

Digital Literacy in Early Childhood Education for Career-Phase Teachers: Evidence from Northwest China's Resource-disparity Region

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Abstract:

Background: The swift advancement of educational technology has made educational digitization a key factor propelling worldwide educational reform. Digital technology is having a 0significant impact on early childhood education by altering instructional strategies, educational concepts, and the design of learning settings. It is generally accepted that one of the most important factors in raising the standard of early childhood education is teachers' digital literacy. Systematic research on the current level of digital literacy among kindergarten teachers in areas with notable resource disparities, particularly those with limited resources, is still lacking, despite the international community's growing emphasis on the development of such abilities. **Methods:** The Digital Literacy Scale (*Cronbach's $\alpha = 0.968$*) was given to 671 kindergarten teachers in Lanzhou City using convenience sampling in this study. The effects of organizational and demographic characteristics on teachers' digital literacy were investigated using Tukey HSD post hoc tests and single-factor analysis of variance. **Results:** Overall, Lanzhou City kindergarten teachers exhibited intermediate digital literacy, with structural differences between dimensions. Digital awareness scored highest, followed by professional development and social responsibility, and application scored lowest. Age, the kindergarten's location, its type (public or private), whether the teacher has computer experience, their highest academic degree, and gender did not significantly affect their digital literacy. Professional title, position, teaching experience, education, and kindergarten grade affect kindergarten teachers' digital literacy. Municipal model kindergarten teachers score higher than teachers at other kindergartens; first-level professional title teachers score the lowest; lead teachers have higher digital literacy than assistant teachers; associate degree or higher teachers score higher than high school or vocational school diploma teachers; and novice (0-3 years) and senior (20+ years) teachers score higher. **Implications:** The empirical results of this study offer the following insights to help kindergarten teachers build digital literacy: First, the tiered training system must be restructured to meet teachers' career growth cycles, taking into account the U-shaped relationship between teaching experience and digital competence. Second, since local demonstration kindergarten instructors are more digitally literate, new regional resource sharing and allocation methods could lessen the digital divide across

kindergartens. Finally, to break the promotion logic that prioritizes seniority over technical proficiency, a special fund for technological exploration could be created and digital literacy could be included in the core criteria for professional title evaluations.

Keywords:

Digital Literacy, Kindergarten Teachers, Urban Northwest China, Teacher Professional Development, Educational Management

1. Introduction

In recent years, educational digitization has become a core driving force behind global educational reform. Digital technology is significantly changing teaching concepts, methodologies, and environmental construction models, particularly in the field of early childhood education. It is important to note that digital literacy has emerged as the primary component of 21st-century teacher professional competency, having a direct impact on kids' social and cognitive development in the age of intelligence. This change is especially critical in the Chinese setting. Improving teachers' digital literacy is a "foundational task" in creating an education powerhouse, according to the Ministry of Education's July 2025 "Notice on the Action Plan for Empowering Teacher Development through Digitalization." According to the Ministry of Education of the People's Republic of China, it also mandates that "teachers' digital literacy be comprehensively enhanced, and the proficient application of digital tools in education and teaching become the new norm" within three to five years [18]. Gilster originally defined "digital literacy" as "the critical ability to understand and use complex information presented by computers" [8], when he first used the word in 1997. International organizations and scholars have broadened this concept beyond merely technical skills as technology continues to advance and societal needs change. Instead, they emphasize the information capabilities and value realization of individuals in their civic life, professional endeavors, and personal development [9]. As a result, digital literacy has expanded beyond its limited technological use and is now a major force behind educational change, progressively becoming integrated into educational systems. In light of this, governments and academic institutions across numerous nations have released frameworks for teacher digital literacy in an effort to methodically describe its essential elements. Despite minor differences, these frameworks generally concur that teacher digital literacy covers five essential areas: digital instructional design, digital content creation, digital communication and collaboration, digital safety and ethics, and digital assessment. These three dimensions are knowledge, skills, and attitudes [22].

The two main areas of current research on kindergarten teachers' digital literacy are the creation of comprehensive evaluation frameworks [2,6,15] and practical investigations of digital tool applications in education, which include the real-world use of various digital technologies or applications in kindergarten classrooms [12,23,24] as well as the difficulties teachers face [1,4,12]. These studies provide crucial evidence for the development of effective teacher training approaches. Furthermore, studies show that children's language development [17], computational thinking, self-regulation abilities [20], and mental health [17] are all much enhanced

by digital surroundings. However, instructors' levels of digital literacy have a significant impact on how well students develop their digital competencies [3].

However, the following issues remain with current research: First, the research subjects are primarily university and primary school instructors [7,14], with kindergarten teachers receiving less attention and the geographic coverage being inconsistent. Second, research on in-service teachers, especially those with longer tenure, discussing their digital adaption and support pathways is still lacking. This is because current techniques have mostly concentrated on pre-service teacher preparation [5]. The five main components of the Chinese Ministry of Education's 2022 "Teacher Digital Literacy" standards—digital awareness, digital technology knowledge and skills, digital application, digital social responsibility, and professional development—form the basis of this study [19]. It asks the following study questions and focuses on the group of in-service kindergarten teachers in Lanzhou City, Gansu Province, in western China:

(1) How well do kindergarten teachers in this area perform across the five characteristics of digital literacy, and what is their total level?

(2) Do instructors with varied demographic characteristics (gender, age, years of teaching experience, educational background, major, professional title, kind of kindergarten, location, etc.) differ significantly in the aspects of digital literacy?

2. Methods

2.1. Research Design

The convenience sampling principle was used to choose research participants for this study, which used a questionnaire survey method. An online questionnaire platform called "QuestionStar" was used to survey frontline teachers in kindergartens of various types (such as public and private) and in various regions (as indicated by administrative boundaries) in Lanzhou City, Gansu Province, after gaining participants' informed consent and guaranteeing data anonymity and confidentiality. The purpose of the poll was to thoroughly evaluate the region's kindergarten teachers' true level of digital literacy. The period of data collecting in 2025 was May through July.

2.2. Sample Characteristics

A total of 750 questionnaires from kindergarten teachers were gathered for this investigation. Following screening, questions that had response durations less than 105 seconds, logical errors, or response patterns were deemed invalid. 671 valid questionnaires were eventually collected, yielding an effective response rate of 89.47%. The collection of all eligible samples, which showed strong regional representativeness, came from Lanzhou City in Gansu Province in western China. Table 1 provides specific information about the samples' distribution. At 75.1%, women make up the majority of the gender mix, whereas men make up 24.9%. The largest age distribution of teachers is under 25 (38.6%), followed by those between 25 and 35 (21.9%), 36 and 46 (20.0%), and under 46 (19.5%).

Table 1. Descriptive statistics of demographic information.

Variable	Category	Frequency	Percentage
Gender	Male	167	24.9
	Female	504	75.1
Age	Under 25	259	38.6
	25-35	147	21.9
	36-46	134	20.0
	46 years old and above	131	19.5
Education Level	High School/Vocational School	25	3.7
	Junior College	237	35.3
	Bachelor's Degree	332	49.5
	Master's Degree	77	11.5
Major	Early Childhood Education-Related Major	415	61.8
	Other Teacher Education Majors	157	23.4
	Non-teacher education majors	99	14.8
Position	Assistant teacher	468	69.7
	Lead teacher	203	30.3
Professional title	Unclassified	357	53.2
	Second-level kindergarten teacher	160	23.8
	First-level kindergarten teacher	124	18.5
	Senior Kindergarten Teacher	30	4.5
Years of Teaching Experience	3 years or less	271	40.4
	3-10 years	153	22.8
	11-20 years	154	23.0
	Over 20 years	93	13.9
Computer-related academic background	No	284	42.3
	Yes	387	57.7
Location of kindergarten	Municipal district	434	64.7
	County	169	25.2
	Functional zone	68	10.1
Type of kindergarten	Public kindergarten	487	72.6
	Private kindergarten	184	27.4
	Unrated	188	28.0
Kindergarten level	Level 3 kindergarten	192	28.6
	Level 2 kindergarten	126	18.8
	Level 1 kindergarten	77	11.5
	Municipal model kindergarten	45	6.7
	Provincial model kindergarten	43	6.4

Bachelor's degree holders make up the largest percentage of those with educational attainment (49.5%), followed by associate degree holders (35.3%), postgraduate degree holders (11.5%), and high school/vocational school graduates (3.7%). Regarding professional background, early childhood education-related programs accounted for 61.8% of teacher graduates, followed by other teacher education programs (23.4%) and non-teacher education programs (14.8%). As for employment titles, 30.3% are lead instructors and 69.7% are assistant teachers. Teachers without a recognized title make up the largest percentage of professional titles (53.2%), followed by second-level kindergarten teachers (23.8%), first-level kindergarten teachers (18.5%), and senior kindergarten teachers (4.5%). The majority of teachers (40.4%) have fewer than three years of experience, followed by those with three to ten years (22.8%), eleven to twenty years (23.0%), and more than twenty years (13.9%). 57.7% of instructors said they had "learned" from their computer-based learning experience, whilst 42.3% said they had "not learned." Geographically, 10.1% of

teachers are found in functional zones, 25.2% in rural counties, and 64.7% in urban districts. In terms of kindergarten type, 27.4% of instructors work in private kindergartens, while 72.6% work in public kindergartens. Of all kindergarten classes, Grade 3 kindergartens have the largest percentage of instructors (28.6%), while provincial demonstration kindergartens have the lowest percentage (6.4%).

2.3. Instrumentation

The five core dimensions—digital awareness, digital technology knowledge and skills, digital application, digital social responsibility, and professional development—described in the Chinese Ministry of Education’s 2022 “Teacher Digital Literacy Standards” served as the primary basis for the questionnaire used in this study. Additionally, Wang Xiaoyue’s pertinent questionnaire was consulted [21]. The researchers appropriately reworded some items to match the job context, linguistic habits, and comprehension skills of kindergarten instructors after carefully examining the substance of the standard items. The goal of these modifications is to make the items’ linguistic style more appropriate for kindergarten instructors’ cognitive traits while maintaining the items’ semantic value. Basic information on kindergarten teachers and an evaluation of their present level of digital literacy make up the two primary sections of the questionnaire. Digital awareness (7 things), digital technology knowledge and abilities (3 items), digital application (14 items), digital social responsibility (8 items), and professional development (3 items) are among the characteristics and amount of items included in the section on digital literacy status assessment. All other items, with the exception of the basic information section, are scored on a five-point Likert scale, with values ranging from 1 to 5 with responses ranging from “strongly disagree” to “strongly agree.” Teachers with higher ratings have higher levels of digital literacy. The scale’s dependability needs to be confirmed because it was created using data from earlier research surveys. According to reliability testing, the questionnaire scale’s overall Cronbach’s alpha coefficient was 0.964, which is higher than 0.9. This suggests that the questionnaire has good internal consistency and may be used to gauge kindergarten teachers’ digital literacy.

3. Results

3.1. Current Status of Digital Literacy (RQ1)

Table 2 displays the findings of the descriptive statistical analysis about the digital literacy of preschool teachers. The average score for teachers’ digital literacy (DL) was 3.52 ($SD = 0.79$), which is slightly above average generally and higher than the scale’s theoretical midpoint of 3 points. The Digital Social Responsibility dimension came in third place ($M = 3.52$, $SD = 0.85$); the Digital Awareness dimension had the highest mean score ($M = 3.78$, $SD = 0.88$); the Professional Development dimension came in second ($M = 3.76$, $SD = 0.90$); the Digital Technology Knowledge and Skills dimension ($M = 3.28$, $SD = 0.93$) and the Digital Application dimension ($M = 3.24$, $SD = 0.82$) had comparatively lower scores, and the Digital Application dimension had the lowest mean score.

Table 2. Descriptive statistics for each dimension of digital literacy among kindergarten teachers.

Dimension	Mean	Standard Deviation
Digital Awareness	3.78	0.88
Digital Technology Knowledge and Skills	3.28	0.93
Digital Application	3.24	0.82
Digital Social Responsibility	3.52	0.85
Digital Professional Development	3.76	0.90
Digital Literacy	3.52	0.79

3.2. Differences in Digital Literacy by Background Variables (RQ2)

Variables like age, the region in which the kindergarten is located, the type of kindergarten (public or private), whether the teacher has experience in computer-related fields, the category of the highest academic degree earned, and gender do not significantly affect the digital literacy of kindergarten teachers, according to the results of the one-way analysis of variance (ANOVA) and Tukey HSD post hoc test. On the other hand, digital literacy levels are highly influenced by teaching experience, kindergarten grade, teacher title, position occupied, and educational attainment. These variables show statistically significant variations across groups, suggesting that they have a significant impact on teachers' levels of digital literacy.

3.2.1. Differences in Digital Literacy Among Kindergarten Teachers of Different Teaching Experience Groups

Table 3 indicates a “U-shaped” distribution trend with significant variations in digital literacy between teaching experience groups ($F = 5.556$, $\eta^2 = 0.024$). In other words, teachers in the intermediate stage score lower on digital literacy tests, while those with the shortest and longest teaching experience score higher. Teachers with more than 20 years of experience have the highest specific ratings, followed by recently hired teachers with fewer than three years of experience, and teachers with three to ten years of experience have the lowest results. Significant variations in literacy development were also observed within the mid-career teacher group, as evidenced by the fact that teachers with 3–10 years of teaching experience had the largest individual variation in literacy levels ($SD = 0.98$), while those with over 20 years of teaching experience had the most concentrated distribution ($SD = 0.46$). Significant differences were also found between the four groups of teaching experience, according to the Tukey Honestly Significant Difference (HSD) post-hoc test ($\alpha = 0.05$) (Table 4). The group with 3–10 years of experience had significantly lower digital literacy ($M = 3.31$) than the group with less than 3 years of experience ($MD = -0.262$, $p = .001$), the group with more than 20 years of experience ($MD = -0.384$, $p < .001$), and the group with 11–20 years of experience ($MD = -0.189$, $p = .036$). There were no statistically significant differences between the other teaching experience groups.

Table 3. Analysis of variance of teachers' years of service on digital literacy levels.

Age	Number of people	Average	Standard deviation	F value	Significance	Partial Eta square
3 years or less	271	3.57	0.64	5.556	< .001	0.024
3-10 years	153	3.31	0.98			
11-20 years	154	3.50	0.95			
Over 20 years	93	3.70	0.46			

Table 4. Post-hoc comparison of teaching experience groups.

Teaching experience (I)	Teaching experience (J)	Mean difference (I - J)	Standard error	Significance
3 years or less	3-10 years	.262*	.080	0.001
	11-20 years	.073	.079	0.360
	Over 20 years	-.122	.094	0.198
3-10 years	3 years or less	-.262*	.080	0.001
	11-20 years	-.189*	.090	0.036
	Over 20 years	-.384*	.103	< .001
11-20 years	3 years or less	-.073	.079	0.360
	3-10 years	.189*	.090	0.036
	Over 20 years	-.195	.103	0.060
Over 20 years	3 years or less	.122	.094	0.198
	3-10 years	.384*	.103	< .001
	11-20 years	.195	.103	0.060

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

3.2.2. Differences in Digital Literacy Among Kindergarten Teachers Across Different Kindergarten Levels

Table 5 demonstrates that teachers' digital literacy is significantly impacted by kindergarten level ($F = 3.844$, $p = 0.002$, $\eta^2 = 0.028$). There is a general trend toward "higher level, stronger literacy" when examining the average scores of teachers at various levels. In particular, first-level kindergartens ($M = 3.49$) > unrated kindergartens ($M = 3.48$) > third-level kindergartens ($M = 3.44$), municipal demonstration kindergartens ($M = 3.91$), provincial model kindergartens ($M = 3.73$), and second-level kindergartens ($M = 3.53$). There were notable internal variations in digital literacy levels among these, with unrated kindergartens showing the highest score variability ($SD = 0.85$) and third-level kindergartens having the lowest scores. Digital literacy was significantly higher among teachers in municipal model kindergartens than among teachers in unrated, third-level, second-level, and first-level kindergartens ($p < 0.01$), according to post-hoc comparisons (Table 6); teachers in provincial model kindergartens scored significantly higher than those in third-level kindergartens ($p = 0.013$). These findings imply that higher-level kindergartens' institutional support, resource guarantees, and teacher professional development processes can offer advantageous circumstances for improving their students' digital literacy.

Table 5. Analysis of variance of digital literacy levels by kindergarten level.

Kindergarten level	Number of people	Average	Standard deviation	F value	Significance	Partial Eta square
Unrated	188	3.48	0.85	3.844	0.002	0.028
Level 3 kindergarten	192	3.40	0.81			
Level 2 kindergarten	126	3.53	0.70			
Level 1 kindergarten	77	3.49	0.72			
Municipal model kindergarten	45	3.91	0.77			
Provincial model kindergarten	43	3.73	0.76			

Table 6. Kindergarten Level—Post-Comparison.

Kindergarten level(I)	Kindergarten level(J)	Mean difference (I - J)	Standard error	Significance
Unrated	Level 3 kindergarten	.078	.081	.331
	Level 2 kindergarten	-.052	.090	.568
	Level 1 kindergarten	-.013	.106	.901
	Municipal model kindergarten	-.432*	.130	.001
	Provincial model kindergarten	-.251	.133	.059
Level 3 kindergarten	Unrated	-.078	.081	.331
	Level 2 kindergarten	-.130	.090	.149
	Level 1 kindergarten	-.092	.106	.387
	Municipal model kindergarten	-.510*	.130	.000
	Provincial model kindergarten	-.330*	.133	.013
Level 2 kindergarten	Unrated	.052	.090	.568
	Level 3 kindergarten	.130	.090	.149
	Level 1 kindergarten	.038	.114	.736
	Municipal model kindergarten	-.380*	.136	.005
	Provincial model kindergarten	-.200	.139	.151
Level 1 kindergarten	Unrated	.013	.106	.901
	Level 3 kindergarten	.092	.106	.387
	Level 2 kindergarten	-.038	.114	.736
	Municipal model kindergarten	-.419*	.147	.005
	Provincial model kindergarten	-.238	.150	.112
Municipal model kindergarten	Unrated	.432*	.130	.001
	Level 3 kindergarten	.510*	.130	.000
	Level 2 kindergarten	.380*	.136	.005
	Level 1 kindergarten	.419*	.147	.005
	Provincial model kindergarten	.180	.168	.282
Provincial model kindergarten	Unrated	.251	.133	.059
	Level 3 kindergarten	.330*	.133	.013
	Level 2 kindergarten	.200	.139	.151
	Level 1 kindergarten	.238	.150	.112
	Municipal model kindergarten	-.180	.168	.282

3.2.3. Differences in Digital Literacy Among Kindergarten Teachers of Different Titles

Teachers with different titles had significantly variable levels of digital literacy, as Table 7 illustrates ($F = 4.838$, $p = 0.002$). Kindergarten instructors with the senior title had the highest score ($M = 3.71$), while those with the first-level title had the lowest ($M = 3.28$). Teachers with the lowest professional title scored significantly lower than those without a professional title, significantly lower than those with a second-level professional title, and even more significantly lower than those with a senior professional title, according to the results of the Tukey HSD post hoc test. Other groups with professional titles did not differ significantly, especially those

without a professional title and those with the second-level professional title, whose scores were quite close ($MD = 0.007$).

Table 7. Analysis of variance of digital literacy levels by professional title.

Professional title	Number of people	Average	Standard deviation	F value	Significance	Partial Eta square
Unclassified	357	3.56	0.69	4.838	0.002	0.021
Second-level kindergarten teacher	160	3.56	0.86			
First-level kindergarten teacher	124	3.28	0.88			
Senior Kindergarten Teacher	30	3.71	1.04			

Table 8. Post-hoc comparison of titles.

Professional title(I)	Professional title(J)	Mean difference (I - J)	Standard error	Significance
Unclassified	Second-level kindergarten teacher	.007	.075	.928
	First-level kindergarten teacher	.282*	.082	.001
	Senior Kindergarten Teacher	-.146	.150	.331
Second-level kindergarten teacher	Unclassified	-.007	.075	.928
	First-level kindergarten teacher	.275*	.094	.004
	Senior Kindergarten Teacher	-.152	.157	.331
First-level kindergarten teacher	Unclassified	-.282*	.082	.001
	Second-level kindergarten teacher	-.275*	.094	.004
	Senior Kindergarten Teacher	-.427*	.160	.008
Senior Kindergarten Teacher	Unclassified	.146	.150	.331
	Second-level kindergarten teacher	.152	.157	.331
	First-level kindergarten teacher	.427*	.160	.008

3.2.4. Differences in Digital Literacy Among Kindergarten Teachers in Different Positions

An independent samples t-test (Table 9) showed that the digital literacy of lead teachers ($M = 3.63$, $SD = 0.82$) was significantly higher than that of assistant teachers ($M = 3.46$, $SD = 0.82$), $t = -2.496$, $p = 0.013$.

Table 9. Position-Independent Samples t-Test.

	Group: (M±SD)		t	p
	Assistant teachers(n = 468)	Lead teachers(n = 203)		
Teachers' digital literacy	3.46 ± 0.78	3.63 ± 0.82	-2.496	.013

3.2.5. Differences in Digital Literacy Among Kindergarten Teachers with Different Educational Backgrounds

The findings of the one-way analysis of variance (Table 10) show that kindergarten teachers' digital literacy is significantly influenced by their educational background. Teachers with an associate's, bachelor's, or master's degree scored considerably higher than those with only a high school or vocational school education ($p < 0.001$). Digital literacy scores were lowest among kindergarten instructors with a high school or vocational school background and highest among those with an associate degree. While there were no statistically significant differences between the associate degree, bachelor's degree, and master's degree groups, post-hoc analysis results (Table 11) show that teachers with a high school or vocational school education had significantly lower digital literacy scores than the higher education group ($MD \leq -0.589$, $p < .001$).

Table 10. Analysis of variance of educational attainment on digital literacy levels.

Education Level	Number of people	Average	Standard deviation	F value	Significance	Partial Eta square
High School/Vocational School	25	2.91	1.04	5.992	< .001	0.026
Junior College	237	3.60	0.73			
Bachelor's Degree	332	3.50	0.79			
Master's Degree	77	3.54	0.83			

Table 11. Educational Attainment - Post-hoc Comparison.

Education Level(I)	Education Level(J)	Mean difference (I - J)	Standard error	Significance
High School/Vocational School	Junior College	-.692*	.165	.000
	Bachelor's Degree	-.589*	.163	.000
	Master's Degree	-.635*	.181	.000
Junior College	High School/Vocational School	.692*	.165	.000
	Bachelor's Degree	.103	.067	.123
	Master's Degree	.057	.103	.583
Bachelor's Degree	High School/Vocational School	.589*	.163	.000
	Junior College	-.103	.067	.123
	Master's Degree	-.047	.099	.640
Master's Degree	High School/Vocational School	.635*	.181	.000
	Junior College	-.057	.103	.583
	Bachelor's Degree	.047	.099	.640

4. Discussion

4.1. Current Status of Digital Literacy Among Kindergarten Teachers

According to this study, kindergarten teachers in Lanzhou City, Gansu Province, China, have an intermediate level of digital literacy overall, with notable structural variations in five different areas. Digital awareness received the highest score of all of these ($M = 3.78$, $SD = 0.88$), suggesting that the majority of kindergarten instructors have a favorable attitude toward and a fundamental comprehension of the significance of digital education. Digital social responsibility ($M = 3.52$, $SD = 0.85$) and digital professional development ($M = 3.76$, $SD = 0.90$) follow, indicating that educators are somewhat sensitive and eager to grow in terms of digital ethics and self-improvement. Digital application ($M = 3.24$, $SD = 0.82$) and digital technology knowledge and

abilities ($M = 3.28$, $SD = 0.93$), on the other hand, had the lowest scores, indicating serious deficiencies in technical operation and classroom integration. This structural characteristic of “strong awareness but weak ability” implies that although educators are open to digital transformation, there is still a disconnect between their practical skills and technological literacy. Inadequate information infrastructure in certain kindergartens, a lack of systematic digital training, and a lack of practical support are some potential causes of this gap, which hinder teachers’ capacity to successfully incorporate digital tools into their teaching practices [15]. According to earlier research findings, kindergarten instructors in this study have a medium-to-high level of digital literacy overall. However, when compared to some places, there are variations in certain dimension scores. Local kindergarten instructors have comparatively low levels of digital awareness, which results in unfavorable or avoidant attitudes toward digital educational activities, according to surveys conducted in Zhejiang and Hunan provinces [21]. On the other hand, the study’s findings indicate that teachers performed best in the “digital awareness” category. Almost 40% of the teachers in this study’s sample are in the “onboarding adaptation phase,” which increases their likelihood of aligning with and internalizing policy directions and demonstrating high acceptance of digital discourse. This discrepancy may be caused by two factors. On the other hand, a greater percentage of senior teachers in Wang et al.’s sample had set fixed teaching habits, and inertia affected their digital awareness, leading to a more conservative mindset. Second, from a regional development standpoint, the “technology overload” problem in economically developed eastern regions may cause instructors to become weary of their tools and become concerned about their ethics, which would lower their level of initiative and sense of identification with digitalization. Western regions, on the other hand, have a higher level of acceptability in terms of cognitive awareness despite being in the early stages of digital transformation.

4.2. Differences in Digital Literacy Among Kindergarten Teachers with Different Background Characteristics and from Different Regions

Factors like years of teaching experience, kindergarten level, professional title, position, and educational background all had a significant impact, according to the analysis of variance data. According to these findings, teachers’ personal growth stages and the workplace culture they operate in have a significant impact on how digital literacy is constructed. First, there is a U-shaped curve in the relationship between years of teaching experience and digital literacy. Kindergarten instructors with 0–3 years of teaching experience are still in the “onboarding adaptation phase,” dealing with the combined problems of identity shift and teaching skill development, according to Huberman’s (1989) five-stage model of the teacher career [11]. Teachers who have three to ten years of teaching experience enter the “stabilization phase” of their careers, where their teaching styles become more established, and they are highly motivated to learn digital technologies and demonstrate higher levels of digital literacy in order to improve teaching efficiency and classroom engagement. Teachers may oppose the adoption of new technologies due to the combined effects of “experience replacing rational exploration” and “technology anxiety,” which could result in a drop in literacy [13]. This demonstrates even more how crucial the “mid-career” stage of a teacher’s career is for providing support and intervention in digital literacy.

Second, teachers' growth of digital literacy is also greatly influenced by the kindergarten level at which they teach. In comparison to teachers at unrated kindergartens, third-level kindergartens, second-level kindergartens, and first-level kindergartens, teachers in municipal demonstration kindergartens received the highest scores. The substantial benefits of demonstration kindergartens in terms of funding, building professional development platforms, and information technology support systems—which give teachers steady institutional support and help them internalize their own digital skills—may be the cause of this trend. This result emphasizes how important resource allocation is for fostering teachers' professional growth. Third, there is a “U-shaped” correlation between digital literacy and teachers' professional titles. Compared to teachers with senior titles and those with uncertain titles, first-level teachers had the lowest digital literacy scores. Their career advancement reaching a “promotion bottleneck period” could be the cause of this. Mid-level instructors' desire to improve their technical skills has been stifled by a long-standing absence of professional incentives and organized training, as well as cumulative occupational burnout. Significant inequalities in digital literacy levels are also caused by variances in teaching roles. Compared to assistant instructors, class teachers had substantially higher digital literacy scores. Class instructors usually take on fundamental duties such curriculum development, communication between the family and the school, and teaching assessment. As a result of their role expectations, they actively incorporate digital technology, which helps them advance their technical and practical skills. Lastly, teachers' digital literacy is also greatly influenced by their level of education. Digital literacy is substantially greater among teachers with associate degrees or above than among those with only a high school or vocational school background. This suggests that the growth of teachers' digital literacy is facilitated by higher education. It also highlights how important it is to build digital literacy courses in pre-service education in order to develop teacher competency.

5. Conclusions

This study meticulously evaluated kindergarten teachers' digital literacy in Lanzhou, resource-constrained Western China, uncovering key trends and practical lessons for global educational fairness. Even though teachers' digital literacy is moderate, our main findings demonstrate structural inequalities across dimensions: While digital application, the foundation of pedagogical implementation, scored lowest, digital awareness scored highest, followed by digital professional development and digital social responsibility. Despite popular opinion, demographic factors like age, gender, region, kind of institution, and prior computer knowledge did not statistically affect technology adoption. Digital literacy was higher in rookie and senior instructors than mid-career colleagues. Municipal model kindergarten, lead-class, and higher-educated teachers also benefited. The key factors were professional development variables such teaching experience, kindergarten tier, professional rank, position, and education level.

5.1. Theoretical Implications

Traditional research frequently models the relationship between digital literacy and years of teaching experience as a linear negative correlation, implying that more seasoned teachers may be resistant to technology because they rely on traditional teaching methods, while younger teachers, who are considered “digital natives,” have an inherent advantage in adjusting to technology [10]. This study, however, contradicted this one linear assumption by discovering that senior teachers with more

than 20 years of classroom experience showed a notable “rebound” tendency in digital literacy ratings. This finding implies that teachers’ abilities to use digital technology are impacted by generational variables as well as ongoing professional development and identification throughout their careers. To put it another way, coordinated professional support can help to integrate the relationship between experience accumulation and technology advancement, which is not always antagonistic. This conclusion presents a fresh viewpoint on the theory of teacher development stages, recommending that “dynamic career stage support” rather than “static generational categorization” be the focus of future studies on teachers’ digital competencies. The creation of a “tenure-sensitive” tiered development scheme is also supported practically by this finding. For instance, create technology integration workshops for mid-career educators based on teaching cognitive conflicts; for senior educators, use their reflecting skills and teaching knowledge to create age-appropriate digital training programs and give them technical leadership responsibilities.

5.2. Practical Implications

Improving teachers’ digital literacy is a crucial part of their professional development process and cannot be accomplished by imparting skills in short bursts. Two major drawbacks of current mainstream training methods are that the intervention model is short-term and phased, which makes it challenging to offer ongoing support; and the content concentrates on operational skills rather than delving deeper into the structure of educational philosophy and technology integration. Teachers may therefore be able to “use the equipment,” but they find it difficult to “use technology with an educational mindset,” which causes a gap between their professional identities and the usage of technology. The study’s empirical results have led to the following particular recommendations being put forth: First, a tiered and categorized training system should be created to meet the developmental needs of teachers at various times of their careers, considering the “U-shaped” relationship between literacy and teaching experience. Teachers with three to ten years of experience can be given “cognitive conflict-based” professional development tasks to help them overcome the inertia of their prior experiences; teachers with more than twenty years of experience should take part in a “technology leadership” program to help them convert their educational wisdom into technology-driven leadership capabilities; and new teachers can learn digital integration experience from senior teachers through a “mentorship system.” Second, procedures for resource sharing should be optimized in response to the phenomenon of teachers in municipal demonstration kindergartens having much greater levels of digital literacy. To support capacity building in tertiary kindergartens and underperforming kindergartens, it is advised to create a regional digital research and development community focused on municipal demonstration kindergartens. This community would be defined by “shared technology, collaborative research on concepts, and shared outcomes.” Additionally, it would require the opening of the municipal demonstration kindergartens’ digital platforms and training materials. Third, interventions should be implemented at the evaluation mechanism level to address the issue of teachers with first-level professional titles having the lowest digital literacy scores. Their innovative teaching methods might be supported by the creation of a “Digital Exploration Special Fund.” In order to reverse the trend of technological marginalization in professional title promotions, it is also advised that digital literacy be included in the fundamental requirements for professional title evaluations. This would cause teacher evaluations

to change from “emphasizing seniority” to “emphasizing capabilities and development.”

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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