International Education Forum, 2026, Volume 4, Issue 5
http://ojs.bbwpublisher.com/index.php/IEF
Online ISSN: 2981-8605
Print ISSN: 3083-4902

A Study on the Current Status of University Teachers' Digital Literacy Under the Background of Educational Digital Transformation

Yuqi Bai[1]†*, Qiang Li[1]†, Zihan He[1], Hengda Mao[2], Jiayu Zhang[3]

[1]School of Education, Chengdu College of Arts and Sciences, Chengdu 610401, China
[2]Beixing Primary School, Xindu District, Chengdu 610504, China
[3]Shishang School, Longquanyi District, Chengdu 610100, China
[†]These authors contributed equally to this work and share the first authorship.

**Author to whom correspondence should be addressed.*

Abstract: In the educational area, digital literacy is now an important capability required by university teachers. According to the national standard issued by the Ministry of Education, this investigation employs a mixed method combining questionnaires and semi-structured interviews to examine the digital literacy of 240 professors from four universities in Chengdu in five aspects: digital awareness, digital technology knowledge and skills, digital application, digital social responsibility, and professional development. The findings indicate that the overall digital literacy of university teachers is at a high level (mean score M=4.28), however, there exists an obvious imbalance: the mean scores of digital social responsibility (M=4.41) and professional development (M=4.33) are higher, whereas those of digital application (M=4.19) and digital technology knowledge and skills (M=4.20) are lower, suggesting a situation where "moral concepts are strong but technical application is weak." Analysis of the differences reveals that gender and educational background do not have a great influence, while age, teaching experience, academic position, and disciplinary background have a significant impact. For example, teachers aged 31–40 and having 11–15 years of teaching experience have the highest comprehensive digital literacy, but professors in arts and humanities always obtain the lowest scores in all dimensions. Therefore, based on these results, this research proposes targeted and detailed measures to enhance the digital literacy of university teachers, aiming to provide an empirical basis and practical suggestions for the transformation of higher education into a digital environment.

Keywords: Educational digital transformation; Digital literacy; University teachers; Teacher development; Higher education

Online publication: June 16, 2026

1. Introduction

The swift advancement of artificial intelligence, big data, cloud computing, and digital platform technologies has caused a notable modification in the educational field, making educational reform one of the prominent trends in modern higher education. These technologies not only change the ways of information transmission but also reconstruct the arrangement of teaching, the interaction between teachers and students, and the educational management system. During this process, university teachers play two significant parts, that of the reform implementers and the promoters of educational innovation. The successful completion of educational reform mainly relies on the ability of teachers to utilize digital technologies efficiently in the design of instruction, classroom teaching, assessment of learning, and cooperation in research. Now, digital literacy is not limited to the use of technical devices; it includes various skills enabling teachers to carry out instructional innovations, resource combination, value evaluations, and ongoing professional growth in the digital environment. In 2022, the Ministry of Education publicly announced the industry standard "Teacher's Digital Literacy", establishing for the first time a five-dimensional framework which consists of digital awareness, digital technology knowledge and skills, digital application, digital social responsibility and professional development. This standard provides a reliable basis for the evaluation and improvement of teachers' digital literacy [1].

Previous investigations about the digital literacy of Chinese teachers mainly concentrate on primary and secondary school teachers, whereas systematic studies concerning university professors, especially those in local universities, are relatively inadequate. Additionally, the current scholarship often deals with theoretical discussions without providing sufficient analyses based on empirical data.

Therefore, the research objects of this study are university teachers from four institutions in Chengdu. Based on the Ministry of Education's standard of Teacher Digital Literacy and using a combination of questionnaire surveys and interviews, the study comprehensively examines the actual levels, distinctive features and existing issues of university teachers' digital literacy, then investigates the influencing factors and puts forward corresponding improvement measures. The purpose is to offer practical guidance for enhancing the digital capability of university staff and to provide a theoretical basis for the digital transformation of higher education.

2. Research design

2.1. Research participants

This investigation examined university teachers from four educational institutions in Chengdu, using a method of random sampling combined with stratified sampling. Considering the significant differences among university teachers in terms of their disciplinary background, academic rank, teaching experience, and instructional tasks, the sample was organized to include a variety of teacher types in order to improve the representativeness of the results.

A total of 261 questionnaires were distributed, and 240 valid ones were collected, resulting in an effective response rate of 91.9%. The sample includes teachers from the fields of arts and humanities, science and engineering, economics and management, and medicine and agriculture, covering various professional title levels. Moreover, in order to obtain a deeper insight into the actual problems encountered by university teachers in improving their information literacy, eight experienced faculty members with different professional titles and academic disciplines were chosen for unstructured interviews, together with

the quantitative results.

The interviewees mostly come from teaching and research positions, such as junior teachers, mid-level key teachers, and full professors, which provides a fairly complete understanding of the present development of university faculty in digital literacy.

2.2. Research methods

2.2.1. Questionnaire survey

The questionnaire survey is the main way to obtain data in our research. The questionnaire was mainly established based on the MoE industry standard for Teacher Digital Literacy and then modified to suit the actual conditions of digital teaching in higher education, making sure that the measured aspects coincide with the research objects.

The questionnaire consists of two sections. The first section deals with the teachers' basic personal details such as gender, educational qualification, age, teaching experience, professional rank, and subject area. The second section evaluates their digital literacy by means of 19 items on a five-point Likert scale from 1 = "Strongly Disagree" to 5 = "Strongly Agree." The dimensional structure is shown in **Table 1**.

Table 1. Questionnaire dimensional structure

Primary Dimension	Secondary Dimension	Number of Items
Digital Awareness	Digital Cognition / Digital Willingness / Digital Volition	3 items
Digital Technology Knowledge & Skills	Digital Technology Knowledge / Digital Technology Skills	3 items
Digital Application	Digital Instructional Design / Digital Teaching Implementation / Digital Academic Assessment / Digital Collaborative Education	9 items
Digital Social Responsibility	Legal and Ethical Norms / Digital Security Protection	2 items
Professional Development	Digital Learning and Professional Training / Digital Teaching Research and Innovation	2 items

2.2.2. Interview method

To compensate for the limitations of the questionnaire survey in probing underlying causes, this study employed semi-structured interviews with eight university faculty members. The interview protocol covered five thematic areas:

(1) Actual use of digital technology in teaching practice
(2) Teachers' self-perception and self-assessment of their digital literacy
(3) Primary difficulties encountered in digital teaching
(4) Teachers' understanding of digital security and digital ethics
(5) The role of digital technology in the integration of teaching and research, and practical recommendations

The basic information of the eight interviewees is presented in **Table 2**.

Table 2. Basic information of interview participants

ID	Gender	Teaching Exp.	Title	Discipline	Highest Degree
T1	Male	3 yrs	Teaching Assistant (Initial)	Science & Engineering	Master's
T2	Female	4 yrs	Lecturer (Intermediate)	Economics & Management	Master's
T3	Male	12 yrs	Associate Professor (Associate Senior)	Science & Engineering	Ph.D.
T4	Female	15 yrs	Associate Professor (Associate Senior)	Science & Engineering	Ph.D.

T5	Female	11 yrs	Associate Professor (Associate Senior)	Arts & Humanities	Master's
T6	Male	6 yrs	Lecturer (Intermediate)	Medicine & Agriculture	Ph.D.
T7	Female	22 yrs	Professor (Senior)	Arts & Humanities	Ph.D.
T8	Male	18 yrs	Associate Professor (Associate Senior)	Economics & Management	Ph.D.

2.3. Sample characteristics

The demographic characteristics of the sample are presented in **Table 3**. The overall sample structure is well-balanced and demonstrates good representativeness.

Table 3. Demographic characteristics of research participants

Category	Sub-category	Frequency	Valid Percentage
Gender	Male / Female	90 / 150	37.5% / 62.5%
Education	Master's / Ph.D.	169 / 71	70.42% / 29.68%
Age	≤30 / 31–40 / 41–50 / ≥51	28 / 108 / 70 / 34	11.67% / 45.00% / 29.17% / 14.17%
Teaching Exp.	0–5 yrs / 6–10 yrs / 11–15 yrs / 16–20 yrs / ≥21 yrs	47 / 72 / 63 / 40 / 18	19.58% / 30.00% / 26.25% / 16.67% / 7.50%
Title	Initial / Intermediate / Associate Senior / Senior	16 / 133 / 53 / 18	6.67% / 55.42% / 22.08% / 15.83%
Discipline	Arts & Humanities / Sci. & Eng. / Econ. & Mgmt. / Med. & Agri.	92 / 66 / 49 / 32	38.33% / 27.50% / 20.42% / 13.75%

A total of 240 valid responses have been obtained. The distribution of the sample regarding gender, educational background, age, teaching experience, professional title, and disciplinary background is similar to that of the full-time faculty in higher education, showing a balanced overall structure with good representativeness.

2.4. Reliability and validity of the questionnaire

2.4.1. Reliability

The questionnaire data were entered into IBM SPSS Statistics 27.0 for reliability analysis. The overall Cronbach's alpha was 0.926, indicating an acceptable level of internal consistency among items and confirming that the questionnaire yields highly reliable results suitable for further analysis. The SPSS output is presented in **Table 4**.

Table 4. Questionnaire reliability test

Cronbach's Alpha	Number of Items
0.926	19

2.4.2. Validity

The KMO measure of sampling adequacy was 0.905, exceeding the recommended threshold of 0.6. Bartlett's test of sphericity was statistically significant at the 0.05 level, confirming the factorability of the data and the appropriateness of factor analysis. The validity analysis results are presented in **Table 5**.

Table 5. Questionnaire validity test

Test	Statistic	Value
KMO Measure of Sampling Adequacy		0.905
Bartlett's Test of Sphericity	Approx. Chi-Square	2740.354
	df	171
	Sig.	.000

3. Results

3.1. Overall digital literacy of university teachers

In accordance with the MoE industry standard of Teacher Digital Literacy, this research evaluated the digital literacy of university teachers in five aspects: digital awareness, digital technology knowledge and skills, digital application, digital social responsibility, and professional development. The main results are shown in **Table 6**.

Table 6. Descriptive statistics of the overall digital literacy of university teachers in Chengdu

Dimension	N	Min	Max	Mean	SD
Overall Digital Literacy	240	1	5	4.28	0.697
Digital Awareness	240	1	5	4.26	0.807
Digital Technology Knowledge & Skills	240	1	5	4.20	0.758
Digital Application	240	1	5	4.19	0.686
Digital Social Responsibility	240	1	5	4.41	0.778
Professional Development	240	1	5	4.33	0.786

The average digital literacy score of university teachers in Chengdu is 4.28, which indicates a relatively high general level. This shows that the teachers can satisfy the educational requirements caused by the digital transformation. In the five aspects, digital social responsibility (M = 4.41, SD = 0.778) and professional development (M = 4.33, SD = 0.786) have obtained higher scores, suggesting the teachers' strong sense of digital ethics and their comprehensive understanding of the significance of digitalization in career improvement. However, the scores of digital application (M = 4.19, SD = 0.686) and digital technology knowledge and skills (M = 4.20, SD = 0.758) are relatively low, indicating that there are still some weaknesses in practical digital techniques and their application in teaching and research fields.

3.2. Dimension-level analysis

3.2.1. Digital awareness

Digital awareness is required to improve digital literacy, which consists of digital cognition, digital willingness, and digital volition. The research indicates that the average digital awareness of university teachers is 4.26, suggesting a relatively high level (**Table 7**).

Table 7. Descriptive statistics of digital awareness of university teachers in Chengdu

Item	N	Min	Max	Mean	SD
Digital Cognition	240	1	5	4.22	0.863
Digital Willingness	240	1	5	4.30	0.975
Digital Volition	240	1	5	4.26	0.908

Among the sub-factors, the digital willingness obtained the highest score (M = 4.30), showing that the majority of teachers have a strong desire to actively acquire digital technologies and take part in the reform of digital instruction. The digital volition scored 4.26, indicating that teachers generally show a high ability to adapt and a positive attitude towards continuous improvement when facing difficulties in digital teaching. The digital cognition scored relatively low (M = 4.22), suggesting that the understanding of the deeper values of educational digitalization and its future development among some teachers needs to be strengthened.

From the interviews with some university teachers, it is known that they have recognized the significance of digital technology in modifying the teaching methods, particularly in establishing smart classrooms, delivering online courses, and enhancing cooperation in research. Most of the teachers are quite active in these fields. Teacher T3 mentioned, "I think that digital teaching will certainly develop into an inevitable trend, especially with the emergence of AI tools which significantly improve the efficiency of lesson preparation and strengthen the effectiveness of interactive teaching. I actively learn these tools and apply them in the classroom." His high score of digital willingness indicates that the middle-aged backbone teachers strongly support the educational reform through digitization. However, some teachers indicated that they are not clear about the substantial changes brought by digitalization to their special courses. Teacher T7 stated, "Although the importance of digitalization is emphasized and I do use PowerPoint and online resources, in fact, I do not have a clear understanding of the essential differences that digitalization can bring to my course contents--it appears to be just a formal change." This point of view agrees with his low score of digital cognition, suggesting that although some experienced teachers are aware of the existence of digitalization, they only consider it from the viewpoint of utilizing the tools rather than developing a comprehensive digital educational philosophy.

3.2.2. Digital technology knowledge and skills

Digital technology knowledge and skills include the basic knowledge of digital technologies and the operation abilities with digital tools. The survey shows a dimension mean of 4.20, which is higher than the average level but suggests considerable differences among individuals (**Table 8**).

Table 8. Descriptive statistics of digital technology knowledge and skills of university teachers in Chengdu

Item	N	Min	Max	Mean	SD
Digital Technology Knowledge	240	1	5	4.12	0.939
Digital Technology Skills	240	1	5	4.21	0.788

Digital technology knowledge obtained a relatively low score (M = 4.12), indicating that some teachers have insufficient basic theoretical knowledge in fields such as artificial intelligence, big data analysis, and the working principles of teaching systems. The score of digital technology skills is 4.21, which is slightly higher than that of the knowledge component, showing that the teachers have a certain ability to use common teaching systems, apply online instructional aids, and combine digital resources.

Interview findings revealed that most teachers are proficient in using teaching platforms, learning management systems, and common AI-assisted tools for lesson preparation and classroom management; however, their competency in deeply applying data analytics tools, intelligent assessment systems, and research-oriented digital platforms remains considerably weaker, with digital skills largely confined to basic operational use. T2 (4 years of teaching experience) acknowledged: "I am fairly proficient with tools like

Chaoxing Learning Pass and Rain Classroom, and I use AI tools to help organize materials, but statistical software is a struggle—it seems rarely needed in my current work, so I have never systematically studied it." T4 (15 years of experience) noted: "I use data visualization tools in research and have tried intelligent scoring assistance for grading student assignments in teaching, but the use of these advanced tools has mostly been self-taught—the institution has not provided systematic training specifically targeting such needs." Some teachers also reported that technical barriers are not confined to advanced tools. T6 (6 years of experience) commented: "Sometimes when campus systems update or equipment is unstable, it disrupts the entire rhythm of a class—situations like that sometimes make me somewhat resistant to digital technology." These accounts indicate a clear tool-tier gap in the digital skill development of university teachers: while proficiency with basic tools is adequate, the development of specialized, higher-order digital skills lacks effective institutional support.

3.2.3. Digital application

Digital application is the most central practical dimension of teacher digital literacy, encompassing digital instructional design, digital teaching implementation, digital academic assessment, and digital collaborative education (**Table 9**).

Table 9. Descriptive statistics of the digital application of university teachers in Chengdu

Item	N	Min	Max	Mean	SD
Digital Instructional Design	240	1	5	4.11	0.805
Digital Teaching Implementation	240	1	5	4.25	0.758
Digital Academic Assessment	240	1	5	4.17	0.795
Digital Collaborative Education	240	1	5	4.19	0.802

The survey results show that the use of digital methods by university teachers is generally above average, with considerable differences in various teaching activities. The score of digital teaching implementation is the highest (M = 4.25), indicating that teachers frequently apply digital equipment in their daily classes. The scores of digital cooperative education (M = 4.19) and digital academic assessment (M = 4.17) are next, indicating a basic level of digital procedures in cross-disciplinary cooperation and process-oriented evaluation. However, the score of digital instructional design is relatively low (M = 4.11), suggesting that, compared with the application of tools, the planning and design of curriculum based on digital concepts are weaker areas in the present use of digital methods by the teachers.

The interview results show the internal division of digital applications. Concerning the implementation of digital teaching, most teachers mentioned that they had already incorporated digital tools into their daily classes. T5 said, "At present, teaching platforms are usually used in each class, including attendance, material distribution, post-class discussion, and so on, which receives a positive response from the students and makes the interaction more abundant compared with before." However, some teachers pointed out some difficulties in the design of digital instruction. T1 expressed, "Although I know I should make high-quality digital courses, I really have no idea how to begin. The training sessions organized by the school mainly focus on the operation of the platform, and nobody teaches me how to integrate digital concepts systematically throughout an entire course." As for the digital cooperative education, T8 remarked, "Currently, cross-disciplinary and cross-departmental online cooperation is still quite difficult. The main problem lies in the fact that different departments use different systems, and there is no interoperability of the data, making the communication

very inconvenient." From these descriptions, it can be seen that the shortcomings of digital applications are not due to the lack of teaching motivation of the teachers, but reflect the systematic institutional defects in the training of digital course design, the mechanism of platform interoperability, and the technical support infrastructure.

3.2.4. Digital social responsibility

Digital social responsibility encompasses legal and ethical norms and digital security protection. The survey results show that this dimension scored highest overall (M = 4.41), indicating that university teachers demonstrate generally strong digital ethics and security awareness (**Table 10**).

Table 10. Descriptive statistics of digital social responsibility of university teachers in Chengdu

Item	N	Min	Max	Mean	SD
Legal and Ethical Norms	240	1	5	4.46	0.927
Digital Security Protection	240	1	5	4.36	0.827

Among the sub-dimensions, the scores for legal and ethical norms are the highest (M = 4.46), showing that teachers generally have a strong digital ethical awareness and voluntarily observe the relevant laws, regulations, and professional codes of conduct in both online and teaching environments. The score for digital security protection is slightly lower (M = 4.36), indicating that though teachers pay great attention to the protection of personal information and data security in actual work, there is still an opportunity for enhancement. Teachers usually abide by the online behaviour rules, value the protection of intellectual property rights, maintain academic integrity and respect students' privacy, and exhibit a good sense of data security.

In the interviews, most teachers mentioned that they had acquired a strong sense of digital risk prevention during online teaching, research cooperation, and student information management, which helped them to take preventive measures against data leakage, especially academic dishonesty. Teacher T4 said, "In my academic research, I attach great importance to the confidentiality of data and citation standards. When supervising graduate students, I specially emphasize that the artificial intelligence tools should not be used to produce texts and the authenticity and novelty of theses must be ensured." Teacher T5 also pointed out, "After recording and uploading online courses to the system, I make sure that the course materials do not infringe on copyright and remind the students to pay attention to the sources of the images and music used in their assignments." However, from the aspect of digital security protection at the operational level, some teachers recognized a difference between their knowledge and actual actions. Teacher T1 admitted, "I know that data security is very important, but in fact, I do not give it much attention — sometimes I directly send the list of students' names and scores to my colleagues by WeChat without careful consideration." These cases support the survey result that the mean score of digital security protection (M = 4.36) is slightly lower than that of legal and ethical norms (M = 4.46), indicating that although the teachers' normative awareness is generally high, their security behaviors in daily activities need to be strengthened and standardized.

3.2.5. Professional development

The professional development part evaluates the teachers' capability to participate in lifelong learning, instructional research and technological improvements. The questionnaire indicates an average score of 4.33,

suggesting an overall satisfactory achievement (**Table 11**).

Table 11. Descriptive statistics of professional development of university teachers in Chengdu

Item	N	Min	Max	Mean	SD
Digital Learning and Professional Training	240	1	5	4.38	0.921
Digital Teaching Research and Innovation	240	1	5	4.28	0.874

University professors show a good understanding of the influence of digitalization on professional improvement. The scores for digital instruction and professional training were the highest (M = 4.38), showing that teachers are usually ready to improve their digital teaching abilities by means of online training and e-learning courses. However, the score for digital teaching research and innovation was lower (M = 4.28), indicating that there is potential for teachers to increase their participation and creativity in conducting such research and practice.

The interviews indicated the differences in the professional progress of the teachers. T3 said, "I often take part in new technology courses on Bilibili and other websites and read research papers on digital teaching; I think that keeping up to date is very important, or else one may be easily left behind." This indicates that the intermediate teachers have a strong urge to improve themselves in their profession. However, some teachers believed that the digital training provided by their school had little practical value. T2 pointed out, "Our university conducts a digital teaching training every year, but the main topics concentrate on the operation of the platform; there is almost no guidance on the establishment of a real digital course or the application of data to improve teaching. There is a great gap between the training and the actual needs." T7 also mentioned, "My research work is already very busy; if one wants to learn systematically about the innovation in digital teaching, it is difficult to find time, and the motivation is not strong enough. It is also hard to manage the present courses properly." From these remarks, it can be observed that the obstacles to professional development come from both the individual's time and motivation as well as the shortcomings of the institution in arranging the digital training programs — particularly in providing more specialized and substantial professional assistance during the short training period.

3.3. Differential analyses of university teachers' digital literacy

To investigate the influences of various background factors on the digital literacy of university teachers, we carried out differential analyses in six aspects: gender, educational background, age, teaching experience, professional rank, and disciplinary background. The findings show that there is no statistically significant difference between gender and educational background in affecting digital literacy, while age, teaching experience, and professional rank have more notable influences.

3.3.1. Gender differences in digital literacy

Independent samples t-tests revealed no statistically significant gender differences across any dimension of digital literacy ($P > 0.05$), indicating that gender is not a primary determinant of digital literacy among university teachers (**Table 12**). In the digital awareness dimension, male and female teachers scored similarly, reflecting broadly comparable levels of academic literacy, educational philosophy, and receptiveness to digital teaching. Although male teachers scored marginally higher in digital technology knowledge and skills and digital application, the differences were negligible and non-significant; as digital instruction in

universities is still in an early stage of widespread adoption, the low operational threshold for teaching tools and comprehensive institutional digital training coverage means that no gender gap has yet emerged in technology proficiency or daily application. Female teachers performed slightly better in digital social responsibility and professional development, which may be partly attributable to the concentration of female teachers in arts and humanities disciplines in this study—disciplines that place greater emphasis on professional norms and development—yet the inter-group differences remain small. Overall, digital literacy among university teachers is more substantially shaped by disciplinary background, teaching experience, and digital training history, with individual differences attributable to gender being minimal.

Table 12. Independent samples T-test: Digital literacy differences by gender

Dimension	Gender	Mean	SD	t	*P*	Sig.
Digital Awareness	Male	4.25	0.811	-0.620	0.536	n.s.
	Female	4.28	0.800			
Digital Technology Knowledge & Skills	Male	4.22	0.731	0.196	0.845	n.s.
	Female	4.20	0.775			
Digital Application	Male	4.20	0.651	0.162	0.871	n.s.
	Female	4.19	0.705			
Digital Social Responsibility	Male	4.39	0.762	-0.485	0.628	n.s.
	Female	4.42	0.799			
Professional Development	Male	4.32	0.760	-0.230	0.818	n.s.
	Female	4.34	0.772			

Note: n.s. = not significant ($P > 0.05$)

3.3.2. Educational background differences in digital literacy

The findings show that there are considerable differences in the levels of digital literacy among teachers from different educational backgrounds ($P < 0.05$), especially that the doctoral degree holders score much higher than those with master's degrees in all aspects (**Table 13**). In reality, doctoral degree holders usually bear more research duties and often use various digital software, data processing devices, and online academic resources frequently, so they have gained more experience in digital knowledge, technical abilities, and applications in teaching and research, resulting in better performance. On the other hand, the master's degree teachers in this sample are mainly distributed in the fields of arts and humanities, where lectures are the main teaching method, and they do not rely much on advanced digital tools and research-oriented technologies, which may affect the average score of the group. Moreover, doctoral degree teachers exhibit greater maturity in the planning of professional development and digital ethics, leading to their higher scores in digital awareness and digital social responsibility. In summary, the results indicate that higher educational qualifications are related to better overall digital literacy.

Table 13. T-test: Digital literacy differences by educational background

Dimension	Education	Mean	SD	t	*P*	Sig.
Digital Awareness	Master's	4.26	0.795	-2.316	0.021	*
	Ph.D.	4.39	0.762			
Digital Technology Knowledge & Skills	Master's	4.21	0.758	-2.452	0.015	*

	Ph.D.	4.35	0.725			
Digital Application	Master's	4.18	0.696	-2.462	0.010	*
	Ph.D.	4.33	0.671			
Digital Social Responsibility	Master's	4.37	0.788	-2.285	0.023	*
	Ph.D.	4.48	0.751			
Professional Development	Master's	4.32	0.779	-2.368	0.018	*
	Ph.D.	4.45	0.743			

Note: * $P < 0.05$

3.3.3. Age differences in digital literacy

Significant age-group differences in digital literacy were observed across all dimensions ($P < 0.05$), with a clearly stratified age pattern (**Table 14**). Teachers aged 31–40 scored highest across all dimensions, followed by those aged 30 and below, then those aged 41–50, with teachers aged 51 and above scoring lowest. As the core workforce in university teaching and research, teachers aged 31–40 tend to have higher educational credentials, regularly rely on digital platforms and specialized software for coursework, research projects, and academic exchange, and more actively engage in technology-enhanced teaching training. Younger teachers (≤30) grew up in a digitally pervasive environment, demonstrate high receptivity to emerging internet tools and teaching platforms, and are quick adopters, yet their limited teaching and research experience places their overall performance slightly below that of mid-career teachers. Teachers aged 41 and above possess solid instructional experience and professional self-discipline, but their long-established traditional pedagogical patterns are difficult to transform rapidly; coupled with the higher proportion of arts and humanities teachers in this subsample, who have less demand for advanced digital tools, performance in digital knowledge and instructional application weakens progressively with age. Notably, inter-group differences in digital social responsibility are relatively small, suggesting that university teachers across age groups maintain sound digital ethical awareness and professional self-regulation.

Table 14. One-way ANOVA: Digital literacy differences by age group

Dimension	Age Group	Mean	SD	F	*P*	Sig.
Digital Awareness	≤30	4.31	0.775	3.426	0.018	*
	31–40	4.38	0.752			
	41–50	4.29	0.783			
	≥51	4.21	0.796			
Digital Technology Knowledge & Skills	≤30	4.25	0.746	3.715	0.012	*
	31–40	4.34	0.721			
	41–50	4.22	0.758			
	≥51	4.14	0.772			
Digital Application	≤30	4.23	0.685	3.862	0.009	**
	31–40	4.32	0.663			
	41–50	4.20	0.712			
	≥51	4.11	0.730			
Digital Social Responsibility	≤30	4.40	0.768	2.953	0.033	*
	31–40	4.47	0.745			
	41–50	4.39	0.774			

	≥51	4.34	0.788			
Professional Development	≤30	4.36	0.759	3.541	0.016	*
	31–40	4.43	0.736			
	41–50	4.33	0.767			
	≥51	4.27	0.781			

Note: * $P < 0.05$; ** $P < 0.01$

3.3.4. Teaching experience differences in digital literacy

Digital literacy has shown statistically significant differences among different teaching experience groups in digital awareness, digital technology knowledge and skills, and digital application ($P < 0.05$), which follows an inverted-U pattern with higher scores in the middle group and lower scores at the other ends (**Table 15**).

Moreover, the teachers who have 11–15 years of experience showed the best results in digital application (M = 4.29, SD = 0.859) and professional development (M = 4.46, SD = 0.662), with small standard deviations indicating both a high general level of digital literacy and uniform performance in this category. These teachers combine experienced teaching methods with good abilities in digital learning and adaptation, which facilitates the proper combination of educational skills and digital technology - thus making them the top group in the improvement of digital literacy.

Novice teachers with 0–5 years of experience, who are very interested in using digital technologies, obtained lower average scores and larger standard deviations (for example, SD = 1.045 in the digital application dimension), suggesting significant variations in their performance and continuous shortcomings in the organization of instruction and the compatibility of digital tools with teaching environments.

Teachers with 21 or more years of experience, influenced by long-entrenched traditional teaching models, scored lowest in digital awareness and digital technology knowledge and skills, lagging significantly behind mid-career peers in motivation and capacity for deep digital application.

Table 15. One-way ANOVA: Digital literacy differences by teaching experience

Dimension	Teaching Exp.	Mean	SD	F	*P*	Sig.
Digital Awareness	0–5 yrs	4.22	0.934	2.033	0.019	*
	6–10 yrs	4.41	0.937			
	11–15 yrs	4.39	0.731			
	16–20 yrs	4.34	0.678			
	≥21 yrs	4.03	0.991			
Digital Technology Knowledge & Skills	0–5 yrs	4.01	0.857	2.305	0.049	*
	6–10 yrs	4.20	0.914			
	11–15 yrs	4.28	0.724			
	16–20 yrs	4.34	0.574			
	≥21 yrs	3.99	0.896			
Digital Application	0–5 yrs	4.08	1.045	1.175	0.032	*
	6–10 yrs	4.19	0.834			
	11–15 yrs	4.29	0.859			
	16–20 yrs	4.26	0.618			
	≥21 yrs	4.06	0.848			

Digital Social Responsibility	0–5 yrs	4.23	1.127	1.551	0.188	n.s.
	6–10 yrs	4.35	0.914			
	11–15 yrs	4.49	0.690			
	16–20 yrs	4.48	0.652			
	≥21 yrs	4.29	0.974			
Professional Development	0–5 yrs	4.07	0.978	1.630	0.167	n.s.
	6–10 yrs	4.33	0.962			
	11–15 yrs	4.46	0.662			
	16–20 yrs	4.38	0.768			
	≥21 yrs	4.15	0.908			

Note: * $P < 0.05$; n.s. = not significant

3.3.5. Professional title differences in digital literacy

Significant variations in digital literacy were observed among different professional title groups in aspects of digital awareness, digital application, and professional development ($P < 0.05$; $P = 0.002$ for professional development, a highly significant difference), and the intermediate- and associate-senior-title teachers showed the greatest advantages in general (**Table 16**).

Moreover, the intermediate-title teachers showed a good level of digital awareness (M = 4.43) and digital application (M = 4.28, SD = 0.516), having both high mean scores and small standard deviations, which indicate a high degree of digital literacy and uniform performance. The associate-senior-title teachers were superior in digital application (M = 4.40), digital social responsibility (M = 4.50), and professional development (M = 4.48), thus being the best group in the aspect of digital literacy improvement. Both groups usually have heavy teaching and research tasks, often applying large language model platforms and intelligent teaching devices, and possess strong practical motivation and ability in the innovation and cooperation of digital teaching.

Senior-title teachers have a good performance in digital social responsibility (M = 4.29), but get fewer marks in digital application (M = 4.19) and professional development (M = 4.16) compared with intermediate and associate-senior teachers, indicating a conservative attitude towards deep digital application and instructional innovation. The initial-title teachers, although they accept new technologies, score below average in digital awareness (M = 4.26), digital application (M = 4.11), and professional development (M = 4.06), with larger differences in some respects (such as the standard deviation of professional development being 0.961), suggesting that their digital literacy has not reached a stable and mature application system yet.

Upon closer examination, the title-based differences in digital literacy fundamentally reflect differences in career development stage, instructional and research practice, and job requirements. Professional title is not a direct determinant of digital literacy, but rather an external marker of the professional identity acquired through sustained teaching practice and research accumulation—these process-driven practical experiences constitute the core driver of digital literacy development.

Table 16. One-way ANOVA: Digital literacy differences by professional title

Dimension	Title	Mean	SD	F	*P*	Sig.
Digital Awareness	Initial	4.26	0.903	4.965	0.020	*
	Intermediate	4.43	0.807			

	Associate Senior	4.14	0.652			
	Senior	4.39	0.931			
Digital Technology Knowledge & Skills	Initial	4.45	0.714	4.135	0.070	n.s.
	Intermediate	4.33	0.956			
	Associate Senior	3.97	0.609			
	Senior	4.20	0.876			
Digital Application	Initial	4.11	0.930	3.102	0.027	*
	Intermediate	4.28	0.516			
	Associate Senior	4.40	0.811			
	Senior	4.19	0.686			
Digital Social Responsibility	Initial	4.41	0.883	2.452	0.064	n.s.
	Intermediate	4.32	0.760			
	Associate Senior	4.50	0.916			
	Senior	4.29	0.776			
Professional Development	Initial	4.06	0.961	5.057	0.002	**
	Intermediate	4.33	0.649			
	Associate Senior	4.48	0.862			
	Senior	4.16	0.778			

Note: * $P < 0.05$; ** $P < 0.01$; n.s. = not significant

3.3.6. Disciplinary background differences in digital literacy

Statistically significant differences were found in the five digital literacy dimensions among teachers from the four disciplines—arts and humanities, science and engineering, economics and management, and medicine and agriculture ($P < 0.05$) (**Table 17**). The scores of science and engineering teachers were the highest, followed by medicine and agriculture teachers in descending order, then economics and management teachers, and finally arts and humanities teachers, who obtained the lowest scores in all dimensions.

These distinctions in discipline are due to the different teaching and researching methods in each field. Science and engineering teachers usually make use of special software, data processing devices, and information-based experimental setups in their regular classes and research, which helps to develop a better understanding of digital knowledge and practical application. Whereas the medical and agricultural teachers frequently apply virtual simulation experiments, specific databases, and online academic resources, thus offering more varied digital application environments. As for the economics and management teachers, they mainly depend on statistical software and online practical training systems, and have an intermediate level of digital ability. In contrast, the art and humanities teaching is mainly conducted by lectures and offline creative activities, and there is a low requirement for special digital equipment; moreover, the considerable number of art and humanities teachers in the present sample lowers the average score in all aspects.

Digital social responsibility scores are very high and are clustered together in different fields (science and engineering: 4.46; medicine and agriculture: 4.43; economics and management: 4.41; arts and humanities: 4.37), showing little difference among the fields. This indicates that the teachers from all the fields have good digital ethical sense and can regulate their own behavior, which is influenced by the common professional training environment of higher education. The field of study mainly affects the digital technology ability and teaching application capability of the teachers, but its influence on digital social responsibility is relatively small, which has practical significance for the planning of personalized training programs.

Table 17. One-way ANOVA: Digital literacy differences by disciplinary background

Dimension	Discipline	Mean	SD	F	*P*	Sig.
Digital Awareness	Arts & Humanities	4.26	0.785	3.382	0.020	*
	Sci. & Engineering	4.39	0.746			
	Econ. & Management	4.33	0.762			
	Med. & Agriculture	4.36	0.751			
Digital Technology Knowledge & Skills	Arts & Humanities	4.19	0.773	3.756	0.013	*
	Sci. & Engineering	4.34	0.725			
	Econ. & Management	4.27	0.743			
	Med. & Agriculture	4.31	0.732			
Digital Application	Arts & Humanities	4.17	0.728	3.915	0.009	**
	Sci. & Engineering	4.32	0.674			
	Econ. & Management	4.25	0.695			
	Med. & Agriculture	4.29	0.683			
Digital Social Responsibility	Arts & Humanities	4.37	0.791	2.876	0.036	*
	Sci. & Engineering	4.46	0.748			
	Econ. & Management	4.41	0.765			
	Med. & Agriculture	4.43	0.754			
Professional Development	Arts & Humanities	4.29	0.782	3.453	0.018	*
	Sci. & Engineering	4.42	0.736			
	Econ. & Management	4.36	0.753			
	Med. & Agriculture	4.39	0.742			

Note: * $P < 0.05$; ** $P < 0.01$

4. Discussion

4.1. Structural imbalance in overall performance and theoretical interpretation

The average digital literacy score for university teachers in Chengdu is 4.28, showing a relatively high level; however, there exists an obvious imbalance in different aspects: the scores of digital social responsibility (M = 4.41) and professional development (M = 4.33) are higher, whereas those of digital application (M = 4.19) and digital technology knowledge and skills (M = 4.20) are relatively lower. The situation of "strong normative cognition and weak technological application" is presented in all the sub-aspects—the willingness is higher than the cognition, the skills are higher than the knowledge, the implementation is higher than the design, and the legal norms are higher than the security practice, indicating that the transition from "knowing" to "doing" and from "awareness" to "deep application" is the most significant structural weakness in the present digital literacy improvement of university teachers. From the theoretical point of view, both Self-Efficacy Theory and Technology Acceptance Model (TAM) suggest that the perceived usefulness being greater than the perceived ease of use is an important mechanism leading to the structural differences between awareness and application [2]. In addition, the interview results confirm the main conclusion that the deficiencies in the digital literacy of teachers are not due to attitude resistance, but are fundamentally caused by the systematic institutional problems, such as the lack of practical training systems, insufficient guidance on digital instructional design, and the division of platform interoperability mechanisms. This will have a direct influence on the formulation of the institutional digital training policies: the focus should be changed

from “promoting awareness” to “strengthening capability”, with practical support as the main tool to bridge the transformational gap between awareness and application.

4.2. Discussion of the effects of demographic variables

There is no significant effect of gender ($P > 0.05$), indicating that the policy resources should be focused on other variables that have greater differential influences, such as disciplinary background and teaching experience. The positive role of educational background mainly acts through the long-term and frequent use of special digital tools by doctoral students—“the internalization of digital skills promoted by research practice” is the main causal link, suggesting that university training should improve a “digital skill integration oriented” method. The non-linear relationship between age and digital literacy (with the best performance shown by teachers aged 31–40) supports the “career prime” hypothesis; the usage frequency driven by demands is the key mechanism for ability formation. For the senior teachers aged 51 and over, their poor performance is not only due to the decreased technology acceptance, but also to the cognitive inertia in terms of pedagogical values, which requires peer learning and case study seminars as the priority way to facilitate concept renewal. The inverted-U shaped effect of teaching experience shows different intervention requirements for the novice teachers (whose training system cannot meet the need of digital instructional design) and the experienced teachers (which show cognitive inertia); the differences in professional titles indicate the demand-driven distinctions across the career development stages; and the disciplinary differences act mainly through the disciplinary culture and the habitual use of digital tools in practice, which provide a basis for individualized training methods.

4.3. Limitations and future directions

This investigation has some disadvantages. Firstly, the sample consists of only four universities in Chengdu, which leads to a high degree of homogeneity in both geographical and institutional aspects; it is advisable to be careful when extending the results to other situations. Secondly, the use of self-report methods might cause subjective cognitive bias; in the future, objective performance indices, such as observations of digital teaching habits and student evaluation data, should be used for verification. Thirdly, the cross-sectional design does not allow for the longitudinal study of the changing process of digital literacy; further longitudinal research will be helpful in clarifying the causal relationships among the variables. Although there are these shortcomings, this study uses the MoE standard as its measurement basis to systematically reveal the actual level and the differences between groups of university teachers’ digital literacy in our local Chinese environment, offering an important starting point for subsequent research.

5. Conclusion

Based on the MoE industry standard Teacher Digital Literacy as a research framework, this investigation used a mixed-methods approach to thoroughly investigate the digital literacy level and group differences among 240 professors from four universities in Chengdu. The main findings are as follows.

Initially, the general digital competence of university teachers in Chengdu is at a relatively high level ($M = 4.28$), but there exists a significant structural disparity, particularly in the situation of “strong normative understanding and weak practical use”, which is observed in all aspects. The cause of this structural deficiency lies in the lack of practical training systems and the disunity of platform interconnections;

therefore, the improvement of digital competence should be changed from "raising awareness" to "increasing ability."

Second, there is no statistically significant difference between genders in digital literacy ($P > 0.05$); hence, the policy resources should be mainly allocated to the variables showing greater variations, like disciplinary background and teaching experience.

Furthermore, an educational background has a significant positive influence, in which doctoral degree holders show better performance than those with master's degrees in all aspects ($P < 0.05$). The main causal relationship — "research experience leading to the acquisition of digital skills" — suggests that the university training programs should focus more on a "research-oriented integration of digital skills."

Moreover, the relation between age and digital literacy is not in direct proportion, where the teachers aged 31–40 have the highest general ability and those aged 51 and above exhibit poorer performance. Their poor results are caused by the effect of cognitive inertia on educational values; therefore, appropriate intervention measures for different ages are required.

Fifth, the relation between teaching experience and digital literacy is in an inverted-U shape, and teachers with 11–15 years of experience show the best performance. The weaknesses of the new teachers indicate the lack of systematic guidance on digital instructional design in the training courses; the experienced teachers need a renewal of value as a must, and both categories require different and specific measures of intervention.

Sixth, intermediate- and associate-senior-title teachers demonstrate the strongest overall digital literacy; full professors perform more conservatively; and initial-title teachers exhibit the greatest internal differentiation. Professional title serves as an external marker of cumulative practical experience, with "demand driven by career development stage" constituting the core explanatory variable.

Seventh, disciplinary background exerts a significant and systematic influence on digital literacy, following a gradient pattern of science and engineering > medicine and agriculture > economics and management > arts and humanities ($P < 0.05$). Disciplinary culture and the everyday embeddedness of digital tools in practice are the primary mechanisms; the comparatively small inter-disciplinary gap in digital social responsibility—shaped by the shared professional environment of higher education—provides an important basis for designing differentiated training strategies.

In conclusion, institutional administrators ought to establish a diversified and targeted digital literacy improvement system: taking disciplinary background as the basic unit, teaching experience and professional title as classification criteria, and following the sequence of "tool practice → curriculum integration → value renewal" for ability building, to carry out the corresponding policies in an integrated way. Further studies may increase the sample size, include longitudinal investigation methods and objective assessment indices, and clarify the causal processes by which each factor influences the development of teachers' digital literacy.

Funding

This work was supported by the Sichuan Association of Higher Education (Grant NO.SZJJ2024YB-047)

Disclosure statement

The authors declare no conflict of interest.

References

[1] Ministry of Education of the People's Republic of China, 2022, Teacher Digital Literacy (Industry Standard). Ministry of Education, Beijing.

[2] Davis FD, 1989, Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. MIS Quarterly, 13(3): 319–340.