

Digital Reading Strategies and EFL Students' Reading Comprehension in Digital Classrooms: The Mediating Roles of Self-Efficacy and Motivation

Ye Li^{1,2}, Nalini Arumugam¹

¹SEGI University & College, Kuala Lumpur, Malaysia

²Shijiazhuang Information Engineering Vocational College, Hebei, China

Abstract: *With the rapid integration of digital technologies into higher education, EFL learners' reading practices have undergone profound transformations. This study investigates the relationship between digital reading strategies (cognitive, metacognitive, digital navigation) and reading comprehension (literal, inferential, evaluative) among 508 undergraduate EFL students in Shijiazhuang, China, with self-efficacy and motivation as mediators. A mixed-methods design was adopted, combining Partial Least Squares Structural Equation Modeling (PLS-SEM) for quantitative data and thematic analysis for qualitative interview data. Quantitative results revealed that digital reading strategies had a significant direct effect on reading comprehension ($\beta=0.277$, $p<0.001$) and indirectly influenced comprehension through self-efficacy (indirect effect= 0.078 , $p<0.001$) and motivation (indirect effect= 0.066 , $p<0.001$). Cognitive and metacognitive strategies contributed more to comprehension than digital navigation strategies, while cognitive and performance-driven motivation emerged as stronger mediators than strategic motivation. Gender, age, and academic year significantly moderated the relationships between constructs, with males, younger students (<20 years), and Year 1 students deriving greater benefits from strategy use. Qualitative findings confirmed that students perceive self-efficacy as a confidence booster and motivation as a driver of strategic engagement. This study contributes to digital literacy scholarship by validating mediation mechanisms in EFL contexts and offers practical implications for enhancing digital reading instruction.*

Keywords: Digital reading strategies, Reading comprehension, Self-efficacy, Motivation, EFL learners, Digital learning environments.

1. Introduction

In the era of digital transformation, the shift from traditional print-based reading to digital reading has reshaped EFL teaching and learning (Habók et al., 2024). Digital classrooms offer interactive, multimodal resources that enhance accessibility and engagement, but they also demand new literacy skills, such as navigating hyperlinks, evaluating online sources, and regulating attention, that differ from those required for print reading (Salmerón et al., 2023). For EFL students, digital reading comprehension is not only a foundational academic skill but also a critical determinant of employability and lifelong learning (Clinton-Lisell et al., 2022). However, existing research indicates that EFL learners often struggle with higher-order comprehension skills (e.g., inferencing, evaluation) in digital environments (Zhang & Zhang, 2023), and the mechanisms linking digital reading strategies to comprehension remain underexplored, particularly in Chinese contexts.

Digital reading strategies—encompassing cognitive (e.g., summarization), metacognitive (e.g., self-monitoring), and digital navigation (e.g., hyperlink use) strategies—are widely recognized as key predictors of reading success (Habók et al., 2024). Yet, their effectiveness is not direct; psychological factors such as self-efficacy (belief in one's ability to succeed) and motivation (intrinsic and extrinsic drivers) are posited to mediate this relationship (Bandura, 1977; Deci & Ryan, 1985). Self-efficacy influences students' persistence and strategy use in challenging tasks (Greco et al., 2022), while motivation shapes their willingness to engage deeply with digital texts (Chen & Zhang, 2022). Additionally, demographic variables such as gender, age, and academic year may moderate these relationships, as different groups may adapt to digital learning environments differently (Haiyan, 2023).

Despite growing interest in digital literacy, prior studies have primarily focused on traditional classrooms or isolated constructs, leaving gaps in understanding how strategies, self-efficacy, and motivation interact in digital EFL contexts (Heydarnejad et al., 2022; Li et al., 2023). This study addresses this gap by investigating three core research questions: (1) What are the levels of literal, inferential, and evaluative comprehension among EFL students in digital classrooms? (2) What is the relationship between digital reading strategies and comprehension? (3) Do self-efficacy and motivation mediate this relationship? (4) Do gender, age, and academic year moderate these relationships? By addressing these questions, this study aims to advance theoretical understanding and inform evidence-based digital reading instruction.

2. Literature Review

2.1 Digital Reading Strategies and Comprehension

Digital reading strategies are defined as deliberate cognitive and metacognitive actions used to navigate, process, and comprehend digital texts (Leu et al., 2015). They are categorized into three dimensions: cognitive strategies (e.g., summarizing, inferencing), metacognitive strategies (e.g., monitoring understanding, adjusting strategies), and digital navigation strategies (e.g., using search functions, hyperlinks; Habók et al., 2024). Research has consistently shown that these strategies enhance reading comprehension by promoting active engagement with texts (Salmerón et al., 2023). For example, cognitive strategies help construct meaning from texts, while metacognitive strategies support self-regulation—critical in digital environments with abundant distractions (Chen & Xiao, 2024). Digital navigation strategies, though important for accessing information, are less strongly associated with deep comprehension than cognitive and metacognitive strategies (Habók et al., 2024).

Reading comprehension in digital contexts encompasses three hierarchical levels: literal (identifying explicit information), inferential (drawing implicit conclusions), and evaluative (critiquing and synthesizing content; Zhang & Zhang, 2023). EFL students typically perform better on literal comprehension than higher-order skills, as inferential and evaluative comprehension require integrating linguistic knowledge with critical thinking (Bråten et al., 2024). Digital environments may exacerbate this gap by encouraging superficial reading (e.g., skimming) at the expense of deep processing (Konukati, 2025).

2.2 Mediating Roles of Self-Efficacy and Motivation

Self-efficacy, rooted in Bandura's (1977) Social Cognitive Theory, refers to individuals' beliefs in their ability to execute tasks successfully. In digital reading, self-efficacy is shaped by vicarious experiences (observing peers succeed) and verbal persuasion (teacher/peer feedback; Greco et al., 2022). High self-efficacy predicts greater strategy use and persistence, leading to better comprehension (Chen & Zhang, 2022). For EFL students, self-efficacy mitigates anxiety about digital text complexity, enabling them to apply strategies more effectively (Jiang, 2023).

Motivation, guided by Self-Determination Theory (Deci & Ryan, 1985), includes cognitive motivation (intrinsic interest in content), strategic motivation (using strategies to improve comprehension), and performance-driven motivation (extrinsic goals like grades). Motivated students engage more deeply with digital texts, using diverse strategies to enhance comprehension (Rahmasari, 2023). Cognitive and performance-driven motivation are particularly influential in EFL contexts, as intrinsic interest and external rewards both drive sustained engagement (Ma & Zhao, 2025).

2.3 Moderating Effects of Demographic Variables

Gender, age, and academic year may moderate the relationships between digital reading strategies, mediators, and comprehension. Gender differences in digital literacy have been reported, with males often showing stronger motivation for technical navigation (Habók et al., 2024), while females may prioritize cognitive strategies (Korlat et al., 2021). Age-related differences reflect developmental stages: younger students (<20 years) may benefit more from structured strategy training, while older students may rely on prior experience (Haiyan, 2023). Academic year also matters: Year 1 students may need more support for self-efficacy and strategy use, while senior students have more autonomous learning skills (Zhou & Zhang, 2025).

2.4 Theoretical Framework

This study integrates three frameworks: Leu et al.'s (2015) Online Research and Comprehension Framework (emphasizing digital literacy skills), Bandura's (1977) Self-Efficacy Theory, and Deci & Ryan's (1985) Self-Determination Theory. The conceptual model posits that digital reading strategies directly influence comprehension and indirectly through self-efficacy and motivation, with gender, age, and academic year as moderators.

3. Methodology

3.1 Research Design

A mixed-methods design was adopted, combining quantitative (survey, comprehension test) and qualitative (semi-structured interviews) data to triangulate findings (Creswell & Plano Clark, 2018). Quantitative data tested structural relationships using PLS-SEM, while qualitative data explored students' perceptions of mediation mechanisms via thematic analysis (Braun & Clarke, 2006).

3.2 Participants

The sample included 508 undergraduate EFL students from 10 universities in Shijiazhuang, Hebei Province: 236 males (46.5%) and 272 females (53.5%); 147 (28.9%) below 20 years, 128 (25.2%) 20–24 years, 233 (45.9%) 25+ years; 123 (24.2%) Year 1, 147 (28.9%) Year 2, 238 (46.9%) Year 3. Stratified random sampling ensured representation across demographics and institutions (Tipton, 2022).

3.3 Instruments

Digital Reading Strategies Scale: Adapted from Habók et al. (2024), 15 items (Cronbach's $\alpha=0.87$) measuring cognitive (5 items), metacognitive (5 items), and digital navigation (5 items) strategies.

Self-Efficacy Scale: Based on Greco et al. (2022), 10 items ($\alpha=0.75$) assessing vicarious experiences (5 items) and verbal persuasion (5 items).

Motivation Scale: Derived from Chen & Zhang (2022), 15 items ($\alpha=0.89$) measuring cognitive (5 items), strategic (5 items), and performance-driven (5 items) motivation.

Reading Comprehension Test: Adapted from Salmerón et al. (2023), 15 items (item-total correlations= 0.70–0.83) assessing literal (5 items), inferential (5 items), and evaluative (5 items) comprehension.

All instruments used a 5-point Likert scale (1=strongly disagree to 5=strongly agree), validated via pilot testing ($n=205$) for reliability ($\alpha>0.70$) and validity (AVE>0.50; Hair et al., 2022).

3.4 Data Collection

Quantitative data were collected via Wenjuanxing (December 1–8, 2024), with a 97.5% valid response rate (508/521). Qualitative data were collected via semi-structured interviews with 20 students (maximum variation sampling: high/medium/low self-efficacy/motivation scores), lasting 30–40 minutes and transcribed verbatim (Lincoln & Guba, 1985).

3.5 Data Analysis

Quantitative: PLS-SEM (SmartPLS 4) assessed measurement model (indicator reliability, convergent validity, discriminant validity) and structural model

(direct/indirect/moderation effects) with 5,000 bootstraps (Hair et al., 2022).

Qualitative: Thematic analysis in NVivo 12 identified themes related to self-efficacy and motivation as mediators (Braun & Clarke, 2006).

4. Results

4.1 Descriptive Statistics

Reading comprehension levels were moderate: literal (M=3.04, SD=0.69), inferential (M=2.92, SD=0.81), evaluative (M=2.95, SD=0.78; Alkharusi, 2022). Digital reading strategies (M=3.63, SD=0.80), self-efficacy (M=3.70, SD=0.82), and motivation (M=3.75, SD=0.76) were moderate to high (Table 1).

Table 1: Descriptive Statistics of Constructs

Construct/Dimension	Mean ± SD	Skewness	Kurtosis	Level
Digital Reading Strategies	3.63 ± 0.80	-0.95	0.76	Moderate-High
Self-Efficacy	3.70 ± 0.82	-0.96	0.64	Moderate-High
Motivation	3.75 ± 0.76	-0.81	1.06	Moderate-High
Reading Comprehension	2.97 ± 0.56	-1.09	0.70	Moderate
- Literal	3.04 ± 0.69	-1.03	0.55	Moderate
- Inferential	2.92 ± 0.81	-0.89	-0.64	Moderate
- Evaluative	2.95 ± 0.78	-0.76	-0.72	Moderate

4.2 Measurement Model Assessment

Indicator Reliability: All factor loadings >0.70 (range: 0.701–0.884), confirming indicator reliability (Hair et al., 2022).

Convergent Validity: Lower-order constructs had AVE>0.50 (e.g., cognitive strategies=0.606, vicarious experiences=0.615), while higher-order constructs had AVE<0.50 (common in hierarchical models; Hair et al., 2022).

Discriminant Validity: HTMT<0.85 (e.g., CRSC vs. SE=0.446) and Fornell-Larcker criterion (square root of AVE>inter-construct correlations) confirmed discriminant validity (Henseler et al., 2015).

4.3 Structural Model Results

4.3.1 Direct Effects

Digital reading strategies positively predicted reading comprehension ($\beta=0.277$, $t=6.454$, $p<0.001$), self-efficacy ($\beta=0.424$, $t=9.153$, $p<0.001$), and motivation ($\beta=0.279$, $t=6.107$, $p<0.001$). Self-efficacy ($\beta=0.185$, $t=4.148$, $p<0.001$) and motivation ($\beta=0.238$, $t=5.124$, $p<0.001$) positively predicted comprehension (Table 2).

Table 2: Direct Effects

Path	β	t-value	p-value
CRSC → RC	0.277	6.454	<0.001
CRSC → SE	0.424	9.153	<0.001
CRSC → MRSC	0.279	6.107	<0.001
SE → RC	0.185	4.148	<0.001
MRSC → RC	0.238	5.124	<0.001

4.3.2 Mediation Effects

Table 3: Mediation Effects

Mediation Path	Indirect Effect	t-value	p-value	% Mediation
CRSC → SE → RC	0.078	3.563	<0.001	18.5
CRSC → MRSC → RC	0.066	3.658	<0.001	15.9
Total Indirect Effect	0.145	5.013	<0.001	34.4

Self-efficacy partially mediated CRSC→RC (indirect effect=0.078, $t=3.563$, $p<0.001$, 18.5% mediation), and motivation partially mediated CRSC→RC (indirect

effect=0.066, $t=3.658$, $p<0.001$, 15.9% mediation). Total indirect effect=0.145 (34.4% mediation; Table 3).

4.3.3 Moderation Effects

Gender: Moderated CRSC→MRSC ($\beta=0.204$, $p=0.028$), with a stronger relationship for males.

Age: Moderated CRSC→MRSC ($\beta=0.184$, $p=0.000$) and CRSC→RC ($\beta=0.155$, $p=0.000$), with stronger relationships for students <20 years.

Academic Year: Moderated CRSC→SE ($\beta=-0.318$, $p=0.000$), with a stronger relationship for Year 1 students (Table 4).

Table 4: Key Moderation Effects

Moderator	Path	β	p-value
Gender	CRSC → MRSC	0.204	0.028
Age (<20 vs 20–24)	CRSC → MRSC	0.184	0.000
	CRSC → RC	0.155	0.000
Academic Year (Y1 vs Y3)	CRSC → SE	-0.318	0.000

4.4 Qualitative Findings

Two key themes emerged:

Self-Efficacy as a Confidence Booster: Students with high self-efficacy reported greater willingness to use strategies (e.g., “When I feel confident, I use highlighting and summarizing to grasp content better”) and cited vicarious experiences (peer success) and verbal persuasion (teacher feedback) as key sources (Bandura, 1977).

Motivation as a Driver of Strategic Engagement: Cognitive (interest in content) and performance-driven (grades) motivation encouraged deep engagement (e.g., “Interest makes me use critical thinking strategies, leading to better understanding”), aligning with Self-Determination Theory (Deci & Ryan, 1985).

5. Discussion

5.1 Main Findings

EFL students demonstrated moderate reading comprehension, with literal comprehension highest—consistent with Zhang &

Zhang (2023), who noted EFL learners' struggles with higher-order skills. Digital reading strategies had a significant direct effect on comprehension, supporting H1b and aligning with Habók et al. (2024) and Salmerón et al. (2023). Cognitive and metacognitive strategies were more impactful than digital navigation strategies, as they focus on meaning construction and self-regulation—critical for deep comprehension (Chen & Xiao, 2024).

Self-efficacy partially mediated the strategy-comprehension relationship (H3b), validating Bandura's (1977) theory. Vicarious experiences and verbal persuasion were key sources of self-efficacy, consistent with Chen & Zhang (2022). Motivation also partially mediated the relationship (H4b), with cognitive and performance-driven motivation as stronger mediators—supporting Self-Determination Theory (Deci & Ryan, 1985) and Rahmasari (2023).

Moderation effects highlighted demographic differences: males benefited more from strategy use for motivation, younger students for strategy-comprehension links, and Year 1 students for strategy-self-efficacy links. These findings underscore the need for differentiated instruction (Haiyan, 2023).

5.2 Theoretical Contributions

This study extends the Online Research and Comprehension Framework (Leu et al., 2015) by identifying self-efficacy and motivation as critical mediators in EFL contexts. It validates Bandura's (1977) and Deci & Ryan's (1985) theories in digital learning environments, showing that psychological factors explain how strategies translate into comprehension. The moderation findings refine understanding of demographic influences, filling gaps in digital literacy scholarship.

5.3 Practical Implications

Pedagogical: EFL teachers should integrate explicit strategy training (cognitive/metacognitive) and foster self-efficacy via peer demonstrations and feedback. Motivation can be enhanced through content relevance (cognitive) and recognition (performance-driven).

Curriculum: Design digital reading materials balancing strategy training and mediator support. Incorporate adaptive tools (e.g., annotation software) to cater to demographic differences.

Policy: Invest in digital infrastructure and teacher training to reduce the digital divide and support differentiated instruction (Liu & Darvin, 2024).

5.4 Limitations and Future Research

Limitations include a cross-sectional design (no causal inference) and sample restriction to Shijiazhuang (limited generalizability). Future research could adopt longitudinal designs to explore long-term effects, investigate specific digital tools (e.g., VR) on strategy use, and expand to other Chinese regions.

6. Conclusion

This study clarifies the relationship between digital reading strategies and EFL students' comprehension, with self-efficacy and motivation as partial mediators. Cognitive and metacognitive strategies, along with cognitive and performance-driven motivation, are key drivers of comprehension. Demographic variables moderate these relationships, emphasizing differentiated instruction. The findings contribute to digital literacy theory and offer practical guidance for enhancing EFL digital reading instruction. By integrating strategy training with mediator support, educators can improve comprehension and prepare students for lifelong digital learning.

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