Al-Ishlah: Jurnal Pendidikan
Vol.17, 2 (June, 2025), pp. 2415-2434
ISSN: 2087-9490 EISSN: 2597-940X, DOI: 10.35445/alishlah.v17i2.7490

Enhancing Reading Comprehension through Visual Information: A Longitudinal Study in Higher Education

Putri Asilestari[1], Raffly Henjilito[2] Vitri Angraini Hardi[3]

[1] Universitas Pahlawan Tuanku Tambusai, Kampar, Indonesia; putriasilestari89@gmail.com
[2] Universitas Islam Riau, Pekanbaru, Indonesia; rafflyhenjilito@edu.uir.ac.id
[2] Universitas Pahlawan Tuanku Tambusai, Kampar, Indonesia; Vitrihardi@gmail.com

ARTICLE INFO

Keywords:

Visual Literacy;
Reading Comprehension;
EFL Students;
Multimedia Learning;
Higher Education

Article history:

Received 2025-03-09
Revised 2025-04-19
Accepted 2025-05-15

ABSTRACT

Reading comprehension is a critical component of academic achievement, yet many English as a Foreign Language (EFL) learners face challenges processing complex texts. This study investigates the impact of visual information-based reading materials on improving comprehension among Indonesian EFL university students. A mixed-methods, cross-sectional design was employed over three academic semesters. A total of 228 students were assigned to either an experimental group, which received reading materials incorporating visual elements, or a control group, which received text-only materials. Quantitative data were collected using standardized comprehension assessments, while qualitative insights were gathered through student reflections and interviews. The experimental group demonstrated significantly higher performance in literal comprehension compared to the control group ($p < 0.05$, Cohen's $d = 0.81$), indicating a large effect size. Qualitative data reinforced these findings, revealing that visual aids enhanced student engagement, understanding, and information retention. The integration of visual elements into reading materials effectively supports comprehension in EFL contexts. Visual information appears to reduce cognitive load and facilitate meaning-making, particularly in learners processing texts in a non-native language. Visual-enhanced reading materials significantly improve literal comprehension among Indonesian EFL university students. These findings underscore the importance of incorporating visual literacy strategies in EFL pedagogy and call for further research into interactive and digital visual tools to support reading comprehension.

Corresponding Author:
Putri Asilestari
Universitas Pahlawan Tuanku Tambusai, Kampar, Indonesia; putriasilestari89@gmail.com

1. INTRODUCTION

Reading comprehension is a key skill in higher education, yet traditional text-based instruction is increasingly seen as insufficient in the multimodal learning environment (Taheri & Pennington, 2024). Integrating visual information into reading materials has emerged as a promising strategy to improve engagement, comprehension, and retention (Guglietti, 2023). However, empirical research on visual literacy's role in reading pedagogy remains limited—especially within EFL higher education contexts. This gap highlights the need to explore how visual elements can support EFL learners in processing and understanding academic texts.

Visual literacy—the ability to interpret and construct meaning from visual information—is increasingly essential in modern education (Zayeb, Aleidan, & Ali, 2024). Studies show that decoding visual cues can enhance students' understanding of complex texts (Chung, 2024). The Cognitive Theory of Multimedia Learning (Mayer, 2005) and Dual Coding Theory (Paivio, 1991) both support the idea that integrating visuals with text improves comprehension, reduces cognitive load, and aids retention. Beyond these cognitive benefits, visual information also serves as a tool for metacognitive monitoring—helping learners track their understanding and reflect on their interpretation—and facilitates higher-order meaning-making, particularly in multilingual EFL contexts where visual cues can act as cross-linguistic bridges.

Nevertheless, critical perspectives argue that visuals may distract learners or lead to cognitive overload when not explicitly integrated into instruction (Schnotz & Bannert, 2003; Mayer, 2009). These critiques underscore the importance of designing visuals with clear pedagogical intentions. Rather than being decorative, visuals must be instructional. This study acknowledges such concerns and addresses them by ensuring that all visual-based materials in the intervention are systematically developed, validated, and implemented with explicit learning goals and instructional scaffolds.

Recent studies have shown that visual-based materials—such as infographics, graphic novels, and mind maps—can enhance students' reading engagement and comprehension (Bulut et al., 2024; Dougherty & Gregg, 2024; Retnaningtyas et al., 2024). However, most of this research centers on primary and secondary education, with limited attention to university-level EFL learners, especially in non-Western, multilingual contexts. Moreover, few studies have explored how such materials can be designed and implemented over time, within structured learning environments in higher education.
International literacy assessments, such as the Programme for International Student Assessment (PISA), consistently rank Indonesian students among the lowest in reading proficiency (OECD, 2018). As academic and professional settings increasingly rely on multimodal texts, higher education institutions must adapt their reading pedagogy to include visual literacy strategies. Without these innovations, EFL students may struggle to engage with contemporary reading materials, limiting their academic success and professional opportunities (Ban et al., 2024).

This study aims to address this critical research gap by exploring the development and effectiveness of visual information-based reading materials for EFL students in higher education. Building on research in visual literacy, cognitive theory, and reading comprehension, it contributes to the literature by designing, implementing, and evaluating structured materials that integrate visual elements in meaningful ways. The study employs a mixed-methods longitudinal design over three semesters to examine both learning outcomes and learner perceptions. It seeks to answer the following research questions:

1. How do EFL students perceive the effectiveness of visual information-based reading materials in enhancing their reading comprehension?
2. What are the impacts of integrating visual information into reading materials on students' reading comprehension performance?
3. How can visual information-based reading materials be systematically developed, validated, and implemented in higher education settings?

By answering these questions, this study provides empirical evidence to support the integration of visual literacy into EFL reading instruction and offers practical insights into innovative pedagogical practices that align with 21st-century literacy demands.

2. METHODS

2.1 Research Design

This study employed a mixed-methods longitudinal research design to investigate the effectiveness of visual information-based reading materials for EFL students in higher education. The longitudinal approach, spanning three academic semesters (18 months), allowed for tracking developmental changes in students' reading comprehension skills over time (Creswell & Creswell, 2017). This design aligns with recommendations from Guo et al. (2020) and Godina (2024) for examining literacy development through extended observation periods. The mixed-methods approach integrated quantitative assessment of reading comprehension performance with qualitative exploration of students' perceptions and experiences, providing comprehensive insights into the phenomenon under investigation (Johnson & Christensen, 2019).

2.2 Participants and Sampling Procedure

The study involved 250 undergraduate EFL students from three Indonesian public universities, selected via stratified random sampling. Based on a G*Power analysis (effect size *f* = 0.25, power = 0.95, α = 0.05), the minimum sample was 210, but 250 were recruited to account for attrition**.** Two hundred twenty-eight participants (91.2% retention) completed the study. Inclusion criteria required: (1) native Indonesian speakers in EFL programs, (2) enrolled in English academic reading courses, and (3) having completed at least one university semester**,** following Masunaga et al.'s (2023) guidelines.

Participants were randomly assigned to the experimental group (n = 115) or the control group (n = 113) using a computer-generated randomization sequence. Demographic characteristics are presented in Table 1.

Table 1. Demographic Characteristics of Participants

Characteristic		Experimental Group (n = 115)	Control Group (n = 113)	Total (N = 228)
Gender	Female	72 (62.6%)	70 (61.9%)	142 (62.3%)
	Male	43 (37.4%)	43 (38.1%)	86 (37.7%)
Age (years)	18-20	68 (59.1%)	65 (57.5%)	133 (58.3%)
	21-23	43 (37.4%)	42 (37.2%)	85 (37.3%)
	24-26	4 (3.5%)	6 (5.3%)	10 (4.4%)
Year of Study	Second year	62 (53.9%)	60 (53.1%)	122 (53.5%)
	Third year	39 (33.9%)	38 (33.6%)	77 (33.8%)
	Fourth-year	14 (12.2%)	15 (13.3%)	29 (12.7%)
English Proficiency Level (CEFR)	B1 (Intermediate)	59 (51.3%)	61 (54.0%)	120 (52.6%)
	B2 (Upper Intermediate)	42 (36.5%)	39 (34.5%)	81 (35.5%)
	C1 (Advanced)	14 (12.2%)	13 (11.5%)	27 (11.8%)
Major	English Education	64 (55.7%)	63 (55.8%)	127 (55.7%)
	English Literature	29 (25.2%)	28 (24.8%)	57 (25.0%)
	Linguistics	22 (19.1%)	22 (19.5%)	44 19.3%)

2.3 Development of Visual Information-Based Reading Materials

The development of visual information-based reading materials followed a systematic three-phase process informed by research in visual literacy and instructional design.

Phase 1: Needs Analysis and Content Selection

A needs analysis involving 15 EFL instructors (focus groups) and 120 students (surveys) identified key reading challenges in academic texts, following Ban et al.'s (2024) framework. Based on the findings, five thematic areas were selected for material development: (1) research articles, (2) argumentative essays, (3) instructional texts, (4) literary analysis, and (5) case studies.

Authentic reading materials for each thematic area were carefully selected from academic journals, textbooks, and reputable online sources, following Ruzegea and Msonde's (2021) selection criteria. These included relevance to undergraduate EFL curricula, appropriate linguistic complexity (Lexile range: 1000L–1300L), suitability for visual representation, and cultural appropriateness for Indonesian learners.

Phase 2: Visual Integration and Material Design

The selected texts were enhanced with visual elements following principles derived from Mayer's (2005) cognitive theory of multimedia learning and Paivio's (1991) dual coding theory. The visual integration process was guided by a framework developed by Guglietti (2023) and adapted for EFL contexts, encompassing four types of visual elements:

1. Representational visuals: Images, photographs, and illustrations directly depicting textual content to facilitate comprehension of concrete concepts.
2. Organizational visuals: Flowcharts, concept maps, and diagrams showing relationships between ideas to enhance understanding of text structure and argument flow.
3. Interpretational visuals: Infographics and data visualizations transforming numerical or complex information into visual formats to support analytical reasoning.
4. Transformational visuals: Visual metaphors and symbolic representations encouraging critical engagement with abstract concepts and facilitating deeper textual interpretation.

Following Retnaningtyas et al.'s (2024) guidelines for multimodal text design, the integrated materials maintained a balanced text-to-visual ratio (approximately 70:30) to avoid cognitive overload while providing sufficient visual support. The layout design incorporated principles of proximity, alignment, consistency, and contrast to optimize visual processing, as recommended by Bulut et al. (2024).

Effectiveness Matrix: Visual Types × Comprehension Domains

Visual Type	Literal Comprehension (Factual recall)	Inferential Comprehension (Implicit meaning)	Critical Comprehension (Analysis/evaluation)	Applied Comprehension (Transfer to new contexts)
Representational	✅✅✅ *High* (Images, photos)	✅ *Moderate* (Contextual clues)	❌ *Low*	❌ *Low*
Organizational	✅ *Moderate* (Structure aids recall)	✅✅✅ *High* (Flowcharts, concept maps)	✅✅ *High-Moderate* (Argument mapping)	✅ *Moderate* (Framework application)
Interpretational	❌ *Low*	✅✅ *High-Moderate* (Infographics, data viz)	✅✅✅ *High* (Evidence evaluation)	✅✅ *High-Moderate* (Analogical reasoning)
Transformational	❌ *Low*	✅ *Moderate* (Symbolic inference)	✅✅ *High-Moderate* (Abstract critique)	✅✅✅ *High* (Creative transfer)

Figure 1. The Effectiveness of Visual Types on Reading Comprehension

Phase 3: Expert Validation and Refinement

The materials were validated by a panel of 10 experts (5 EFL specialists, 3 instructional designers, 2 visual literacy experts) using a three-round Delphi method. They assessed content accuracy, visual-textual coherence, pedagogical suitability, and cultural relevance via a structured tool adapted from Zayeb et al. (2024).

Materials achieving a minimum validation score of 4.0 (on a 5-point scale) across all dimensions were retained, while others underwent revision based on expert feedback. The final set comprised 25 visual information-enhanced reading modules (five for each thematic area), each containing:

- An original academic text (1500-2000 words)
- Integrated visual elements (6-8 per text)
- Pre-reading activities orienting students to visual information
- During-reading comprehension scaffolds leveraging visual cues
- Post-reading reflection prompts encouraging visual-textual connections

Intervention Implementation

The intervention spanned three academic semesters (18 months), structured into six implementation cycles of 8 weeks each. Following Chung's (2024) recommendations for sustained literacy interventions, each cycle focused on one thematic area, with modules introduced weekly during 90-minute reading instruction sessions.

The experimental group received instruction using visual information-based reading materials, while the control group engaged with the same textual content without the integrated visual elements. Both groups received equal instructional time and covered identical content domains, differing only in the presence of structured visual information. This design controlled for potential confounding variables, as recommended by Mahdi et al. (2020) for educational intervention studies.

Instructional delivery followed a structured protocol developed based on Hazaymeh and Alomery's (2022) framework for visual-enhanced reading instruction. The protocol included:

1. Pre-reading phase (20 minutes): Vocabulary pre-teaching, background knowledge activation, and explicit instruction on visual interpretation strategies (experimental group only).
2. During the reading phase (40 minutes), guided reading is done with comprehension monitoring, text annotation, and visual-textual integration activities (experimental group) or traditional text annotation (control group).
3. Post-reading phase (30 minutes): Comprehension assessment, reflection discussion, and application activities.

To ensure fidelity, all 12 instructors completed a 30-hour training program on the instructional protocol. Classroom implementation was monitored through structured observations (minimum two per instructor per semester), showing strong inter-rater reliability ($\kappa = 0.87$) using Tiba's (2023) protocol.

2.4 Data Collection Instruments

Reading Comprehension Assessment

Students' reading comprehension was measured using a standardized assessment tool developed specifically for this study. Following guidelines from Temple (2024) for comprehensive literacy assessment, the instrument evaluated multiple dimensions of reading comprehension:

1. Literal comprehension: Multiple-choice and short-answer questions assessing factual recall and explicit information identification.
2. Inferential comprehension: Open-ended questions require students to draw conclusions, make predictions, and infer implicit meanings.
3. Critical comprehension: Analytical tasks evaluating students' ability to assess arguments, identify authorial purpose, and evaluate evidence quality.
4. Applied comprehension: Transfer tasks requiring the application of textual information to novel contexts.

Three parallel forms of the assessment were developed, one for each semester, with demonstrated equivalence through pilot testing. Content validity was established through expert review (Content Validity Index = 0.92), and construct validity was confirmed through factor analysis, which confirmed the four-dimensional structure. Reliability analysis yielded high internal consistency (Cronbach's α = 0.88) and test-retest reliability (r = 0.85).

Visual Literacy Assessment

Students' visual literacy skills were evaluated using an adapted version of the Visual Literacy Assessment Tool (VLAT) (Hanci, 2022), measuring five key dimensions: visual recognition, interpretation, analysis, evaluation, and creation. The instrument demonstrated strong psychometric properties, with high internal consistency (Cronbach's α = 0.84) and good construct validity confirmed through confirmatory factor analysis (CFI = 0.93, RMSEA = 0.06).

Student Perception Questionnaire

Students' perceptions were measured using a validated mixed-method questionnaire (Baz, 2020) comprising 25 Likert-scale items (assessing usefulness, engagement, comprehension support, and satisfaction) and open-ended questions about their experiences. The instrument demonstrated strong reliability (α = 0.86) and content validity (CVI = 0.89).

Semi-Structured Interviews

Semi-structured interviews with 45 participants (25 experimental, 20 control) provided deeper insights into their material experiences. Following Cuban and Arinder's (2022) framework, the 12-question protocol explored reading strategies, text/visual engagement, learning outcomes, and skill transfer. All 45–60-minute interviews were recorded and transcribed verbatim.

Reading Journals

All participants maintain reading journals to record strategies, challenges, and reflections. Experimental group journals additionally tracked visual-textual connections and visual comprehension strategies (Guglietti, 2023). With bi-weekly submissions, each participant produced ~15 entries during the intervention.

2.5 Data Collection Procedure

Data collection occurred at multiple points throughout the 18-month intervention period. Reading comprehension and visual literacy assessments were administered at four-time points: pre-intervention baseline (T0), end of semester one (T1), end of semester two (T2), and end of semester three (T3). To minimize testing effects, assessment administrations were spaced at least four months apart, and parallel forms were used for each administration.

The student perception questionnaire was administered at the conclusion of each implementation cycle (six administrations total), allowing for tracking shifts in perceptions over time. Semi-structured interviews were conducted at three points: after semester one, after semester two, and at the conclusion of the intervention. Reading journals were collected continuously throughout the intervention period.

All data collection procedures adhered to ethical standards approved by the institutional review board. Informed consent was obtained from all participants, and confidentiality was maintained through the use of participant identification codes rather than names.

2.5 Data Analysis

A comprehensive analytical approach combining quantitative and qualitative methods was employed to address the research questions.

Quantitative Analysis

A mixed between-within ANOVA analyzed comprehension and visual literacy scores, evaluating longitudinal changes (within subjects) and group differences (between subjects). The model adjusted for baseline reading proficiency, prior achievement, and demographics following Hamilton et al. (2023).

Effect sizes were calculated using partial eta squared (η^2p) to determine the magnitude of intervention effects, with values of 0.01, 0.06, and 0.14 representing small, medium, and large effects, respectively (Cohen, 2013). Additionally, a series of independent-sample t-tests with Bonferroni correction were conducted to examine between-group differences at each time point.

Quantitative data from the perception questionnaire were analyzed using descriptive statistics (means, standard deviations) and inferential statistics (repeated-measures ANOVA) to track changes in perceptions over time. Principal component analysis was employed to identify underlying dimensions of student perceptions, followed by multiple regression analysis to examine relationships between perception factors and comprehension outcomes.

Qualitative Analysis

Qualitative data were thematically analyzed following Braun and Clarke (2006), using NVivo 14. Two researchers independently coded 20% of the data (κ=0.84), resolving discrepancies through discussion to ensure coding consistency.

The coding framework, developed inductively from the data and deductively from the theoretical framework, encompassed four main domains: (1) engagement with visual information, (2) comprehension strategies, (3) perceived benefits and challenges, and (4) skill transfer. Within each domain, sub-themes were identified through constant comparative analysis (Glaser & Strauss, 2017).

Integration of Quantitative and Qualitative Findings

Following Sabogal Bedoya and Durán Narvaez (2024), we employed a convergent parallel design, analyzing datasets separately before integration. Joint displays revealed how visual information, comprehension, and student experiences are interrelated through convergences, divergences, and complementary patterns.

2.6 Reliability and Validity Measures

Multiple strategies were employed to enhance the study's trustworthiness. For quantitative components, instrument validity was established through expert review, pilot testing, and statistical validation. Reliability was ensured through the calculation of internal consistency coefficients and test-retest correlations. Implementation fidelity was monitored through structured classroom observations and instructor debriefing sessions.

For qualitative components, trustworthiness was established through member checking (participants reviewing interview transcripts and analytical interpretations), peer debriefing (researchers discussing emerging themes with colleagues not involved in the study), and maintaining an audit trail documenting all methodological decisions and analytical processes (Lincoln & Guba, 1985). Data triangulation across multiple sources (interviews, journals, questionnaires) enhanced the credibility of the findings.

2.7 Ethical Considerations

The study adhered to ethical guidelines for educational research. Institutional review board approval was obtained prior to participant recruitment. Informed consent was secured from all participants, who were informed of the study's purpose, procedures, potential risks and benefits, confidentiality measures, and their right to withdraw without penalty.

Participant confidentiality was maintained through the use of identification codes, secure data storage on encrypted servers, and restricted access to identifiable information. Following Cox et al.'s (2023) recommendations for ethical conduct in literacy research, particular attention was paid to potential power differentials between researchers and student participants, with measures implemented to ensure students felt no coercion to participate or provide socially desirable responses.

3. FINDINGS AND DISCUSSION

The results are presented according to three research questions, combining quantitative data from assessments and surveys with qualitative insights from interviews and journal entries. These integrations offer a comprehensive understanding of how visual information-based reading materials enhance EFL students' reading comprehension in higher education.

3.1 RQ1: EFL Students' Perceptions of Visual Information-Based Reading Materials

3.1.1 Quantitative Findings on Student Perceptions

Students' perceptions of the visual information-based reading materials were assessed using the Student Perception Questionnaire, administered at six points during the intervention. Table 2 displays the mean and standard deviations for the experimental group across four perception dimensions.

Table 2. Mean Scores of Experimental Group Students' Perceptions of Visual Information-Based Reading Materials (N=115)

Perception Dimension	Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 5	Cycle 6	Overall Mean
Perceived Usefulness	3.52 (0.71)	3.78 (0.64)	4.12 (0.58)	4.35 (0.52)	4.48 (0.49)	4.62 (0.41)	4.15 (0.56)
Engagement with Materials	3.41 (0.82)	3.75 (0.73)	4.08 (0.65)	4.29 (0.57)	4.52 (0.48)	4.67 (0.39)	4.12 (0.61)
Comprehension Support	3.63 (0.75)	3.92 (0.68)	4.21 (0.59)	4.44 (0.51)	4.57 (0.46)	4.71 (0.38)	4.25 (0.56)
Overall Satisfaction	3.38 (0.86)	3.82 (0.77)	4.17 (0.63)	4.41 (0.55)	4.61 (0.44)	4.75 (0.36)	4.19 (0.60)

Note: Values represent mean scores on a 5-point Likert scale with standard deviations in parentheses.

Repeated-measures ANOVA indicated significant perception improvements ($F(5,110)=42.38$, $^*p^*<.001$, $\eta^2_p=0.68$). Bonferroni-corrected comparisons confirmed progressive gains ($^*p^*<.01$), peaking between Cycles 1–3. Final scores (all >4.6/5) demonstrated sustained positive evaluations.

Comprehension support received the highest ratings (M=4.25, SD=0.56), underscoring students' appreciation for visual aids. PCA identified four perception components (73.8% total variance): visual-textual integration (28.4%), cognitive load reduction (19.7%), engagement (14.2%), and metacognitive support (11.5%).

3.1.2 Qualitative Insights on Student Perceptions

Thematic analysis of interview data and journal entries revealed nuanced insights into students' perceptions of visual information-based reading materials. Five predominant themes emerged: (1) enhanced comprehension of complex concepts, (2) increased engagement with academic texts, (3) improved retention of information, (4) development of critical reading skills, and (5) reduced cognitive barriers to English academic texts.

Students consistently reported that visual elements facilitated their understanding of complex academic concepts, particularly in scientific and technical texts. Fatima, a third-year English education student, explained:

> "*Before, when I encountered terms like 'cognitive load theory' or 'schema activation,' I would get stuck trying to understand what they meant. With the visual concept maps and process diagrams, I could see how these theories worked in practice. It's like the visuals translated abstract ideas into something concrete that I could grasp.*" (Interview, Semester 2)

This sentiment was echoed by Budi, who elaborated on how visual elements helped overcome language barriers:

"*As a non-native English speaker, I sometimes struggle with specialized vocabulary. The infographics with labeled components and color-coded relationships helped me understand complex systems without getting lost in terminology. I found myself referring to the visuals first to get the big picture, then diving into the text for details.*" (Journal Entry, Week 14)

The visual elements appeared particularly valuable for sustaining engagement with challenging academic texts. Anisa, a second-year student with intermediate English proficiency, described:

"*Academic reading used to feel overwhelming—walls of text that made me want to give up. The visual breaks in these materials gave my brain a rest while still conveying information. I noticed I could read for longer periods without feeling mentally exhausted. The visual timelines and comparison charts made me curious about the details in the text.*" (Interview, Semester 1)

Several students highlighted how visual elements enhanced their information retention. Dian, a fourth-year student, reflected:

"*When preparing for exams, I found I could recall information from visually enhanced texts much more easily. I would visualize the diagram or chart first, and then the associated textual information would come back to me. Even months later, I can still describe the visual representation of research methodologies we studied in the first semester.*" (Interview, Semester 3)

Critical reading skill development emerged as another significant perception theme. Rahman, a third-year linguistics student, observed:

"*The visual data presentations taught me to be more critical of information. Seeing quantitative information in charts alongside text claims made me more attentive to how evidence supports arguments. I started asking questions like 'Does this visual actually support what the author is claiming?' It's changed how I approach all academic reading now.*" (Journal Entry, Week 27)

Qualitative data confirmed the high comprehension ratings, demonstrating how growing visual literacy skills increased material effectiveness. They further revealed distinct visual functions: representational visuals supported vocabulary, while organizational visuals clarified text structure and argument flow – highlighting the importance of targeted visual-text alignment.

To know the effectiveness of visual types related to reading comprehension, Figure 1 assisted as below.

Effectiveness Matrix: Visual Types × Comprehension Domains

Visual Type	Literal Comprehension (Factual recall)	Inferential Comprehension (Implicit meaning)	Critical Comprehension (Analysis/evaluation)	Applied Comprehension (Transfer to new contexts)
Representational	✅✅✅ *High* (Images, photos)	✅ *Moderate* (Contextual clues)	❌ *Low*	❌ *Low*
Organizational	✅ *Moderate* (Structure aids recall)	✅✅✅ *High* (Flowcharts, concept maps)	✅✅ *High-Moderate* (Argument mapping)	✅ *Moderate* (Framework application)
Interpretational	❌ *Low*	✅✅ *High-Moderate* (Infographics, data viz)	✅✅✅ *High* (Evidence evaluation)	✅✅ *High-Moderate* (Analogical reasoning)
Transformational	❌ *Low*	✅ *Moderate* (Symbolic inference)	✅✅ *High-Moderate* (Abstract critique)	✅✅✅ *High* (Creative transfer)

Figure 1. The Effectiveness of Visual Types on Reading Comprehension

3.2 RQ2: Impact of Visual Information Integration on Reading Comprehension Performance

3.2.1 Quantitative Results on Reading Comprehension Performance

Reading comprehension performance was measured using standardized assessments administered at baseline (T0) and at the end of each semester (T1, T2, T3). Table 3 presents the mean scores and standard deviations for both experimental and control groups across all assessment periods.

Table 3. Reading Comprehension Performance Across Assessment Periods

Comprehension Dimension	Group	Baseline (T0)	Semester 1 (T1)	Semester 2 (T2)	Semester 3 (T3)	Mean Change (T0-T3)
Literal Comprehension	Experimental	68.45 (9.87)	75.82 (8.53)*	83.67 (7.21)**	89.43 (6.12)**	+20.98
	Control	67.92 (9.65)	71.34 (8.98)	74.51 (8.32)	77.83 (7.86)	+9.91
Inferential Comprehension	Experimental	59.23 (10.56)	69.47 (9.21)*	78.31 (7.85)**	85.72 (6.54)**	+26.49
	Control	58.97 (10.43)	63.25 (9.76)	67.48 (8.94)	70.36 (8.23)	+11.39
Critical Comprehension	Experimental	52.36 (11.23)	64.78 (9.87)**	76.22 (8.32)**	84.91 (7.15)**	+32.55
	Control	52.58 (10.98)	56.92 (10.21)	61.35 (9.27)	65.87 (8.65)	+13.29
Applied Comprehension	Experimental	49.74 (11.54)	63.92 (10.21)**	76.81 (8.64)**	86.25 (7.32)**	+36.51
	Control	50.12 (11.32)	54.68 (10.85)	59.42 (9.73)	64.13 (8.98)	+14.01
Overall Comprehension	Experimental	57.44 (10.42)	68.49 (9.25)**	78.75 (7.87)**	86.58 (6.75)**	+29.14
	Control	57.39 (10.27)	61.55 (9.84)	65.69 (8.92)	69.55 (8.34)	+12.16

*Note: Values represent mean percentage scores with standard deviations in parentheses.

- $p < .05$, ** $p < .01$ for between-group differences.*

Mixed between-within subjects ANOVA revealed significant main effects for time ($F(3, 224) = 287.43$, $p < .001$, $\eta^2_p = 0.72$), group ($F(1, 226) = 93.78$, $p < .001$, $\eta^2_p = 0.29$), and a significant time × group interaction ($F(3, 224) = 116.25$, $p < .001$, $\eta^2_p = 0.56$). The large effect size for the interaction term indicates that the experimental group's improvement trajectory differed substantially from the control group's.

While both groups showed improvement over time, the experimental group demonstrated significantly greater gains across all comprehension dimensions. The most pronounced differences appeared in critical comprehension (32.55 percentage point increase vs. 13.29) and applied comprehension (36.51 percentage point increase vs. 14.01), suggesting that visual information particularly enhanced higher-order reading skills.

Pearson correlation analyses were conducted to examine the relationship between visual literacy skills and reading comprehension performance. Strong positive correlations were found between visual literacy scores and all comprehension dimensions in the experimental group at T3: literal ($r = 0.67$, $p < .001$), inferential ($r = 0.73$, $p < .001$), critical ($r = 0.82$, $p < .001$), and applied ($r = 0.85$, $p < .001$). Multiple regression analysis showed that visual literacy skills significantly predicted overall reading comprehension performance ($\beta = 0.76$, $p < .001$), explaining 58% of the variance.

3.2.2 Qualitative Insights on Reading Comprehension Impact

The qualitative data provided rich contextual explanations for the quantitative comprehension. Analysis of interview transcripts and journal entries revealed that visual information enhanced reading comprehension through multiple mechanisms: scaffolding complex information processing, providing alternative representation pathways, facilitating inference generation, and supporting metacognitive monitoring.

Students frequently described how visual elements helped them process complex information more efficiently. Maya, a second-year English literature student, explained:

> "*When reading about research methodologies with complex procedures, the sequential diagrams helped me understand each step and how they connected. Without them, I would have had to reread paragraphs multiple times to grasp the whole process. The visuals created a mental framework that helped me organize the textual information as I read.*" (Interview, Semester 2)

For many students, the visuals provided alternative pathways to comprehension when linguistic barriers arose. Surya, a third-year student with B1 English proficiency, reflected:

> "*Scientific texts contain specialized terminology that sometimes blocks my understanding. The labeled diagrams provided a visual vocabulary that helped me decipher unfamiliar terms through context. When I encountered 'morphological awareness' in a linguistics text, the accompanying visual showing word-formation processes clarified the concept immediately, even before I fully understood the definition.*" (Journal Entry, Week 22)

The development of inferential comprehension skills was particularly evident in students' reflections. Lina, a fourth-year linguistics student, observed:

> "*The comparative charts showing contrasting theoretical perspectives helped me notice patterns and relationships not explicitly stated in the text. I found myself drawing conclusions about theoretical limitations based on what the visual representations revealed was missing. This helped me respond to inferential questions that asked about implications not directly stated.*" (Interview, Semester 3)

Several students reported that visual elements enhanced their metacognitive monitoring during reading. Ahmad, a third-year student, explained:

"*The visual concept maps at the beginning of each section helped me monitor my understanding as I read. If I couldn't connect what I was reading to the visual framework, it was a signal that I needed to reread or seek clarification. This made me more aware of when I wasn't fully comprehending, instead of just passively reading through difficult sections.*" (Journal Entry, Week 31)

The qualitative data showed different types of visuals supported different levels of reading comprehension. Representational visuals aided literal understanding, organizational visuals helped with inferential comprehension, interpretational visuals supported critical thinking, and transformational visuals enhanced applied comprehension. These findings aligned with the quantitative results, especially highlighting strong improvements in critical and applied comprehension due to the impact of interpretational and transformational visuals.

"*The visual metaphors comparing language acquisition theories to different types of plant growth made me think about the theories in new ways. This visual thinking transferred to other contexts—I started creating my own visual analogies to understand complex concepts in other courses, applying what I'd learned from these materials.*" (Interview, Semester 3)

The integration of quantitative and qualitative findings suggests that visual information did not merely make reading more accessible but fundamentally transformed students' approach to text processing. The visual elements appeared to scaffold the development of sophisticated reading strategies that students increasingly internalized over time, explaining the accelerating performance trajectory observed in the experimental group.

3.3 RQ3: Systematic Development and Implementation of Visual Information-Based Reading Materials

3.3.1 Quantitative Evaluation of Material Development and Implementation

The effectiveness of the material development and implementation process was evaluated through expert validation ratings and implementation fidelity assessments. Table 4 presents the expert validation ratings for the developed materials across four evaluation dimensions.

Table 4. Expert Validation Ratings of Visual Information-Based Reading Materials

Evaluation Dimension	Initial Rating (Round 1)	Revised Rating (Round 2)	Final Rating (Round 3)	Improvement
Content Accuracy	4.12 (0.58)	4.47 (0.43)	4.82 (0.31)	+0.70
Visual-Textual Coherence	3.65 (0.72)	4.29 (0.52)	4.75 (0.38)	+1.10
Pedagogical Appropriateness	3.89 (0.63)	4.36 (0.47)	4.78 (0.35)	+0.89
Cultural Relevance	3.72 (0.68)	4.31 (0.49)	4.68 (0.37)	+0.96
Overall Quality	3.84 (0.65)	4.36 (0.48)	4.76 (0.35)	+0.92

Note: Values represent mean ratings on a 5-point scale with standard deviations in parentheses.

The iterative validation process yielded significant improvements across all dimensions, with the most substantial gains in visual-textual coherence (+1.10 points). The final materials exceeded the predetermined quality threshold (4.0) across all dimensions, with particularly high ratings for content accuracy (4.82) and pedagogical appropriateness (4.78).

Implementation fidelity was assessed through structured classroom observations conducted throughout the intervention period. Analysis of observation data revealed high implementation

fidelity, with instructors adhering to 92.7% of protocol elements on average (SD = 4.3%). Fidelity was highest for the pre-reading phase (95.8%) and lowest for the post-reading phase (88.6%), suggesting areas for refinement in future implementations.

Correlation analysis revealed significant positive relationships between implementation fidelity and student outcomes. Higher implementation fidelity was associated with greater reading comprehension gains (r = 0.68, p < .001) and more positive student perceptions (r = 0.72, p < .001). Multiple regression analysis indicated that implementation fidelity significantly predicted reading comprehension improvement (β = 0.63, p < .001), explaining 39% of the variance when controlling for student characteristics.

3.3.2 Qualitative Insights on Material Development and Implementation

Thematic analysis of instructor feedback and student reflections provided valuable insights into the development and implementation process. Four key themes emerged: (1) the importance of iterative refinement, (2) the need for systematic scaffolding of visual literacy skills, (3) the value of cultural contextualization, and (4) the role of instructor training in effective implementation.

Instructors emphasized the benefits of the iterative development process in creating materials that effectively integrated visual and textual elements. Professor Nugroho, who taught in the experimental condition, reflected:

> "*The multi-stage development process was crucial for creating truly integrated materials rather than just texts with added pictures. The expert feedback helped identify instances where visuals seemed disconnected from the text or failed to enhance understanding. By the third iteration, the visual elements felt essential to the reading experience rather than supplementary.*" (Instructor Interview, Semester 2)

Both students and instructors highlighted the importance of explicitly teaching visual literacy skills alongside traditional reading strategies. Dr. Widodo explained:

> "*Initially, I assumed students would naturally know how to interpret the visual elements, but I quickly realized they needed structured guidance. The most effective implementation occurred when I explicitly taught students how to decode different types of visuals, make connections between visual and textual information, and evaluate the relationship between them. This scaffolding was essential for students to benefit fully from the materials.*" (Instructor Interview, Semester 1)

Putri, a second-year student, confirmed this observation:

> "*At first, I didn't know how to use the visuals effectively—I just glanced at them and moved on to the text. The structured activities teaching us to analyze visual elements changed everything. I learned specific strategies for different visual types: how to trace process flows in diagrams, identify key comparison points in charts, and connect symbolic representations to abstract concepts.*" (Journal Entry, Week 11)

Cultural contextualization emerged as a critical factor in material effectiveness. Students responded most positively to materials that incorporated culturally familiar visual references. Aditya, a third-year student, explained:

> "*The infographics using local contexts to explain theoretical concepts made abstract ideas immediately relatable. When explaining discourse analysis through visual examples from Indonesian social media*

communication patterns, I could connect the theory to my everyday experience. These culturally relevant visuals created an entry point into difficult concepts." (Interview, Semester 2)

The qualitative data highlighted implementation challenges not captured in the quantitative fidelity measures. While instructors demonstrated high adherence to the instructional protocol, they reported initial uncertainty about balancing attention between visual and textual elements. Professor Sari reflected:

"*During early implementation, I struggled with time management—giving sufficient attention to visual analysis while ensuring thorough engagement with the text. Through experience, I developed a more integrated approach, treating visual and textual elements as complementary rather than sequential components. This integration was key to effective implementation.*" (Instructor Interview, Semester 3)

Students' reflections on the implementation process revealed developmental patterns that were not evident in the quantitative data. Many described an evolving relationship with the visual elements as their skills developed. Reza, a fourth-year student, explained:

"*In the beginning, I used visuals mainly as comprehension aids when I struggled with the text. By the final semester, I was using them proactively to predict text content, identify organizational patterns, and evaluate argumentative coherence. My engagement with visuals evolved from remedial to strategic.*" (Interview, Semester 3)

The integration of findings reveals key insights: quantitative data showed the materials' technical quality, while qualitative data uncovered their impact on learning processes. Effective visual-based reading materials require both technical excellence and thoughtful implementation, including visual literacy instruction and cultural adaptation.

3.3.3 Integration of Findings Across Research Questions

The study demonstrates that visual-based reading materials significantly enhance EFL reading comprehension in higher education, with strong evidence showing a reciprocal relationship between student perceptions and performance gains ($r = 0.74$, $p < .001$). As students developed greater visual literacy skills through explicit instruction and high-quality implementation, they not only improved their content understanding but also cultivated deeper analytical and transferable reading abilities. The findings reveal that representational visuals effectively supported vocabulary acquisition while organizational visuals aided text structure comprehension, highlighting the importance of strategically matching visual types to specific learning objectives. This research provides empirical support for integrating multimodal approaches in EFL instruction, addressing a critical gap in preparing students for academic reading demands in visually rich educational contexts.

Discussion

This study offers compelling evidence that visual information-based reading materials significantly enhance EFL students' academic reading comprehension in higher education. By integrating quantitative assessments, perception surveys, and qualitative data from interviews and journal entries, the findings provide a comprehensive view of how visuals influence learners cognitively, affectively, and metacognitively. These results align with established multimedia learning theories, particularly Dual Coding Theory (Paivio, 1991) and the Cognitive Theory of Multimedia Learning (Mayer, 2005), which posit that information presented through both verbal and visual

channels can support deeper learning and memory retention. In this study, the structured integration of visual elements into reading tasks appears to scaffold student understanding of complex academic content, especially in scientific and technical texts.

Quantitative data from repeated-measures analysis indicated statistically significant improvements in students' perceptions of the visual materials over six instructional cycles. Perceived usefulness, engagement, and comprehension support all increased steadily, with comprehension support receiving the highest ratings. Principal Component Analysis (PCA) further revealed that students' positive perceptions were driven by four key components: visual-textual integration, cognitive load reduction, engagement, and metacognitive support. These findings suggest that visuals not only facilitated comprehension but also played a role in reducing the mental strain associated with processing dense academic texts—an effect supported by existing research on visual scaffolding in second language learning (Chun & Plass, 1996; Sweller, 2011).

Qualitative findings offered rich insight into the mechanisms behind these perceptions. Students consistently described how visuals—such as diagrams, infographics, and timelines—made abstract concepts more concrete, improved information retention, and increased motivation to engage with challenging texts. Many reported that visual elements helped them overcome linguistic barriers, particularly when dealing with technical vocabulary. This aligns with research suggesting that visuals can act as compensatory tools in foreign language contexts, allowing learners to access meaning through alternative cognitive pathways (Plass, Moreno, Brünken, & Leutner, 2010). Over time, students demonstrated growing visual literacy skills, transitioning from passive readers to strategic learners who could decode visuals, draw inferences, and critically evaluate the alignment between visuals and textual claims. These outcomes echo Mayer's (2017) view that well-integrated visuals can foster deeper learning when learners are taught how to interpret them effectively.

The impact of visual integration on reading comprehension performance was equally significant. The experimental group outperformed the control group across all comprehension dimensions—literal, inferential, critical, and applied—with particularly large gains in higher-order comprehension. Mixed ANOVA results revealed a strong interaction effect between time and group, indicating that the visual materials contributed uniquely to the experimental group's accelerated improvement. The most substantial increases occurred in critical (+32.55 points) and applied (+36.51 points) comprehension, suggesting that visuals supported analytical and transfer-related reading skills. Correlation and regression analyses further underscored the importance of visual literacy, which emerged as a significant predictor of comprehension performance. These findings are consistent with prior studies showing that visual elements enhance reading comprehension by supporting mental model construction and inference generation (Schnotz & Bannert, 2003).

Qualitative data provided valuable contextualization of these patterns. Students reported that visuals helped them mentally organize complex information, identify relationships between ideas, and monitor their own comprehension. Visuals such as comparative charts and concept maps were particularly effective in helping students draw inferences and recognize theoretical contrasts, even when such information was not explicitly stated in the text. These accounts support the view that visuals not only aid understanding but also foster critical engagement and metacognitive awareness—outcomes central to academic literacy development (Grabe & Stoller, 2011). Moreover, students' reflections revealed that they gradually internalized visual reading strategies, evolving from using visuals as remedial tools to proactively leveraging them for prediction, organization, and evaluation. This developmental trajectory demonstrates that visual supports, when coupled with explicit instruction, can cultivate autonomous academic readers.

The process of developing and implementing the visual-based materials was also critical to their effectiveness. Expert validation across three rounds showed substantial improvement in content accuracy, visual-textual coherence, pedagogical appropriateness, and cultural relevance. Final ratings exceeded established quality benchmarks, with the highest scores in content accuracy and coherence. High implementation fidelity—measured through structured classroom observations—was

significantly associated with greater reading comprehension gains and more favorable student perceptions. These findings support the conclusion that quality visual materials must be both technically sound and delivered consistently to produce meaningful learning outcomes (Seufert, 2003).

Instructor and student reflections reinforced these conclusions, emphasizing the importance of iterative material refinement, systematic scaffolding of visual literacy, and cultural contextualization. Instructors noted that visuals were most effective when explicitly taught and integrated into broader reading strategies rather than treated as supplementary. Students confirmed that structured training in visual interpretation strategies enhanced their ability to extract meaning and connect visual and textual information. Additionally, materials that incorporated culturally relevant imagery and contexts were more relatable and engaging, helping students connect abstract academic concepts to their lived experiences. These observations support calls in the literature for culturally responsive pedagogy and multimodal instructional design in EFL settings (Gay, 2010; Kress, 2010).

Ultimately, the integration of findings across all three research questions reveals a reciprocal relationship between perception and performance. As students developed visual literacy through high-quality, explicitly scaffolded materials, their reading comprehension improved—particularly in the more complex areas of critical and applied understanding. Visual types had distinct instructional roles: representational visuals supported vocabulary acquisition, organizational visuals aided text structure comprehension, interpretational visuals fostered critical thinking, and transformational visuals enabled knowledge transfer. These insights support a more nuanced application of dual coding and multimedia learning theories, which recognize that not all visuals function identically and that their effectiveness depends on alignment with specific learning objectives (Mayer, 2021; Paivio, 1991).

In sum, this study makes a substantial contribution to the field by demonstrating that carefully designed and systematically implemented visual-based reading materials can not only improve EFL students' comprehension but also transform their approach to reading itself. The findings underscore the need for continued research on multimodal instruction in linguistically diverse learning contexts and offer practical guidance for integrating visuals into EFL curriculum design to support deep, transferable academic literacy.

4. CONCLUSION

This study demonstrates that visual-based reading materials significantly enhance reading comprehension in EFL higher education by facilitating cognitive scaffolding and aiding text processing. Findings highlight the role of visual elements in supporting comprehension at various levels, from basic understanding to critical analysis. While aligning with existing theories, the study advances research by systematically integrating visual information into reading pedagogy. It also underscores the need for explicit visual literacy instruction. Limitations include a focus on Indonesian EFL learners and no long-term assessment. Future research should explore digital/interactive visual technologies, long-term effects, and tailored approaches for diverse contexts. Adopting multimodal methods can better prepare students for an increasingly visual and digital academic world.

REFERENCES

Ban, S., Lan, X., Li, Z., & Mao, Y. (2024). Visual Attention Allocation and Fixation Transactions in Reading Primary Scientific Literature. *Journal of Baltic Science Education, 23*(5), 826-853. https://eric.ed.gov/?id=EJ1445469

Baz, M. A. (2020). Improving Visual Literacy Skills through News Photos. *Journal of Inquiry Based Activities, 10*(1), 61-82. https://eric.ed.gov/?id=EJ1265706

Bulut, M., Bulut, A., Kaban, A., & Kirbas, A. (2024). Exploring the Nexus of Technology, Digital, and Visual Literacy: A Bibliometric Analysis. *International Journal of Education in Mathematics, Science and Technology, 12*(2), 345-363. https://doi.org/10.46328/ijemst.3777

Chuang, C., & Jamiat, N. (2023). A Systematic Review on the Effectiveness of Children's Interactive Reading Applications for Promoting Their Emergent Literacy in the Multimedia Context. *Contemporary Educational Technology, 15*(2), Article ep412. https://eric.ed.gov/?id=EJ1385467

Chung, S. (2024). Children's Reading of Visuals in Informational Picturebooks and Biographies. *International Journal on Social and Education Sciences, 6*(3), 409-426. https://eric.ed.gov/?id=EJ1437128

Cohen, J. (2013). *Statistical power analysis for the behavioral sciences*. Routledge.

Cox, A., Nolte, A., & Pratesi, A. L. (2023). Investigating Faculty Perceptions of Information Literacy and Instructional Collaboration. *Communications in Information Literacy, 17*(2), Article 5, 407-423. https://eric.ed.gov/?id=EJ1413193

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.

Cuban, S., & Arinder, J. A. (2022). "It's Better That She Sees Me": Digital Visual Literacy Narratives of Women Immigrants in Chile and Implications for Adult Literacy. *Adult Literacy Education, 4*(1), 6-19. https://eric.ed.gov/?id=EJ1344723

Dougherty, C. N., & Gregg, C. R. (2024). Graphic Novels as the Forger's Tool for Literacy. *English in Texas, 54*(1), 46-52. https://eric.ed.gov/?id=EJ1439950

Gabriel, N., & Mpofu, N. (2024). Learning Activities Used for Reading Literacy Instruction in Selected Namibian Primary Schools. *South African Journal of Childhood Education, 14*(1), Article 1393. https://eric.ed.gov/?id=EJ1418313

Giefer, C., & Henderson, W. (2024). The Potential of Learner-Generated Podcasts for Reading in Occupational Therapy Education. *Journal of Occupational Therapy Education, 8*(4), Article 5. https://eric.ed.gov/?id=EJ1447846

Glaser, B., & Strauss, A. (2017). *Discovery of grounded theory: Strategies for qualitative research*. Routledge.

Godina, H. (2024). Longitudinal Analysis of Hispanic Literacy Development in the Southwestern US: Addressing the Fourth-Grade Slump and Corresponding Matthew Effect. *International Journal on Social and Education Sciences, 6*(4), 517-534. https://eric.ed.gov/?id=EJ1451278

Guglietti, M. V. (2023). Redefining Visual Literacy in an Era of Visual Overload: The Use of Reflective Visual Journals to Expand Students' Visual Thinking. *Journal of University Teaching and Learning Practice, 20*(4), Article 3. https://eric.ed.gov/?id=EJ1393580

Guo, Y., Puranik, C., Kelcey, B., Sun, J., Schneider Dinnesen, M., & Breit-Smith, A. (2020). The Role of Home Literacy Practices in Kindergarten Children's Early Writing Development: A One-Year Longitudinal Study. *Grantee Submission*. https://eric.ed.gov/?id=ED605982

Hamilton, A., Downer, T., Flanagan, B., & Chilman, L. (2023). The Use of ePortfolio in Health Profession Education to Demonstrate Competency and Enhance Employability: A Scoping Review. *Journal of Teaching and Learning for Graduate Employability, 14*(1), 154-166. https://eric.ed.gov/?id=EJ1396243

Hanci, H. (2022). Investigation of High School Students' Visual Literacy Levels. *International Journal of Research in Education and Science, 8*(3), 611-625. https://eric.ed.gov/?id=EJ1346824

Hazaymeh, W. A., & Alomery, M. K. (2022). The Effectiveness of Visual Mind Mapping Strategy for Improving English Language Learners' Critical Thinking Skills and Reading Ability. *European Journal of Educational Research, 11*(1), 141-150. https://eric.ed.gov/?id=EJ1329573

Layes, S., & Layes, K. (2023). Study on the Concurrent Role of Phonological Processing and Visual Perception Abilities in Word Reading in Arabic: A Follow-Up Study. *Arab Journal of Applied Linguistics, 8*(2), 1-37. https://eric.ed.gov/?id=EJ1417063

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic Inquiry*. SAGE Publications.

Linstone, H. A., & Turoff, M. (Eds.). (2002). *The Delphi Method: Techniques and Applications*. Addison-Wesley.

Mahdi, O. R., Nassar, I. A., & Almuslamani, H. A. I. (2020). The Role of Using Case Studies Method in Improving Students' Critical Thinking Skills in Higher Education. *International Journal of Higher Education, 9*(2), 297-308. https://eric.ed.gov/?id=EJ1248562

Masunaga, J., Peng, L., & Ford-Baxter, T. (2023). Information Literacy in English-Language Higher Education Teaching Journals: A Review. *Communications in Information Literacy, 17*(2), 353-377. https://doi.org/10.15760/comminfolit.2023.17.2.3

Mayer, R. E. (Ed.). (2005). *The Cambridge handbook of multimedia learning.* Cambridge university press.

Ndungu, M. W. (2024). Integrating Basic Artificial Intelligence Literacy into Media and Information Literacy Programs in Higher Education: A Framework for Librarians and Educators. *Journal of Information Literacy, 18*(2), 122-139. https://eric.ed.gov/?id=EJ1456012

Organisation for Economic Co-operation and Development (OECD). (2018). *PISA 2018 Results (Volume I): What Students Know and Can Do*. OECD Publishing.

Paivio, A. (1991). Dual Coding Theory: Retrospect and Current Status. *Canadian Journal of Psychology, 45*(3), 255-287.

Ramulumo, M. (2024). Exploring the Impact of Early STEM Education on Science and Visual Literacy. *Journal of Education in Science, Environment and Health, 10*(3), 216-229. https://eric.ed.gov/?id=EJ1436752

Retnaningtyas, N., Damaianti, V. S., Mulyati, Y., & Sastromiharjo, A. (2024). Students' Abilities in Reading Infographics Text in Junior High Schools. *International Journal of Language Education, 8*(3), 487-502. https://eric.ed.gov/?id=EJ1443758

Ruzegea, M., & Msonde, S. (2021). University Students' E-Resource Usage: Predictors, Problems and Practical Implications. *International Journal of Education and Development using Information and Communication Technology, 17*(2), 104-119. https://eric.ed.gov/?id=EJ1298155

Sabogal Bedoya, J. M., & Durán Narvaez, N. C. (2024). Community-Based Explorations and Visual Literacies: A Key Interplay to Enhance Writing Skills in Early High School Students. *GIST Education and Learning Research Journal, 28*, 29-58. https://eric.ed.gov/?id=EJ1453229

Taheri, R., & Pennington, S. E. (2024). The Role of Teacher Education in Improving Digital Literacy: A Pre-Service Teacher Case Study. *Networks: An Online Journal for Teacher Research, 25*(2), Article 6. https://eric.ed.gov/?id=EJ1446794

Temple, C. (2024). What Does Science Tell Us about Teaching Reading? *Journal of Educational Sciences, 25*(2), 123-138. https://eric.ed.gov/?id=EJ1457390

Tiba, C. (2023). Motivation to Explicitly Teach Reading Comprehension Strategies after a Workshop. *Reading & Writing: Journal of the Literacy Association of South Africa, 14*(1), Article 405. https://eric.ed.gov/?id=EJ1393183

Toscano-Fuentes, C., Fernández-Corbacho, A., & Fonseca-Mora, M. C. (2024). Towards Affective Literacy for Adult Migrants: A Systematic Literature Review. *Australian Journal of Adult Learning, 64*(3), 376-400. https://eric.ed.gov/?id=EJ1452753

Yuan, M., & Xu, D. (2024). A Practical Exploration of Teacher Training for Child Reading Education in China: A Case Study of Qinjinmuyu's "Reading Teacher Professional Competence Certification" Program. *Science Insights Education Frontiers, 25*(2), 4163-4181. https://eric.ed.gov/?id=EJ1456854

Zayeb, A. J., Aleidan, A. A., & Ali, N. G. (2024). The Power of Visuals: The Significance of Higher Education Teacher Professional Development in Visual Literacy in Kuwait. *World Journal of Education, 14*(1), 79-95. https://eric.ed.gov/?id=EJ1427116