices. Additionally, encouraging teachers to stay informed about advancements in their disciplines through professional literature can help them update their knowledge base and achieve synergistic improvements in technology application and instructional innovation.

5.2 Institutional Level: Strengthen Infrastructure and Optimize Institutional Environment

Supporting the digital transformation of private medical colleges necessitates a comprehensive approach that combines the enhancement of physical infrastructure with the refinement of institutional frameworks. At the hardware level, it is essential to allocate sufficient funding to progressively upgrade facilities such as virtual simulation laboratories and smart classrooms. These upgrades should be complemented by the systematic development of institution-specific digital resource repositories tailored to the unique demands of medical education. Additionally, establishing dedicated technical support teams is crucial to ensure that educators receive prompt and effective assistance in navigating technological challenges. On the institutional front, integrating digital literacy into teacher evaluation systems can provide clear guidance and foster a culture of continuous improvement. Encouraging intrinsic motivation and cultivating an innovative atmosphere among educators can be achieved through structured recognition programs, rewards, and the organization of innovation-focused forums. Furthermore, adopting differentiated training strategies is vital to address the diverse needs of educators at various career stages. For early-career teachers, emphasis should be placed on blending digital tools with foundational teaching techniques. For mid-career and senior educators, gradual and targeted training programs should focus on enhancing their acceptance and effective use of technology, enabling them to refine their teaching methodologies [12, 13]. This holistic approach aims to build a resilient and proficient digital teaching workforce capable of meeting the evolving demands of modern medical education.

5.3 Policy Level: Provide Resource Guarantees and Improve Training Systems

5.3.1 Strengthen Diversified Resource Guarantees to Drive Digital Transformation in Private Medical Colleges

To facilitate the digital advancement of private medical colleges, it is essential to establish a dedicated funding mechanism that prioritizes critical areas such as the modernization of infrastructure, the creation of specialized digital resources, and the enhancement of digital competencies among educators. At the policy level, institutions should focus on issuing comprehensive guidelines that clearly define developmental objectives, outline key tasks, and specify actionable pathways for achieving digital transformation. These guidelines should serve as a strategic framework to ensure systematic progress. Furthermore, efforts should be made to develop collaborative support systems between institutions, enabling the seamless exchange of high-quality digital resources. Such mechanisms would foster a culture of shared learning and

innovation, allowing institutions to benefit from collective expertise and experiences in digital teaching methodologies. By promoting these initiatives, private medical colleges can create a robust foundation for sustainable digital growth and improved educational outcomes.

5.3.2 Improve the In-service Training System to Precisely Enhance the Effectiveness of Teacher Digital Literacy Training

Considering the operational realities and unique faculty characteristics of private medical colleges, it is essential to establish hierarchical and categorized training standards tailored to enhance teacher digital literacy. This approach should include the design and implementation of modular, progressive training courses that emphasize the seamless integration of medical education with digital technology. By adopting such a structured framework, training programs can address diverse skill levels and professional needs effectively. Additionally, the use of online training platforms and mobile learning tools should be prioritized to create accessible and self-directed learning opportunities for educators. These tools can significantly reduce the challenges posed by balancing professional responsibilities with ongoing education, thereby improving the overall flexibility and inclusivity of training programs. Such measures ensure that training initiatives are both comprehensive and adaptable to the evolving demands of digital literacy in medical education [14, 15].

6 Conclusion

This study systematically examined the relationship between digital literacy and teaching efficacy among educators in private medical colleges, revealing a significant positive correlation between these two critical competencies. While the findings indicate that teachers generally exhibit moderate-to-high proficiency in both areas, disparities persist across specific dimensions, particularly in data literacy and the ability to effectively engage students. The study underscores the pivotal role of digital literacy—especially in fostering instructional innovation—as a key driver of pedagogical improvement and professional confidence. These insights emphasize the need for targeted training programs, enhanced institutional support systems, and strategic resource allocation to address existing gaps and promote balanced development. Furthermore, the research highlights the importance of conceptualizing digital literacy as a multifaceted competence that extends beyond technical skills to encompass broader pedagogical capabilities. Tailored developmental pathways are essential for accommodating the diverse needs of educators at varying career stages and professional backgrounds. Looking ahead, future research could broaden the scope of investigation by including larger and more diverse samples, integrating qualitative methodologies, or delving deeper into the mechanisms that connect digital literacy with teaching efficacy. Such efforts would not only enrich theoretical understanding but also provide actionable strategies for advancing educational practices in increasingly digitalized learning environments.

Funding: Planning Special Research Project of Qingdao Binhai University (2026): Research on Tiered Evaluation and Targeted Improvement Pathways of University Teachers' Digital Literacy in Shandong Province from the Perspective of Digital Empowerment (Project No.: 2026ZGY02). Teaching Reform Research Project of Qingdao Binhai University (2025): Research on the Digital Literacy Evaluation System and Improvement Pathways for University Teachers and Students in the Digital Era (Project No.: 2025JY19). Qingdao Binhai University Teaching Reform Research Project: Cultivation Pathways for Digital Literacy of Nursing Professionals in the Context of Higher Education Digital Transformation (Project No.: 2024JY07).

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