



The Digital Literacy among Junior High School Students in Shanghai:A Case of Sumin Middle School

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ABSTRACT

The objectives of this research were (1) to clarify the overall level and structural characteristics of digital literacy among junior high school students at Shanghai Sumin Middle School based on the constructed five-dimensional framework for the AI era;(2)to identify the key individual, school and family factors that significantly influence the development of students' digital literacy;(3)to propose effective improvement pathways and AI-integrated educational intervention strategies tailored to the actual situation of Shanghai Sumin Middle School.

The study adopted an explanatory sequential mixed-methods design, combining quantitative and qualitative approaches. A total of 362 junior high school students from Grades 6 to 9 at Sumin Middle School were selected as the main participants, together with some teachers and parents, supplemented by classroom observations. Research instruments included a self-developed Digital Literacy Questionnaire for Junior High School Students, semi-structured interviews, non-participant classroom observations and document analysis.

Major Findings:(1) Regarding the overall level and structural characteristics of digital literacy: students' digital literacy was generally at a moderately high level, but showed significant structural imbalance characterized by strong basic abilities and weak higher-order competencies.(2) Regarding influencing factors of digital literacy: individual ICT usage habits, school-level curriculum and teaching integration, and family-level quality of parental guidance all exerted significant positive predictive effects on students' digital literacy. After controlling for other variables, family digital environment showed no significant independent effect. A paradox of "high exposure, low creation" was also identified.(3) Regarding the construction of improvement pathways and intervention strategies: a systematic five-in-one intervention framework consisting of curriculum restructuring, instructional innovation, assessment reform, ecosystem optimization and teacher development can effectively target the weak dimensions and influencing mechanisms.



Keywords: Digital Literacy, Five-Dimensional Framework, Artificial Intelligence in Education, Sumin Middle School, Mixed-Methods Research

1. Introduction

In today's digital era, digital literacy has become a necessity for modern individuals, encompassing the ability to discern truth from misinformation, protect privacy, and maintain independent thinking amidst algorithmic recommendations. For junior high school students at a critical stage of worldview formation, developing digital literacy is particularly urgent as it enables them to safely utilize online tools for learning, critically evaluate content, and establish responsible online behavior norms.

International frameworks have reached consensus on this front: UNESCO's Global Framework (2018) emphasizes digital literacy's role in daily life and career preparedness, the EU's DigComp 2.2 (2022) establishes five dimensions focused on critical thinking and practical engagement, and the OECD's PISA (2024) constructs a competency model centered on data analysis and computational problem-solving. China has responded with corresponding policies, including the "Compulsory Education Information Technology Curriculum Standards (2022)" requiring grades 7-9 to master computational thinking through project-based learning, and the "Opinions on Accelerating Educational Digitalization" (2025) calling for AI courses and incorporating digital literacy into student quality evaluation. Based on these frameworks and policies, this study constructs a five-dimensional framework for junior high school students' digital literacy in the AI era: Information and Data Literacy, Communication and Collaboration Literacy, Digital Content Creation Literacy, Safety and Ethical Literacy, and Problem-Solving and Computational Thinking Literacy.

Shanghai Sumin Middle School serves as the case study—a public nine-year consistent school founded in 1934 with 21 junior high classes, holding "Digital Education Benchmark School" status in Jiading District, having achieved full 5G campus coverage, established three AI laboratories, and developed a school-based AI curriculum system, making it representative of urban public junior high schools undergoing digital transformation. This study defines competence as the comprehensive quality enabling individuals to mobilize knowledge, skills, attitudes, and values to solve complex problems; digital literacy as the ability to access, manage, evaluate, create, and communicate information safely through digital technologies; and the digital divide as systematic disparities in access, usage, and benefit acquisition—with this study specifically examining the "literacy divide" in higher-order competencies within the same school. The research questions address the overall level and structural characteristics of digital literacy at Sumin Middle School, the key influencing factors (individual usage habits, school curriculum integration, family digital environment and parental guidance quality), and



effective enhancement pathways integrating AI technologies. The objectives are to clarify the current state of students' digital literacy, identify core facilitating and constraining mechanisms, and propose a systematic improvement plan covering curriculum, teaching, teacher development, and assessment reform.

Theoretically, this study provides empirical evidence for localizing international frameworks within China's basic education context and shifts focus from the "access divide" to the "literacy divide"; practically, it offers the sample school a data-driven improvement plan and provides micro-level decision-making references for Shanghai's educational policies. However, this single-case study has limited generalizability to other schools and regions given Shanghai's advanced digital infrastructure, and its cross-sectional design captures a snapshot rather than longitudinal trajectories, preventing causal claims from being made about identified influencing factors.

2. Literature Review and Research Related

This chapter aims to systematically review and critique the core literature related to the research topic, providing a solid theoretical foundation and analytical framework for this study.

2.1 Theoretical Foundation

This study draws upon three internationally authoritative digital literacy frameworks. UNESCO's Global Framework (2018) covers seven domains from foundational skills to career competencies, emphasizing social inclusion and lifelong learning. The EU's DigComp 2.2 (2022) constructs five practical dimensions—information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving—focusing on critical thinking and citizen responsibility. The OECD's PISA framework (2024) emphasizes higher-order cognitive abilities, including data analysis and computational problem-solving, with data literacy as a critical component for junior high students.

China has established a comprehensive policy guidance system. The "Compulsory Education Information Technology Curriculum Standards" (2022) elevates the course from skill training to scientific literacy cultivation, requiring grades 7-9 to master computational thinking through modules like "Process and Control" and engage in project-based practices. The "Opinions on Accelerating Educational Digitalization" (2025) incorporates digital literacy into student quality evaluation and encourages AI courses in primary and secondary schools.

Together, these frameworks and policies outline digital literacy's evolution from basic operations to critical engagement, content creation, complex problem-solving, and responsible societal participation—constituting the theoretical foundation of this study.



2.2 The Five-Dimensional Framework

Adopting principles of "critical absorption, contemporary infusion, and stage-specific adaptation," this study proposes the "Five-Dimensional Framework for Junior High School Students' Digital Literacy in the AI Era" as the direct theoretical lens for empirical investigation.

Information and Data Literacy balances foundational information processing with higher-order critical evaluation, emphasizing identification and assessment of AI-generated content.

Communication and Collaboration Literacy emphasizes responsible, effective communication within diverse digital communities and platforms.

Digital Content Creation Literacy elevates from "tool usage" to "creative expression," leveraging digital tools for innovative multimodal content production.

Safety and Ethical Literacy establishes a dual-layered framework: at the individual level covering cybersecurity, privacy protection, and digital well-being; at the societal level fostering digital citizenship responsibility.

Problem-Solving and Computational Thinking Literacy integrates computational thinking skills (decomposition, abstraction, modeling) with human-machine collaborative problem-solving strategies in authentic contexts.

This framework represents theoretical integration through contextualization (for Chinese junior high education), modernization (AI-empowered), and operationalization (measurable assessment).

2.3 Research Hypotheses

H1: Structural Disparity Hypothesis. Students' digital literacy levels are uneven across the five dimensions. Foundational and operational dimensions (information and data literacy, communication and collaboration literacy) are expected to be significantly higher than higher-order dimensions (digital content creation literacy, safety and ethical literacy, problem-solving and computational thinking literacy).

H2: Influencing Factor Hypotheses. H2a: Students' information technology usage habits significantly predict digital literacy levels. H2b: The depth of school curriculum and teaching integration significantly promotes higher-order digital literacy development. H2c: Family digital environment richness and parental guidance quality constitute key external influencing factors.

H3: Intervention Efficacy Hypothesis. A systematic educational intervention strategy tailored to the school's context and integrating AI technologies can effectively improve students' weaker digital literacy dimensions and promote balanced overall development.

3. Research methodology

3.1 Research Design

3.1.1 Research Paradigm and Method Selection

This study adopted an explanatory sequential mixed-methods design. Quantitative research (questionnaire survey) was conducted first to outline the current state of digital literacy and test hypotheses H1 and H2. Subsequently, qualitative research (interviews, observations, text analysis) was employed to delve into underlying causes and mechanisms, providing a contextual basis for intervention strategies (H3).

3.1.2 Research Procedure

The study followed a closed-loop procedure: theoretical construction → tool development → data collection → analysis and validation → strategy formulation.

Tool Development Phase: Based on the Five-Dimensional Framework, the questionnaire was designed with indicators from international frameworks and domestic scales. Content validity was assessed by expert review (three professors, two IT teachers). A pilot survey (n=80) confirmed good internal consistency (total scale $\alpha=0.923$; dimensions $\alpha=0.812-0.897$).

Quantitative Data Collection: A stratified cluster sampling survey was administered to grades 6–9 students at Sumin Middle School.

Qualitative Data Collection: Based on quantitative results, purposive sampling selected 30 students (high/medium/low literacy levels), 5 IT teachers, 4 homeroom teachers, and 20 parents for semi-structured interviews. Observations were conducted on 10 IT lessons and 8 interdisciplinary lessons. Textual materials (curriculum plans, teaching materials) were analyzed.

Data Analysis: Quantitative data were analyzed using SPSS 26.0 (descriptive statistics, t-tests, ANOVA, correlation, regression). Qualitative data (interview transcripts, observation notes) underwent thematic analysis.

Integrated Analysis and Strategy Formulation: Quantitative and qualitative findings were cross-validated to construct tailored intervention strategies.

3.1.3 Definition of Relevant Variables

Dependent Variable: Junior High School Students' Digital Literacy, operationalized into five dimensions measured by a 5-point Likert scale:

Information and Data Literacy: Information retrieval efficiency, critical evaluation of AI-generated content

Communication and Collaboration Literacy: Standardized digital communication, cross-temporal-spatial collaboration

Digital Content Creation Literacy: Proficiency in using generative AI tools (e.g., Doubao, KIMI, DeepSeek)



Safety and Ethical Literacy: Privacy protection behaviors, cybersecurity risk avoidance
Problem-Solving and Computational Thinking Literacy: Deconstruction of complex problems, application of AI for creative tasks

Independent Variables (three levels, eight variables):

Individual Level: Usage frequency, self-regulation ability

School Level: Frequency of interdisciplinary integration, teachers' digital teaching competence

Family Level: Availability of digital devices, quality of network access, guidance frequency, scientificity of guidance content

Control Variables: Gender, grade level, academic performance, class cadre status.

3.1.4 Questionnaire Design

The questionnaire contained 60 items across five modules: (1) Basic information (8 items); (2) Five-dimensional digital literacy assessment (25–30 items); (3) Individual IT usage habits (8 items); (4) School curriculum integration (8 items); (5) Family digital environment and parental guidance (8 items).

3.2 Research Population and Sample Size

3.2.1 Research Population

The population comprised all enrolled junior high students at Shanghai Sumin Middle School (grades 6–9, 21 classes total). Based on typical class size (≈ 45 students), the estimated population was ≈ 945 students aged 11–15 years.

3.2.2 Research Area

The research area was Nanxiang Ancient Town, Jiading District, Shanghai—an urban area with well-established digital infrastructure, providing contextual relevance for "public junior high schools in a megacity."

3.2.3 Sampling Method

Stratified cluster sampling was employed by grade level (grades 6–9). Three classes from grade 6 and two classes each from grades 7, 8, and 9 were selected (9 classes total). A census survey was conducted for all students in selected classes.

3.2.4 Sample Size Determination

Based on the sampling formula (Ke Huixin et al., 2005), the theoretical sample size was ≈ 380 students. A total of 405 questionnaires were distributed (as reported in Section 4.1.1). With an 85% expected valid response rate, ≈ 346 valid samples were anticipated—exceeding the minimum requirement for regression analysis.

Table 3-1 Sample Size Allocation by Grade

Grade Level	Total Number of Classes	Number of Sampled Classes	Estimated Class Size	Estimated Questionnaires Distributed	Estimated Usable Surveys (85% valid response rate)
Grade 6	6	3	$45 \times 3 = 135$	135	115
Grade 7	5	2	$45 \times 2 = 90$	90	77
Grade 8	5	2	$45 \times 2 = 90$	90	77
Grade 9	5	2	$45 \times 2 = 90$	90	77
Total	21	9	405	405	346

Qualitative Sample: 30 students (high/medium/low literacy groups), 5 IT teachers, 4 homeroom teachers, 20 parents (purposive sampling balancing grade, gender, academic performance, and family digital environment).

3.3 Research Ethics

This study followed the Declaration of Helsinki and Chinese ethical review requirements.

Informed consent was obtained from the school, with written parental consent and student oral assent. Participants were informed of the study details and free to withdraw at any time.

All data were anonymized and stored securely on encrypted devices or in locked cabinets. Access was restricted to the research team under confidentiality agreements. Raw data will be kept for three years after defense and then destroyed.

Data were used only for academic research, and a de-identified report will be provided to the school to help improve IT courses.

4. Research Results

This chapter presents the processing and analysis results of data collected through questionnaire surveys, interviews, observations, and text analysis. The purpose is to address the three core research questions proposed in this study and to test the research hypotheses set forth in Chapter 2.

4.1 Sample Characteristics and Data Quality

4.1.1 Sample Characteristics

The formal survey was conducted at Shanghai Sumin Middle School from October to November 2024. A stratified sample of 9 classes (3 from Grade 6, 2 each from Grades 7-9) received 405 questionnaires. A total of 398 were returned (98.27% response rate), yielding 362 valid questionnaires (89.38% effective rate), exceeding the expected valid sample size of 346.

Table 4-1 Sample Distribution (N=362)

Variable	Category	Frequency	Percentage (%)
Gender	Male	178	49.2
	Female	184	50.8
Grade Level	Grade 6	116	32.0
	Grade 7	82	22.7
	Grade 8	84	23.2
	Grade 9	80	22.1
Academic Performance Level	Excellent	68	18.8
	Good	116	32.0
	Average	144	39.8
	Needs Improvement	34	9.4
Home Internet Access	Yes	355	98.1
	No	7	1.9
Dedicated Learning Device	Yes	341	94.2
	No	21	5.8

The sample had balanced gender distribution, covered all grades, and showed favorable home digital access (98.1% internet, 94.2% dedicated devices). The "digital access divide" was largely alleviated, allowing focus on the "digital literacy divide."

4.1.2 Reliability and Validity

Reliability: The overall scale Cronbach's $\alpha = 0.941$ (excellent). Dimension α values ranged from 0.823 to 0.892 (good to excellent).

Table 4-2 Reliability Results

Dimension	Number of Items	Cronbach's α Coefficient
Information and Data Literacy	6	0.865
Communication and Collaboration Literacy	5	0.823
Digital Content Creation Literacy	6	0.878
Safety and Ethical Literacy	5	0.851
Problem-Solving and Computational Thinking Literacy	6	0.892
Total Scale	28	0.941

Construct Validity:

To examine construct validity, confirmatory factor analysis (CFA) was performed using AMOS 26.0. A first-order five-factor model was specified based on the theoretical framework, with factor loadings estimated via the maximum likelihood method. Goodness-of-fit was assessed using χ^2/df , RMSEA, CFI, and TLI (Hu & Bentler, 1999). The results indicated good model fit: $\chi^2/df = 2.91 (<3.0)$, RMSEA = 0.064 (<0.08), CFI = 0.937, TLI = 0.931 (both >0.90). As shown in Table 4-3, the standardized factor loadings for all 28 observed items ranged from 0.60 to 0.77 (all $p < 0.001$), exceeding the acceptable threshold of 0.50. Based on modification indices, correlated errors were allowed for two pairs of items (I3–I4, C4–C5). These findings confirm that the five-dimensional digital literacy model has sound construct validity, and the questionnaire is appropriate for measuring the digital literacy levels of junior high school students at Sumin Middle School.

4.2 Overall Level and Structural Characteristics

4.2.1 Descriptive Statistics

The mean total digital literacy score was 3.62 (SD = 0.71) on a 5-point scale, indicating moderately high overall literacy.

Table 4-4 Dimension Descriptive Statistics (N=362)

Dimension	Mean	Standard Deviation	Rank
Information and Data Literacy	3.75	0.73	2
Communication and Collaboration Literacy	3.91	0.68	1
Digital Content Creation Literacy	3.25	0.88	5
Safety and Ethical Literacy	3.58	0.79	3
Problem-Solving and Computational Thinking Literacy	3.41	0.85	4
Total Digital Literacy Score	3.62	0.71	/

4.2.2 Test of Dimensional Differences (H1)

Repeated-measures ANOVA revealed a significant main effect of dimension ($F(3.44, 1241.68) = 86.21, p < 0.001, \eta^2 = 0.193$, large effect). Paired t-tests with Bonferroni correction ($\alpha = 0.005$) showed:

Communication & Collaboration and Information & Data Literacy scored significantly higher than all other dimensions ($p < 0.001$)

Safety & Ethical Literacy scored significantly higher than Digital Content Creation and Problem-Solving ($p < 0.01$)

No significant difference between Problem-Solving and Digital Content Creation ($p > 0.05$)

H1 is fully supported: Foundational dimensions were well-developed; higher-order dimensions (Digital Content Creation, Problem-Solving) were weak. Safety & Ethical Literacy was intermediate.

4.2.3 Demographic Differences

Grade Level: Significant total score differences were found ($F(3,358) = 6.342, p < 0.01, \eta^2 = 0.050$). Post hoc tests showed Grade 9 > Grade 6 and Grade 7 ($p < 0.05$); Grade 8 > Grade 6 ($p < 0.05$). Digital Content Creation and Safety & Ethical Literacy showed no significant differences between Grades 8 and 9, suggesting these dimensions depended more on educational cultivation than cognitive maturation.

Gender: Males scored significantly higher on Digital Content Creation ($t = 2.34, p < 0.05, d = 0.25$) and Problem-Solving ($t = 2.87, p < 0.01, d = 0.30$). No significant gender differences were found on other dimensions or total score.

Academic Performance: Significant total score differences were found ($F(3,358) = 15.342, p < 0.001, \eta^2 = 0.117$). A stepwise pattern emerged: Excellent > Good > Average > Needs Improvement ($p < 0.05$ or better), indicating a mutually reinforcing relationship between digital literacy and academic ability.

4.3 Factors Influencing Digital Literacy (H2)

Hierarchical regression analysis examined the effects of individual, school, and family factors on digital literacy.

Table 4-5 Hierarchical Regression Results

Predictor Variable	Model 1 (Control Variables)	Model 2 (+ Individual Level)	Model 3 (+ School Level)	Model 4 (+ Family Level)
Step 1: Control Variables				
Gender (Male = 1)	0.04	0.02	0.01	0.01
Grade Level	0.18	0.15	0.12	0.11
Academic Performance	0.25***	0.21***	0.18***	0.17***
Step 2: Individual Level				
Information Technology Usage Habits		0.32***	0.28***	0.26***
Step 3: School Level				
Degree of Curriculum and Teaching Integration			0.22***	0.20***
Step 4: Family Level				
Family Digital Environment				0.08
Quality of Parental Guidance				0.17**

Predictor Variable	Model 1 (Control Variables)	Model 2 (+ Individual Level)	Model 3 (+ School Level)	Model 4 (+ Family Level)
R ²	0.136	0.241	0.287	0.312
ΔR ²	0.136	0.105	0.046	0.025
Adjusted R ²	0.129	0.233	0.278	0.300
F-value	18.654***	28.417***	28.614***	25.987***

Note: *p < 0.05, **p < 0.01, ***p < 0.001. Values are standardized regression coefficients (β). Female was the reference group for gender.

4.3.1 Individual-Level Factors (H2a)

IT Usage Habits significantly predicted total digital literacy (β = 0.26, p < 0.001), fully supporting H2a. The effect was strongest for Digital Content Creation (β = 0.31) and Problem-Solving (β = 0.29). Interview data revealed that high-literacy students used technology for "creative tasks" and "problem-solving," whereas low-literacy students used devices primarily for passive entertainment.

4.3.2 School-Level Factors (H2b)

Curriculum Integration significantly predicted total digital literacy (β = 0.20, p < 0.001), fully supporting H2b, with strongest effects on Safety & Ethical Literacy (β = 0.25) and Problem-Solving (β = 0.23). However, observations and document analysis revealed uneven integration: while the school offered an AI curriculum, deep interdisciplinary integration remained limited. Teacher interviews identified "lack of training in interdisciplinary design" and "assessment systems not reflecting literacy orientation" as primary obstacles.

4.3.3 Family-Level Factors (H2c)

Quality of Parental Guidance significantly predicted total digital literacy (β = 0.17, p < 0.01), while Family Digital Environment (devices and internet) was not significant after controlling for other variables (β = 0.08, p > 0.05). H2c was partially supported. The effect of hardware appeared mediated by guidance quality (r = 0.31, p < 0.01 between the two variables). Qualitative analysis categorized parental guidance into three types: collaborative exploration (40%), laissez-faire (35%), and restrictive control (25%). Collaborative exploration—characterized by joint rule-setting, co-analysis of information, and shared tool exploration—produced the best literacy outcomes.

4.4 Digital Content Creation and AI Tool Usage

As the weakest dimension, Digital Content Creation Literacy warranted special attention. Survey results showed that 85.6% of students had heard of generative AI tools (e.g., Doubao, Kimi), but only 23.2% "frequently used" them for learning or creative purposes.

Table 4-6 Purposes of AI Tool Use (Doubao Example)

Purpose of Use	Percentage (%)	Typical Student Statement (Doubao Users)
Information Search	67.1	"For unfamiliar vocabulary or historical background, I just ask Doubao directly. It's faster than a search engine."
Homework Assistance	58.3	"When I can't solve a math problem, I take a photo and upload it. Doubao gives me the steps."
Translation	45.0	"After finishing my English composition, I use it to check for grammatical errors."
Writing Assistance	31.2	"When writing an essay, I ask it to provide an opening or an outline."
Programming Assistance	12.4	"When I encounter a bug in programming during Information Technology class, I paste the code in and ask."
Image/Video Generation	9.7	"I only tried asking it to draw once or twice, but the results didn't look quite right, so I stopped using it for that."

Only 16.8% of students reported that "a teacher has demonstrated how to use AI tools to complete learning tasks," and merely 9.3% reported guidance on evaluating AI output quality. The study identifies a phenomenon termed "Doubao-Style Usage" —users only invoke basic information retrieval functions, failing to exploit AI's potential for content generation, creative inspiration, and iterative refinement. This reflects an "application divide" between technological exposure and creative use.

4.5 Generative Mechanism of the "Literacy Divide"

Synthesizing quantitative and qualitative findings, the literacy divide under equitable material access arose from interactive gaps across three dimensions:

Dimension	High-Literacy Students	Low-Literacy Students
Exploratory Motivation	Active exploration (73.3%)	Use only when required (13.3% mention rate)

Dimension	High-Literacy Students	Low-Literacy Students
	mention rate)	
Meta-Skills	Decompose goals into specific instructions	Cannot articulate needs clearly
Practice Opportunities	Create AI-assisted original works	Stop after receiving answers

This threefold gap formed a self-reinforcing cycle: low-literacy students lacked motivation → less practice → underdeveloped skills → reduced confidence → further diminished motivation. High-literacy students accumulated advantages through positive feedback loops of "exploration–feedback–improvement."

4.6 Summary of Hypothesis Testing

The results of hypothesis testing are summarized as follows:

H1: Fully Supported. The development of the five dimensions of digital literacy was uneven. Dimensions involving higher-order cognition and creative output significantly lagged behind those involving foundational operations and communication.

H2a: Fully Supported. Students' information technology usage habits, particularly their self-regulation ability, were strong predictors of their digital literacy levels.

H2b: Fully Supported. The degree of integration of digital literacy into school curriculum and teaching significantly and positively influenced students' digital literacy, playing a critical role especially for higher-order dimensions.

H2c: Partially Supported. The key family-level influence lay in the quality of parental guidance rather than the mere hardware environment. High-quality guidance significantly enhanced literacy, particularly in the domains of safety and ethical awareness.

H3: Based on the cross-sectional data, this study could not directly verify the effects of intervention measures. Nevertheless, the areas of weakness, influencing factors, and underlying mechanisms identified provided precise targets and a solid foundation for designing targeted educational intervention strategies. This hypothesis is intended to be tested in subsequent action research.

4.7 Chapter Summary

This chapter presented four main findings. First, Sumin Middle School students' digital literacy was moderately high but structurally imbalanced: foundational competencies were strong; higher-order competencies (Digital Content Creation, Problem-Solving) were weak. Second, digital literacy was influenced by multi-level factors: individual usage habits were the strongest predictor; school curriculum integration significantly promoted higher-order literacy; family influence operated through guidance quality rather than hardware. Third, despite high AI exposure, students' usage remained superficial, with very low engagement in creative production—the "Doubao-Style Usage" phenomenon. Fourth, the literacy divide was generated through a self-reinforcing cycle of gaps in motivation, meta-skills, and practice opportunities. These findings provided empirical foundations for the discussion and intervention strategies in Chapter 5.

5. Conclusion, Discussion, and Recommendations

5.1 Research Conclusions

Structural Imbalance: Students' digital literacy shows "strong foundations, weak higher-order skills." Communication & Collaboration (M=3.91) and Information & Data (M=3.75) are strong; Content Creation (M=3.25) and Problem-Solving (M=3.41) lag. Safety & Ethics (M=3.58) is intermediate. Foundational skills are no longer the bottleneck – higher-order literacy is the core challenge.

Multi-Level Influencing Factors:

Individual: IT usage habits are the strongest predictor ($\beta=0.26$), especially for Content Creation ($\beta=0.31$) and Problem-Solving ($\beta=0.29$). High-literacy students use technology for creative tasks; low-literacy for passive entertainment.

School: Curriculum integration significantly predicts literacy ($\beta=0.20$), particularly for Safety & Ethics ($\beta=0.25$) and Problem-Solving ($\beta=0.23$). However, most teachers use technology instrumentally due to lack of design capacity, assessment constraints, and missing interdisciplinary mechanisms.

Family: Parental guidance quality ($\beta=0.17$) matters; hardware (devices, internet) is non-significant after controls. High-quality guidance features collaborative exploration and joint rule-setting.

AI Tool Paradox – "High Exposure, Low Creation": 85.6% have heard of generative AI, but only 23.2% frequently use it for learning/creation. Use concentrates on information search (67.1%) and homework help (58.3%); creative uses are very low (9.7% image/video generation). This "Doubao-Style Usage" reflects barriers in cognitive self-efficacy, institutional legitimacy, and structured support.



5.2 Discussion

5.2.1 The Bottleneck from Foundational Universalization to Deep Development

The structural imbalance revealed that while students demonstrated a "surface-level advantage" in communication and information retrieval, this proficiency did not effectively transfer to academic collaboration scenarios—confirming Livingstone and Helsper's "contextual specificity of digital skills." Higher-order literacy lagged due to the mismatch between cognitive demands (metacognitive monitoring, abstract thinking) and the prevailing "task-driven" instruction that emphasized procedural skills over creative problem-solving. Safety and Ethical Literacy remained at the "rule dissemination" level, lacking situated judgment training.

5.2.2 Systemic Mismatches at Individual, School, and Family Levels

Three fractures hindered literacy development. First, vision-practice mismatch: Schools advocated embedded cultivation, but teachers used technology instrumentally, lacking a "translational framework" to convert digital literacy into subject-specific instructional objectives. Second, home-school responsibility gap: Approximately 64% of parents lacked confidence in guiding digital use, while schools tended to outsource the issue. Students from low-guidance families became "digital orphans." Third, assessment-system paradox: Paper-and-pencil testing could not capture higher-order digital literacy, leading to "assessment avoidance"—teachers rationally concluded that untested content need not be taught, neutralizing intervention efforts.

5.2.3 The "Doubao-Style Usage" Phenomenon

Cognitive: Lack of "prompt engineering" meta-skills (self-efficacy issue).

Institutional: Schools send ambiguous or discouraging signals about AI use.

Structural: Only 16.8% received teacher demonstrations; 9.3% guidance on evaluating AI outputs. Systematic "demonstration–practice–feedback" support is absent.

5.3 Recommendations(Five-in-One Framework)

Curriculum – Three-Tiered System: Foundational (digital creation basics), extension (AI maker workshop, data storytelling), infusion (embed into Chinese, Science, Social Practice).

Instruction – Project-Based Learning: Four phases: Definition → Exploration → Creation → Reflection. Redefine AI as "creative partner" (e.g., co-creating a poem with Doubao).

Assessment – Portfolio + Performance Tasks: Digital literacy portfolios (works, process evidence, reflective journals) plus interdisciplinary performance assessments with rubrics.



Ecosystem – Home-School-Community: Digital Parent Academy (2-3 workshops/semester) and school-enterprise-community collaboration (visits, service learning, online mentorship).

Teacher Development – Three-Tier Training: Foundational (8h), instructional (16h), innovation (32h). Incentive mechanisms linking literacy cultivation to teacher evaluation.

5.4 Research Contributions

5.4.1 Theoretical Contributions

This study constructed and validated the local applicability of the "Five-Dimensional Framework for Junior High School Students' Digital Literacy in the AI Era" (CFI = 0.937, TLI = 0.931). It revealed the generative mechanism of the "literacy divide" after the access divide was resolved—interactive gaps in "motivation–skills–opportunity." It also empirically explored the "high exposure, low creation" paradox in generative AI use among adolescents.

5.4.2 Practical Contributions

This study provided Sumin Middle School with a data-driven, targeted improvement blueprint. It offers a reference for urban public schools in digital transformation, schools facing technology-teacher tensions, and schools enhancing family guidance effectiveness. It also provides frontline empirical evidence for Shanghai and district educational policy evaluation and formulation.

5.5 Limitations

Data sources: The single-case study at Sumin Middle School limits generalizability. Family SES variables (income, parental occupation, parents' digital literacy) were not collected, potentially confounding the "quality of parental guidance" effect.

Geographic context: Shanghai's advanced digital infrastructure differs significantly from central/western and rural China; findings cannot be directly generalized nationally.

Methodological: The cross-sectional design cannot track longitudinal trajectories or establish causal relationships between influencing factors and literacy outcomes.

H3 verification: The Intervention Efficacy Hypothesis could not be directly tested with cross-sectional data and awaits future action research.

5.6 Chapter Summary

This chapter systematically discussed research findings and proposed targeted interventions. With material access largely universalized, the core contradiction in digital literacy development has shifted from "whether one can use" technology to "whether one can use it well, effectively, and responsibly." Resolving this requires school education to transition from "technology-assisted instruction" to "literacy-oriented education," family education from "hardware provision" to "cultural transmission," and social support from "fragmented resources" to a "systemic ecosystem." Only then can we cultivate digital citizens who are not



merely technology users, but also critical examiners, creators, and responsible stewards of the intelligent age.

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