

Design as Literacy: Unlocking EFL Reading and Writing Through the Read–Write–Design Framework

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ABSTRACT

Contemporary communication is multimodal, yet English as a foreign language (EFL) instruction still treats multimodal design as enrichment appended to reading and writing rather than a literacy in its own right. This exploratory mixed-methods study examined the feasibility of a Read–Write–Design (RWD) framework — which positions technology-mediated design as a recursive partner to reading and writing rather than a terminal product — in secondary EFL classrooms, and asked how teachers experienced enacting it. An eleven-week unit was delivered to 24 Grade 10 students in Abu Dhabi's Al-Dhafra region and studied through a single-group pre–post design paired with semi-structured interviews of seven teachers. Because the pre- and post-tasks were curriculum-aligned but not equated, and no control group was used, quantitative results are reported as indicative rather than as treatment effects: students' performance on reading and writing tasks improved markedly, and post-test design performance was the strongest correlate of overall literacy ($r = .70$, 95% CI [.42, .86]). These correlational patterns are interpreted cautiously given the small sample. The qualitative strand provides the study's principal contribution: teachers described reading, writing, and design consolidating into a single recursive cycle in which composing a digital story repeatedly returned students to re-read and revise. The findings offer a hypothesis-generating account of design as an integrative loop, with implications for professional development, instructional time, and curricular support.

Keywords: digital storytelling, EFL reading and writing, multimodal composition, multiliteracies, Read–Write–Design

INTRODUCTION

In the United Arab Emirates, English occupies a high-stakes position within public secondary education as a core subject and a gateway to higher education and the labour market. Public secondary schooling is delivered through the Ministry of Education's Bridge to Success programme, which streams learners into Advanced and General tracks and organises instruction around thematic units; the Grade 9 curriculum, for instance, includes a Film and Media unit that foregrounds multimodal texts. Yet despite this multimodal orientation in curriculum content, classroom literacy practice has remained predominantly print-based, and assessment has continued to privilege conventional reading and writing, leaving the productive, design-oriented dimension of multiliteracies largely unaddressed in both pedagogy and measurement. The present study was conducted in public secondary schools in one region of the UAE, a setting in which the tension between a multimodal curriculum and print-bound practice is especially visible.

Reading and writing have long anchored EFL literacy instruction, yet the communicative world for which that instruction prepares learners is irreducibly multimodal. Meaning is increasingly made through the orchestration of linguistic, visual, audio, spatial, and gestural resources, and competence increasingly means the capacity to design across these modes rather than to decode and encode print alone (Kress, 2010; New London Group, 1996). The technologies that mediate this multimodal communication — levelled reading platforms,

multimodal authoring applications, and, increasingly, generative artificial intelligence — are now ordinary in well-resourced school systems, and a substantial body of computer-assisted language learning (CALL) research examines how learners read and compose with them. What remains far less settled is the pedagogical status of the design work these tools make possible. Is the multimodal artefact a learner produces — an infographic, a slide deck, a digital story — a motivational supplement to the real business of reading and writing, or is it a literacy in its own right that, when properly sequenced, reorganises how reading and writing are learned? This study explores that question, asking whether positioning multimodal design as a co-equal third literacy, technologically integrated with reading and writing, is associated with improved EFL reading and writing outcomes in secondary classrooms, and how teachers experience enacting such a pedagogy.

Empirical interest in digital multimodal composing (DMC) has accelerated, and the field has begun to consolidate. Agenda-setting reviews now map DMC as a maturing programme of second-language research with distinctive constructs, methods, and pedagogical implications (Jiang & Hafner, 2024; Lim & Kessler, 2024; Yu et al., 2024), and process-oriented studies show that multimodal composing reshapes how learners plan, self-assess, and revise (Zhang & Yu, 2024). These reviews converge on a striking observation: although the volume of DMC scholarship has grown rapidly, much of it documents learners' composing processes and perceptions rather than measured learning gains, and the studies that do report outcomes are concentrated in higher-education writing courses. The secondary EFL classroom — where reading and writing are taught together, under curricular constraints, to adolescents — remains comparatively under-examined.

Where intervention evidence does exist, it is encouraging. Carcamo and Pino (2025) found gains in EFL students' multimodal literacy through infographic composition; Hidayat et al. (2024) reported improved EFL reading comprehension through digital storytelling; Lai (2024) demonstrated, in a quasi-experimental study, that multimodal task design strengthened communicative competence; and Fan (2025) showed that implementing multiliteracies with learning-oriented assessment shifted an EFL curriculum from text-centric toward genuinely multimodal practice. A fast-growing strand now integrates generative AI into multimodal composition, examining AI as a design partner and as an assessment aid, and reporting both opportunities and risks for learner agency (Cui et al., 2025; Lin et al., 2025; Ni & Lam, 2025). Across these studies, design-rich, technology-mediated tasks are repeatedly associated with improved engagement and, in several cases, improved language outcomes.

Two limitations nonetheless recur. First, as a recent systematic review concludes, rigorous pre-post intervention designs remain scarce in this literature, which is dominated by qualitative case studies and perception surveys; the review explicitly calls for more controlled, outcome-focused work, particularly outside higher education (Rahmanu & Molnár, 2024). Second, and more fundamentally, studies tend to demonstrate that design-rich tasks help without specifying how design relates to the reading and writing it accompanies. When a study reports that students who made digital stories also read or wrote better, it leaves open whether design caused, accompanied, or merely co-occurred with those gains — and whether design is therefore a supplement to literacy or a constituent of it. This ambiguity is not merely academic: it bears on whether teachers should treat design as an optional reward at the end of a unit or as the structural core around which reading and writing instruction is organised.

The present study is positioned at these two gaps. It is, first, an exploratory, classroom-based intervention conducted in secondary EFL classrooms rather than a perception survey or a higher-education case study, contributing outcome-focused, classroom-level evidence while remaining transparent about the inferential limits of a single-group design. It is, second, designed to explore not merely whether design-rich tasks help but how design relates to reading and writing, by measuring all three and examining their interrelationships. In doing so it treats a question usually left implicit — the pedagogical status of design — as its central object. The premise of the study is that if design is genuinely constitutive of literacy rather than supplementary to it, this should be legible in the pattern of relationships among reading, writing, and design performance, and audible in how teachers describe the way the three fit together in practice.

The question is especially consequential where teachers are already disposed toward multimodal practice but lack a framework to organise it. A prior retrospective needs analysis in the same UAE Western region (Authors, 2026) found that secondary EFL teachers had substantially shifted toward multimodal reading and writing during the COVID-19 closures, yet that these adaptations were intuitive and atheoretical, and that teachers themselves called for structure and support to sustain them. The United Arab Emirates is an instructive setting precisely because access is not the binding constraint: the public system is standards-based and technology-rich, so the interesting question is not whether teachers can use technology but whether a principled framework can convert available tools into integrated literacy learning. The present study responds by testing such a framework — Read–Write–Design (RWD) — which treats the production of a digital story not as a reward at the end of a unit but as the site where reading comprehension and written expression are recruited, coordinated, and consolidated.

The innovation here is context-relative: in a technology-rich system such as the UAE's, the contribution is not the use of digital tools, which is already routine, but the principled framework that converts them into integrated literacy learning — repositioning multimodal design from enrichment to a co-equal third literacy, exploring it through a pre–post intervention paired with a mechanism-level qualitative account, and operationalising it in Gulf-region public secondary EFL, where such pedagogy remains thinly evidenced.

THEORETICAL FRAMEWORK

The study draws on three complementary traditions: multiliteracies theory and its Learning-by-Design elaboration, the cognitive theory of multimedia learning, and contextual teaching and learning. Together they ground the central claim that design is not decoration but a mode of literacy learning in its own right.

Multiliteracies theory originates with the New London Group (1996), which argued that meaning-making is multimodal and that a pedagogy adequate to contemporary communication must move beyond the written word as the sole carrier of meaning. Cope and Kalantzis (2009, 2025) operationalised this vision through recurring knowledge processes — experiencing the known and the new, conceptualising by naming and theorising, analysing functions and interests, and applying knowledge appropriately and creatively — later formalised as the Learning by Design pedagogy (Kalantzis & Cope, 2005). These processes reframe the learner as a designer of meaning who actively recruits semiotic resources rather than a recipient who decodes them. Crucially for the present study, the knowledge processes are not stages tied to a single skill; they recur across reading, writing, and designing, which is what makes it coherent to treat the three as an integrated, recursive cycle rather than a sequence of discrete lessons.

The cognitive theory of multimedia learning supplies a processing-level rationale. Mayer (2021, 2024) shows that learners build deeper understanding when verbal and pictorial information are presented and integrated in well-designed combinations, because the two channels can be coordinated rather than competing for limited capacity. In an RWD sequence, the demand to coordinate words, images, and narration in a single artefact is precisely the kind of integrative task this theory predicts will support deeper processing — provided the design work is structured rather than left to unguided improvisation. Contextual teaching and learning (Sears, 2003) adds the third pillar of the framework's grounding: authentic, purposeful tasks that connect classroom work to learners' lives foster the engagement and transfer on which multiliteracies pedagogy depends, and digital storytelling, with its authorial and audience-oriented character, is a strongly contextualised task.

From these foundations, the RWD framework treats design as a co-equal third literacy rather than a supplement to reading and writing. In an RWD cycle (Figure 1), learners read so that they experience known and new texts and conceptualise how multimodal texts make meaning; conceptualise text features and plan written forms for re-expression across modes; and design as a culminating, integrative act in which a digital story binds the prior reading and writing into a single multimodal artefact — and then cycle back, as the artefact prompts further reading and revision. It is this recursive loop, rather than any single measured association, that the framework proposes as the mechanism of integration.

Figure 1*The Recursive Architecture of the RWD Practice across Knowledge Processes*

Digital storytelling is the design task at the centre of this cycle, and it is well suited to the integrative role the framework assigns it. A digital story requires its author to comprehend and select source material (reading), to compose and sequence a coherent verbal account (writing), and to orchestrate image, narration, pacing, and layout into a single multimodal message (designing) — so the task cannot be completed well without recruiting all three literacies. Design, operationalised through digital storytelling, is therefore positioned as the hub where reading comprehension and written composition converge into multimodal meaning-making. It is also strongly contextualised in Sears's (2003) sense: students author for an audience about content that matters to them, which supports the engagement and transfer that abstract exercises rarely achieve. For these reasons, digital storytelling has featured prominently in recent EFL multimodal research (Hidayat et al., 2024; Wang, 2025); the present study's distinctive move is to position it not as an end-of-unit product but as the structural pivot around which reading and writing instruction is organised from the outset.

RESEARCH QUESTIONS

Three research questions guide the study:

- (1) To what extent is the RWD multiliteracies intervention associated with change in students' EFL reading and writing?
- (2) What pedagogical changes do teachers implement in EFL reading and writing instruction through the RWD framework?
- (3) What pedagogical preferences do teachers develop for EFL reading and writing instruction through the RWD framework?

MATERIALS AND METHODS**4.1 Research design**

The study used an explanatory sequential mixed-methods design (Creswell & Plano Clark, 2018; McKim, 2017) as the second, prospective cycle of a larger two-cycle research programme (Figure 2). A single-group pretest–posttest strand first established whether literacy performance changed over the intervention; semi-structured teacher interviews then explained how and why any change occurred and what implementation demanded. The quantitative strand addressed the magnitude of change, while the qualitative strand addressed its mechanism and its conditions, with the two integrated at interpretation. The single-group design was a deliberate, feasibility-stage choice for this second cycle rather than a fallback. The cohort was small, voluntary, and distributed across several schools, so an equivalent control group was neither practical nor ethically defensible given documented post-pandemic recovery needs. Because the study's central question concerns the mechanism by which design integrates reading and writing rather than an isolated treatment effect, the explanatory-sequential pairing of the quasi-experiment with teacher interviews is a principled fit: the qualitative strand's account of how and why change occurred is designed to compensate for the causal limits of the single group. The threats to internal validity — maturation, testing, and history — are acknowledged directly, and effect sizes are interpreted throughout as indicative magnitudes rather than as treatment effects.

Figure 2*The Cycle 2 Explanatory Sequential Design***4.2 Participants**

Participants were 24 Grade 10 students and seven EFL teachers recruited through a voluntary cross-school initiative across the Western-region Al-Dhafra educational cluster of Abu Dhabi, following a cluster-level professional-development briefing on the RWD framework. Students were Emirati nationals and expatriates

aged 14–18, drawn from several schools rather than a single intact class; the sample is therefore best described as a purposive-voluntary convenience sample, typical of feasibility-stage classroom interventions. The participating teachers comprised native-English-speaking and non-native-English-speaking practitioners spanning a wide range of experience (Table 1), which allowed the qualitative strand to capture varied vantage points on implementation. The intervention ran from November 2023 to February 2024, after schools had fully resumed in-person instruction while retaining many of the digital routines established during the COVID-19 closures, so the study captures technology-mediated practice under normal rather than emergency conditions.

Table 1

Participant Profile

Group	n	Characteristics
Grade 10 students	24	Emirati and expatriate; aged 14–18; mixed proficiency; multiple schools
EFL teachers	7	Native and non-native English speakers; 3–20+ years' experience; reported under pseudonyms; multiple schools

Note. Student artefacts and teacher identities are de-identified throughout; teachers are reported under pseudonyms.

4.3 The RWD intervention and procedure

Over eleven weeks, teachers delivered an RWD sequence built on a Film and Media unit drawn from the national curriculum, Bridge to Success. The sequence moved through three integrated phases, each scaffolded by the Learning-by-Design knowledge processes. In the reading phase, students engaged multimodal texts — levelled articles with audio support drawn from ReadWorks — through comprehension, vocabulary, and text-analysis tasks, experiencing and analysing how multimodal texts make meaning. In the writing phase, they conceptualised genre, organisation, and narrative elements and produced a planned written response grounded in their reading. In the design phase, they applied this knowledge by authoring a digital story in Book Creator and related tools, re-expressing and extending their reading and writing through image, narration, and sequence; the demands of designing a coherent multimodal artefact then sent them back to re-read and revise, closing the recursive loop depicted in Figure 1. Reading materials and authoring tools were curriculum-aligned and pitched at students' proficiency levels. Generative-AI authoring features (within Book Creator and associated storyboarding tools) were used to support drafting (scripting) and design (storyboarding) within teacher-set parameters (cf. Hidayat et al., 2024; Wang, 2025); this use of AI within the pedagogy is disclosed here as part of the research procedure. To protect participant privacy, platform account details and individual student artefacts are not reproduced.

4.4 Implementation timeframe

The intervention ran for eleven weeks (November 2023–February 2024) and progressed through five phases (Table 2), with the main implementation organised as four iterative read-write-design cycles, each enacting the four knowledge processes of the Learning by Design framework — experiencing, conceptualising, analysing, and applying.

Table 2

RWD Timeframe and Administration

Week	Phase	Focus
1	Orientation	Teacher professional development on multiliteracies theory, RWD practice, and supporting technologies; resource distribution and communication channels established
2	Pre-testing	Baseline assessment of reading, writing, and initial design ability

Week	Phase	Focus
3–8	Main implementation	Four iterative RWD cycles enacting the Learning by Design knowledge processes through ReadWorks reading, structured book reports, and storyboard design
9–10	Assessment	Post-test evaluation of reading, writing, and digital storytelling using multimodal rubrics
11	Celebration	Public sharing of digital publications and reflection on achievement across literacy domains

4.5 Data collection

Reading and writing were assessed with analytic rubrics administered at pre- and post-test. Because the study was embedded in a live curriculum rather than a controlled testing environment, the pre- and post-tasks were curriculum-aligned but not statistically equated, and this non-equivalence is important to state plainly at the outset. The reading pre-test comprised a short B2-level non-fiction film-review passage from the British Council LearnEnglishTeens resource (British Council, n.d.), with comprehension items spanning recall, inference, and critical evaluation; the writing pre-test was a film-review composition prompt. The reading post-test was administered through the ReadWorks platform as a curated set of narrative and non-fiction texts spanning Lexile ~510L–1340L to accommodate mixed proficiency, each with a platform-generated question set and embedded audio and vocabulary support; the writing post-test was a structured book-report task on a self-selected ReadWorks narrative. The rubric criteria were held constant across occasions — the reading rubric covered purpose identification, vocabulary, text features, text structure, and comprehension, and the writing rubric covered genre/task fulfilment, organisation, vocabulary and language use, and mechanics — but the underlying tasks differed in platform, text, difficulty range, scaffolding, and genre. Consequently, the quantitative results are best read as change in performance on curriculum-aligned tasks rather than as gains on an equated instrument, and this instrument non-equivalence is treated as a limitation. Overall literacy was operationalised as a composite of the reading comprehension score (0–30) and the writing quality score (0–50), yielding a 0–80 scale. Digital-storytelling design was scored on a separate 50-point rubric and was not a component of the overall-literacy composite; the design–overall-literacy correlation reported below therefore reflects the association between two independently scored measures rather than part–whole overlap.

Digital stories were scored with a 50-point multimodal design rubric assessing the coherence of the multimodal message, integration of image, text, and narration, appropriateness of design choices, and creativity and audience awareness, resolved across eight diagnostic subskills (Table 6). The rubrics were aligned to the national assessment framework and reviewed for content validity before use. Because scoring of writing and design involves judgement, all such components were independently double-rated, and inter-rater reliability was estimated with intraclass correlation coefficients (two-way mixed-effects, absolute-agreement, single measures; Koo & Li, 2016), reported in Table 3. Reading was scored against a fixed key and therefore not double-rated. The near-perfect agreement for the design rubric (ICC = .993) is itself interpreted cautiously in the Limitations section, since agreement this high on partly creative criteria may reflect rater convergence as much as rubric objectivity.

Table 3

Inter-Rater Reliability (Intraclass Correlation Coefficients)

Scored component	ICC	95% CI	F(23, 23)	p
Writing (pre-test, /35)	.901	[.79, .96]	22.86	< .001
Writing (post-test, /35)	.953	[.90, .98]	42.08	< .001
Digital-story design (/50)	.993	[.98, 1.00]	322.40	< .001

Note. ICC = intraclass correlation coefficient (two-way mixed, absolute agreement, single measures). Interpretation follows Koo and Li (2016): .75–.90 = good, > .90 = excellent. Reading was scored against a fixed key and therefore not double-rated.

Digital-storytelling performance was assessed using a multimodal rubric that operationalised design as a distinct, assessable literacy. Each student's storyboard video was rated across eight subskills: ICT mastery, task completion, authenticity, clarity, pronunciation, fluency, relevance, and creativity and innovation. ICT mastery was scored on a ten-point scale to capture the wider technical range involved in producing a multimodal artefact, and the remaining subskills on five-point scales, with the total reported on the 50-point design rubric. Because digital storytelling had no equivalent in students' prior coursework, it was assessed at post-test only and is reported descriptively rather than as a pre-to-post gain. This design choice is acknowledged as a limitation, as it precludes a within-subjects estimate of change for the design construct; the descriptive profile is instead interpreted alongside the reading and writing results and the exploratory design-literacy correlations.

4.6 Data analysis

Quantitative data were analysed in SPSS 27.0. The distribution of pre-post difference scores was screened for normality using the Shapiro-Wilk test and inspection of Q-Q plots before parametric testing. Pre-post change in overall literacy, reading, writing, and each subskill was tested with paired-samples t-tests. Effect sizes are reported as standardised mean differences for paired data (Cohen's d_z , computed on the standard deviation of the difference scores) alongside percentage gains and — given the single-group design and the non-equivalent instruments — are interpreted as indicative magnitudes that may include testing and maturation effects rather than as unbiased treatment effects. Relationships among post-test reading, writing, digital-storytelling design, and overall literacy were examined with Pearson product-moment correlations; because the sample is small, each correlation is reported with a 95% confidence interval (Fisher z transformation), and the correlational analysis is framed as exploratory throughout.

Interview data were analysed using Braun and Clarke's (2006) six-phase reflexive thematic analysis: familiarisation, systematic coding, theme generation, review of themes against the full dataset, definition, and reporting. The six constructs that structured the larger programme — value, confidence, practice, challenges and remedies, implications, and preferences — served as sensitising categories within which data-driven themes were developed, so that the qualitative strand explained rather than merely echoed the quantitative results. Coding was carried out by the lead author; given this single-coder design, trustworthiness was supported through investigator triangulation across the quantitative and qualitative strands, reflexive memoing, and an audit trail (Ahmed, 2024; Morgan, 2024).

4.7 Ethical considerations

Ethical clearance and a confirmation of candidature were obtained from the lead author's university, and a research approval was issued by the national authority overseeing UAE public education, prior to data collection. An invitation-to-participate and consent form communicated the study's purpose, the voluntary nature of participation, and guarantees of participant anonymity and data confidentiality, consistent with established research ethics protocols (Dörnyei & Taguchi, 2010) and the lead author's university code of research conduct. Parental or guardian consent was obtained for all student participants, who were minors, prior to their involvement. Two study-specific considerations warrant note. First, in a small, geographically concentrated professional community of approximately 40 EFL teachers, anonymity required particular care: participants received pseudonyms, and school names were replaced with regional descriptors throughout. Second, the decision not to establish a control group was partly ethical: given documented post-pandemic learning-recovery needs across the region's schools and the voluntary nature of participation, withholding a potentially beneficial literacy intervention from consenting students would have been difficult to justify, reinforcing the methodological decision detailed in the Research design subsection.

RESULTS

5.1 Change in EFL reading and writing (RQ1)

Students' performance improved across all measured domains. Overall literacy rose from a pre-test mean of 35.71 (SD = 6.96) to 48.54 (SD = 4.85), a gain of 12.83 points; reading rose from 14.71 (SD = 3.92) to 20.92

(SD = 3.39), approximately 42%; and writing rose from 20.71 (SD = 4.14) to 27.92 (SD = 4.38), approximately 35% (Table 4). Paired-samples *t*-tests indicated that all changes were statistically significant at $p < .001$, with large standardised effect sizes (Table 5). Because the design is single-group and the pre- and post-tasks were not equated, these effect sizes are reported as indicative magnitudes that may incorporate testing, maturation, and instrument effects rather than as isolated treatment effects.

Table 4

Descriptive Statistics for Reading, Writing, and Overall Literacy (N = 24)

Measure	Pre M	Pre SD	Post M	Post SD
Reading (total)	14.71	3.92	20.92	3.39
Writing (total)	20.71	4.14	27.92	4.38
Overall literacy	35.71	6.96	48.54	4.85

Note. Reading gain +6.21 ($\approx 42\%$); writing gain +7.21 ($\approx 35\%$); overall gain +12.83 ($\approx 36\%$).

Table 5

*Paired-Samples *t*-Tests for Pre–Post Change (N = 24)*

Measure	M difference	t(23)	p	Cohen's <i>dz</i>
Reading (total)	6.21	10.21	< .001	2.08
Writing (total)	7.21	11.63	< .001	2.37
Overall literacy	12.83	13.08	< .001	2.67

Note. *t* values are reported as absolute magnitudes; all reflect significant pre-to-post increases. Effect sizes (Cohen's *dz*) are indicative given the single-group design and non-equivalent instruments.

The shape of the distribution is as informative as the means. The post-test standard deviation narrowed relative to the pre-test on the overall and reading measures, and on both reading and writing no student remained below the 50% band at post-test. The intervention did not simply lift an already-strong group; it raised the floor, extending gains to students who began furthest behind. Figure 3 displays the post-intervention score distributions across the three skills, banded by percentage: 20 of 24 students in reading and 18 of 24 in writing reached the upper bands (70.1–100%), and digital storytelling shows the same upward concentration alongside three non-completing students who fell in the lowest band. The parallel upward shape across reading, writing, and design motivates the exploratory correlational analysis below.

Figure 3

Post-Intervention Score Distributions for Reading, Writing, and Digital Storytelling

This distributional finding speaks to equity as well as to average attainment: whereas literacy interventions often widen the spread by benefiting already-strong students most, here the lower tail on reading and overall literacy contracted and the sub-threshold band emptied. A plausible explanation, consistent with the qualitative accounts, is that the multimodal design route offered an alternative pathway into literacy for students whom print-only tasks had left behind — a learner who struggled with extended prose could still plan, narrate, and assemble a coherent multimodal story, and thereby engage the reading and writing the task required (cf. Alghamdi, 2023). This same narrowing of the reading distribution, however, has a methodological consequence taken up in Section 5.2: range restriction on reading can attenuate or distort its observed correlations in a small sample.

Within reading, the subskill profile was uneven and theoretically informative. Gains were largest for text-features analysis (M difference = 1.92; 2.67 to 4.58) and vocabulary understanding (1.21; 1.58 to 2.79), followed

by text structure (0.83; 3.13 to 3.96) and purpose identification (0.75) — the analytic, design-adjacent dimensions of reading that a compose-to-understand approach would be expected to strengthen. Comprehension showed the smallest change (M difference = 0.50; 6.13 to 6.63); because its effect size was small, this subskill's improvement is interpreted cautiously and flagged for confirmation in a controlled design. Rather than reporting an undifferentiated reading gain, the data locate the intervention's strongest associations in the interpretive processes that multimodal design recruits, refining claims in the multimodal-literacy literature that have tended to treat reading gains as global (Carcamo & Pino, 2025; Hidayat et al., 2024).

Digital-storytelling performance was strong ($M = 37.17$ out of 50, or 74.3%), with 58.3% of students scoring above 80% and 33.3% in the highest range (90.1–100%). Fluency emerged as the strongest competency ($M = 4.71/5$), followed by pronunciation and relevance (both $M = 4.54/5$) and clarity ($M = 4.50/5$). Students achieved $M = 7.25/10$ in ICT mastery, indicating substantial technological skill development given that they were working in their second language while managing multiple technological demands. Three students scored below 40%, in each case because the storyboard task was not completed rather than because of low-quality work on completed elements (Table 6).

Table 6

Storytelling Subskills: Descriptive Statistics ($N = 24$)

Subskill	N	M	SD
ICT mastery (/10)	24	7.25	1.78
Task completion (/5)	24	3.67	0.87
Authenticity (/5)	24	4.25	0.94
Clarity (/5)	24	4.50	0.83
Pronunciation (/5)	24	4.54	0.78
Fluency (/5)	24	4.71	0.55
Relevance (/5)	24	4.54	0.59
Creativity & innovation (/5)	24	3.71	1.04
Total storytelling (/50)	24	37.17	5.10

Note. Subskills were rated on five-point scales except ICT mastery (ten-point). Storytelling was assessed at post-test only. SD = standard deviation.

5.2 Exploratory relationships among reading, writing, and design (RQ1, continued)

Correlational analysis was used to explore the role design played in the pattern of results (Table 7; Figure 4). Because $n = 24$ is small, these correlations are reported with 95% confidence intervals and interpreted as exploratory rather than confirmatory. Digital-storytelling (design) performance was the strongest single correlate of overall literacy ($r = .70$, 95% CI [.42, .86], $p < .001$) and was moderately associated with reading ($r = .58$, 95% CI [.22, .79], $p = .003$). Its association with writing was positive but small and not statistically significant ($r = .36$, 95% CI [−.05, .67], $p = .083$). Reading and writing were each associated with overall literacy (reading $r = .48$, 95% CI [.09, .74], $p = .019$; writing $r = .69$, 95% CI [.40, .85], $p < .001$).

Table 7

Exploratory Correlations Among RWD Dimensions with 95% Confidence Intervals ($N = 24$)

Relationship	r	95% CI	p
Design – Overall literacy	.70	[.42, .86]	< .001
Design – Reading	.58	[.22, .79]	.003

Relationship	r	95% CI	p
Design – Writing	.36	[−.05, .67]	.083
Reading – Overall literacy	.48	[.09, .74]	.019
Writing – Overall literacy	.69	[.40, .85]	< .001
Reading – Writing	−.24	[−.59, .18]	.251

Note. Pearson correlations among post-test measures. Confidence intervals computed via Fisher z transformation. p values are two-tailed. Given $N = 24$, intervals are wide and all estimates are exploratory.

Figure 4

Correlations Among Reading, Writing, and Design across the RWD Practice Cycle

The reading–writing correlation warrants careful, restrained interpretation, because it is the point on which an over-reaching account of this study could most easily rest. The observed value was small, negative in point estimate, and not significantly different from zero ($r = -.24$, 95% CI $[-.59, .18]$, $p = .251$). The confidence interval spans from a moderate negative to a small positive association, so the data cannot establish the direction — let alone the absence — of a reading–writing relationship. Two considerations counsel against reading anything substantive into the negative sign. First, the estimate is underpowered: at this sample size the interval is simply too wide to distinguish a null from a modest positive relationship of the kind one would theoretically expect. Second, and more concretely, the reading distribution underwent range restriction over the intervention (its standard deviation narrowed and the sub-threshold band emptied, as reported in Section 5.1), and range restriction on a variable attenuates and can even reverse its observed correlations in a small sample. The negative point estimate is therefore most plausibly an artefact of the intervention’s own equalising effect rather than evidence that reading and writing are unrelated or opposed. Accordingly, the present study does not treat the reading–writing correlation as evidence for design’s integrative role.

What the pattern does show, read as exploratory, is that design performance tracked overall literacy more closely than either traditional literacy alone, and was associated with both reading and (more weakly and non-significantly) writing. This is consistent with — though, given the sample, cannot confirm — the framework’s proposal that design functions as an integrative hub. The weight of that proposal rests not on this correlation but on the theoretical account of the recursive RWD loop (Section 2) and on the qualitative evidence reported next, which specifies the mechanism the correlational pattern can only gesture toward.

5.3 Pedagogical change and teacher experience (RQ2)

The qualitative strand is the study’s principal explanatory contribution, and it supplies the mechanism-level account that the exploratory statistics cannot. Teachers described the RWD sequence as reorganising, not merely supplementing, their reading and writing instruction, and four themes recurred (Table 8). Across the seven interviews the teacher-experience findings were consistent: all seven teachers (7/7) recognised the value of the approach, and six of the seven (6/7) reported increased confidence, which they attributed to the pairing of theoretical grounding with practical scaffolding. The first was engagement through authorship: teachers linked the multimodal, design-oriented tasks to heightened motivation and student voice. David, for example, described a student who used AI to visualise a ReadWorks story: “The storyboard video blew me away! I noticed AI can boost engagement and inspire young storytellers for creative artistic writing” (David, 24.02.2024, Line 15). The second, and most directly relevant to the integration question, was the enactment of a complete literacy cycle, in which reading fed writing and both fed design, in contrast to teachers’ earlier practice of teaching the three as separate lessons. Emily captured this progression from analysis to creative reconstruction: “I was amazed by my student’s book report... She critically described the story events, added her pet ‘Cattie’ as a character, and alternated with an exciting new ending” (Emily, 26.02.2024, Line 18). This is the qualitative counterpart of the framework’s recursive loop, and it is here — rather than in the correlation matrix — that the integrative claim finds its clearest support.

The third theme was a return to the text: several teachers noted that the demands of designing a coherent digital story sent students back to re-read and re-analyse source material, reinforcing comprehension as a by-product of composition. Martin illustrated this design-to-reading return: “Having them focus on specific story elements like setting, characters, and conflict helped to guide their creative process effectively” (Martin, 21.02.2024, Line 13). This account is significant because it names a directional mechanism — designing prompts re-reading — that a single post-test correlation cannot capture, and it aligns with the differentiated reading profile reported in Section 5.1, in which the analytic, design-adjacent subskills gained most. The fourth theme was alternative pathways for diverse learners: teachers described students who had struggled with conventional writing finding traction in multimodal expression, as Arya observed: “Some who struggled with reading or writing thrived when given the opportunity to explore and extend stories visually” (Arya, 22.02.2024, Lines 16–17), which corroborates, from the classroom, the floor-raising pattern visible in the reading and overall-literacy distributions.

Teachers also described their own development, which mattered for implementation. Confidence had grown experientially rather than through formal training. Emily reported that “after doing RWD multiliteracies practices during the [post-pandemic] intervention, I became more confident and well-informed to enrich my regular literacy classroom with these new approaches” (Emily, 26.02.2024, Line 17). Teachers also reframed engagement in multimodal terms; as Marlina put it, “multiliteracies approaches can get students more engaged... because of the multimodality aspects which meet different learning styles and enhance new digital literacies” (Marlina, 23.02.2024, Lines 16–17). These accounts do more than illustrate the statistics: they specify the mechanism the framework theorises, showing how the design task pulled reading and writing into a single act of meaning-making — an explanatory contribution that purely outcome-based studies cannot offer (Jiang & Hafner, 2024; Ni & Lam, 2025).

Table 8

Summary of Qualitative Themes (RQ2)

Theme	Description	Representative excerpt (Cycle 2)
Engagement through authorship	Heightened motivation and student voice attributed to multimodal authorship and choice.	“The storyboard video blew me away” (David, 24.02.2024)
A complete literacy cycle	Reading, writing, and design experienced as one integrated, recursive sequence rather than separate lessons.	“... alternated with an exciting new ending” (Emily, 26.02.2024)
A return to the text	Designing a coherent digital story drove re-reading and re-analysis, reinforcing comprehension.	“... focus on specific story elements ... guide their creative process” (Martin, 21.02.2024)
Alternative pathways	Multimodal routes gave traction to learners who struggled with conventional writing.	“struggled ... thrived when given the opportunity to ... extend stories visually” (Arya, 22.02.2024)

Note. Representative excerpts from the seven post-intervention interviews (February 2024). Measured teacher-experience counts (value, confidence, continued integration, reservations) are reported in Sections 5.3–5.4.

5.4 Preferences and conditions for sustainability (RQ3)

A majority of teachers (five of the seven; 5/7) expressed a clear preference for continuing RWD-style integration, judging it both practical and theoretically coherent for post-pandemic literacy teaching. The remaining two (2/7) voiced reservations centred on time demands and the complexity of heavy multimodality rather than on the value of the approach. That preference was, however, explicitly conditional. Teachers identified three requirements for sustainability: targeted professional development in multiliteracies and the supporting technologies, since competence had so far been self-taught; adequate instructional time, since design work is demanding to plan and

to assess; and institutional support, including curricular space to treat design as assessable literacy work and the resources to do so. These conditions name the trade-offs of the approach rather than detract from its perceived value, and they anticipate the implications discussed below.

DISCUSSION

The study set out to explore whether positioning multimodal design as a co-equal third literacy is associated with improved EFL reading and writing, and how teachers experience enacting such a pedagogy. Its central contribution is conceptual as much as empirical: the findings offer classroom grounds for treating technology-mediated design not as an enrichment activity appended to literacy instruction but as a candidate co-equal third literacy that mediates reading and writing. The quantitative and qualitative strands converge, from independent directions, on a single interpretation — that design is the site at which reading and writing are coordinated and consolidated. The strong association between design performance and overall literacy, together with teachers' accounts of a “complete literacy cycle” and of design “returning” students to the text, is the most direct support for this integrative role; the small, non-significant reading–writing correlation is consistent with, but underpowered to establish, that architecture, and is not treated here as evidence for it. This positions RWD as a mechanism account to be tested rather than a further demonstration that multimodal tasks help — a point already well established in the DMC literature (Jiang & Hafner, 2024; Lim & Kessler, 2024; Yu et al., 2024).

Three more specific points follow. First, the results give provisional empirical substance to the Learning-by-Design claim that meaning-making is a process of design rather than reception (Cope & Kalantzis, 2025): in teachers' accounts, the conceptualising and analysing demanded by the design phase were precisely what returned students to the text and to their drafts, so the knowledge processes functioned as an integrative engine rather than a mere planning vocabulary. Second, the differentiated reading profile — stronger change in analytic subskills, a modest change in literal comprehension — refines rather than simply confirms multimodal-literacy theory. It suggests that composing-to-understand may strengthen the interpretive, design-adjacent dimensions of reading more directly than basic comprehension, which may require dedicated instruction rather than indirect uptake through design; this qualifies studies that report global reading benefits from multimodal work (Carcamo & Pino, 2025; Hidayat et al., 2024). Third, the pattern is compatible with the cognitive theory of multimedia learning (Mayer, 2024), in which the coordination of verbal and visual representations is the occasion for deeper integration; the digital-story task made that coordination obligatory and public, which may help explain why design performance, more than either traditional literacy alone, tracked overall attainment.

Read against recent work, the findings both corroborate and extend the field. They align with intervention studies reporting literacy benefits from multimodal composition (Carcamo & Pino, 2025; Hidayat et al., 2024; Lai, 2024) and with Fan's (2025) demonstration that multiliteracies, suitably assessed, can reorganise an EFL curriculum. They extend that work by measuring reading, writing, and design together and examining their interrelationships — moving beyond establishing that an intervention produced gains toward proposing an internal architecture for those gains, and supplying, through teachers' explanatory accounts, the mechanism-level evidence that outcome-only and perception studies each lack alone (Jiang & Hafner, 2024; Yu et al., 2024).

Set beside the companion needs analysis, the two studies tell one story rather than two. Where the retrospective study found teachers shifting toward multimodal practice intuitively and without a framework (Authors, 2026), the present study illustrates what a principled framework may add: not merely more multimodal activity, but an organising architecture that turns dispersed techniques into an integrated literacy cycle. RWD thus operationalises the transition that pandemic-era adaptation only gestured toward — a synthesis consistent with recent arguments that the value of multiliteracies depends less on tools than on teachers' reflexive, supported enactment (Veliz & Nguyen, 2026) and on curricular and institutional embedding rather than individual improvisation (Fan, 2025; Ghaluh et al., 2026).

A candid accounting of costs is essential, since reporting only benefits would misrepresent the framework. Teachers were clear that RWD is demanding to plan and to assess, depends on technology and time that schools do not always provide, and presupposes professional learning that many have not had. The modest

comprehension change is a further caution against treating design as a panacea: design-rich work advanced analytic reading more than literal comprehension. And because the study used a single group with non-equated instruments, the large effect sizes should be read as upper bounds that incorporate testing, maturation, and measurement rather than as the framework's isolated effect. These trade-offs temper the framework's promise and define the conditions under which it can realistically be sustained.

IMPLICATIONS FOR PRACTICE, EDUCATIONAL LEADERSHIP, AND POLICY

For classroom practice, the central implication is to treat design as the spine of a literacy unit rather than its decoration, and the RWD sequence is specific enough to be reproduced lesson by lesson. A cycle begins in the experiencing process, where students read a levelled multimodal text and — rather than answering comprehension items in isolation — annotate how its images, captions, and layout carry meaning alongside the words. In conceptualising, the teacher names the target genre and its moves explicitly, modelling for a film review how evaluation is signalled and how a recommendation is built, and students plan a written response against that model. In analysing, attention turns to authorial choices: why this image, this ordering, this framing, and whose interests the text serves. In applying, students author a digital story that re-expresses their reading and writing through image, narration, and sequence, and the demands of assembling a coherent multimodal artefact send them back to re-read the source and revise the draft. The teacher's concrete moves are to think each knowledge process aloud, to supply a storyboard template that couples every written beat to a visual and a line of narration, and to run short, rubric-keyed peer-feedback rounds between drafts.

The framework's equalising effect on the score distribution suggests it may particularly benefit learners who founder in conventional, print-only writing, and the scaffold for such a learner is concrete. A student who cannot yet sustain extended prose can start at the storyboard — planning the narrative visually across a sequence of frames, recording a spoken narration for each, and only then transcribing and refining that narration into written text — so that composing moves from image and speech toward print rather than demanding print from the outset. Several teachers described precisely this route giving traction to disengaged writers. The instructional caution is equally concrete: because literal comprehension changed least, teachers should pair design work with explicit comprehension instruction — targeted questioning, vocabulary pre-teaching, and re-reading for detail — rather than assume that understanding will follow from composition alone.

For teacher education, the clearest message is that competence in technology-mediated multiliteracies should not be left to improvisation: the teachers here built their skills experientially and under pressure, and structured professional development in multiliteracies pedagogy and its supporting technologies — including the responsible use of generative-AI design tools — would likely accelerate and deepen what was achieved unaided (Lim & Kessler, 2024; Ni & Lam, 2025). For policy and curriculum, teachers' conditional endorsement locates the decisive variables beyond the individual classroom: where digital infrastructure is already strong, as in the UAE, the binding constraint is structural rather than technological — curricular permission to treat design as assessable literacy work, and timetabled space for the planning and assessment it demands. Embedding RWD in curriculum and assessment frameworks, rather than leaving it to motivated individuals, is the implication most likely to determine whether patterns of the kind reported here can be reproduced at scale (Ghaluh et al., 2026).

LIMITATIONS

Several limitations bound these claims and indicate directions for further research. The single-group pretest–posttest design without a control condition limits causal inference (Shadish et al., 2002): maturation, repeated testing, and ordinary instruction cannot be separated from the intervention, and the standardised effect sizes are correspondingly inflated and should be read as upper bounds. A distinct and equally important limitation is instrument non-equivalence: the pre- and post-tasks were curriculum-aligned but not statistically equated, differing in platform, text, difficulty range, scaffolding, and genre, so the reported change reflects performance on curriculum-aligned tasks rather than gains on an equated measure. The correlational analysis is exploratory and underpowered at $N = 24$, with wide confidence intervals; in particular, the reading–writing correlation cannot

be interpreted directionally, and its negative point estimate is most plausibly an artefact of range restriction on reading rather than a substantive finding. The near-perfect inter-rater agreement for the design rubric ($ICC = .993$) is unusually high for partly creative criteria and may reflect rater convergence rather than rubric objectivity. Finally, the eleven-week window, the small and self-selected single-region cohort, and the reliance on teacher self-report for the qualitative strand constrain generalisation; the last is mitigated by triangulation and an audit trail but not eliminated. The comprehension finding in particular should be confirmed before it is built upon, given the discrepancy between its small effect size and its statistical significance.

RECOMMENDATIONS FOR FURTHER RESEARCH

Future research should pursue a controlled or multi-site trial with equated, counterbalanced pre- and post-instruments and a delayed post-test to probe the durability of change; incorporate a baseline design measure so that the framework's flagship construct has growth data; and incorporate student voice alongside teacher accounts to triangulate the mechanism proposed here. With a larger sample, the integrative role of design — advanced here as a hypothesis — could be tested directly, for instance through mediation or path models with adequate power. Researchers should also examine, with appropriate ethical safeguards, how generative-AI design tools — now rapidly entering these classrooms (Cui et al., 2025; Lin et al., 2025) — reshape the reading–writing–design relationship. Replication in other Gulf and wider EFL contexts would test how far the integrative role of design generalises beyond the technology-rich UAE setting.

CONCLUSION

An exploratory eleven-week Read–Write–Design intervention was associated with marked improvements in UAE secondary EFL students' performance on reading and writing tasks, and the qualitative evidence — the study's strongest strand — indicates that technology-mediated multimodal design plausibly did integrative work, functioning as a recursive partner that connects reading and writing rather than a supplement appended to them. The study contributes classroom-based, secondary-level evidence to a CALL literature that has called for exactly this, and offers teachers and curriculum designers a concrete architecture for integrated, technology-mediated literacy instruction. Its claims are offered as hypothesis-generating rather than confirmatory, and the design-as-integrative-loop proposal now warrants testing in adequately powered, controlled research.

Appendix A. The 11-Week RWD Operationalisation

The full phase-by-phase RWD operationalisation across the Learning-by-Design knowledge processes (experiencing, conceptualising, analysing, applying), together with the week-by-week implementation timeline, learning objectives, reading-text specifications, and scaffolding tools, is provided as Supplemental Material S1.

Appendix B. Multimodal Literacy Assessment Rubrics

Reading and writing were assessed using analytic rubrics whose criteria were held constant across pre- and post-test, and digital-story design was assessed at post-test using a 50-point multimodal rubric, all aligned to the national assessment framework and reviewed for content validity before use. The complete rubrics for reading, writing, and digital-story design, with all measurable elements and level descriptors, are provided as Supplemental Material S2.

Appendix C. Post-Intervention Teacher Interview Schedule

Semi-structured interviews with the seven participating teachers were conducted after the intervention, organised by research question and by the constructs guiding the qualitative strand (value, confidence, practice, challenges and remedies, preference), and adapted from Ganapathy and Kaur (2013) and Ganapathy and Seetharam (2016). The complete interview schedule, with all questions mapped to research questions and construct categories, is provided as Supplemental Material S3.

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Declaration of Interest Statement

No potential conflict of interest was reported by the author(s).

Declaration of Generative AI in the Preparation of the Manuscript

During the preparation of this manuscript, the authors used Claude (Anthropic) as a generative-AI assistant for the following purposes: language editing and readability; organising and restructuring existing content; formatting references and tables to the journal's style. The authors conceived the study and conducted all data collection, statistical analysis, and thematic coding themselves; no generative-AI tool was used to generate, analyse, or interpret the primary research data. All AI-assisted output was reviewed, verified, and edited by the authors, who checked every reference against its original source and who take full responsibility for the integrity, accuracy, and originality of the manuscript.

Data Availability Statement

The data supporting the findings of this study are not publicly available because they contain potentially identifiable information about minor participants and EFL teachers from a small, geographically concentrated professional community, and because the conditions of ethical approval and informed consent under which they were collected restrict public release. De-identified aggregate data — the inter-rater reliability coefficients (Table 3), descriptive statistics (Table 4), paired-samples t-test outputs (Table 5), storytelling subskill statistics (Table 6), and correlation matrix (Table 7) — are presented in full within the manuscript. De-identified rubric-level scores supporting these analyses are available from the corresponding author upon reasonable request, subject to the terms of the ethical approvals granted by the lead author's university and the national education authority [Universiti Malaya, Malaysia; Emirates Schools Establishment (ESE), UAE] and to a data-use agreement preserving participant anonymity. Raw student artefacts, interview transcripts, and any data that could compromise the confidentiality of student or teacher participants will not be released.

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Figure 1

The Recursive Architecture of the RWD Practice across Knowledge Processes

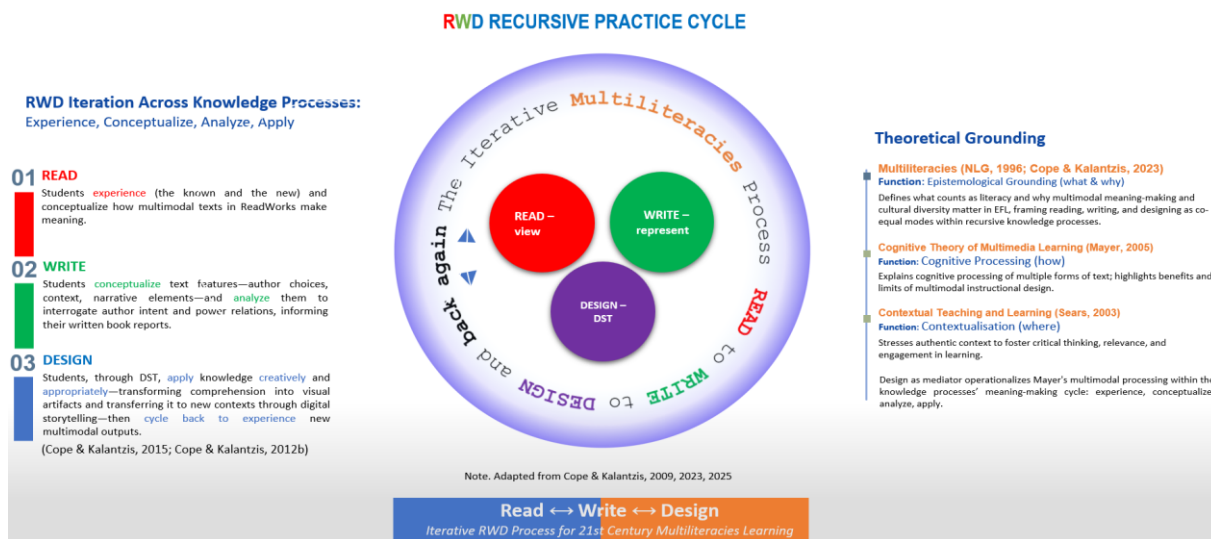
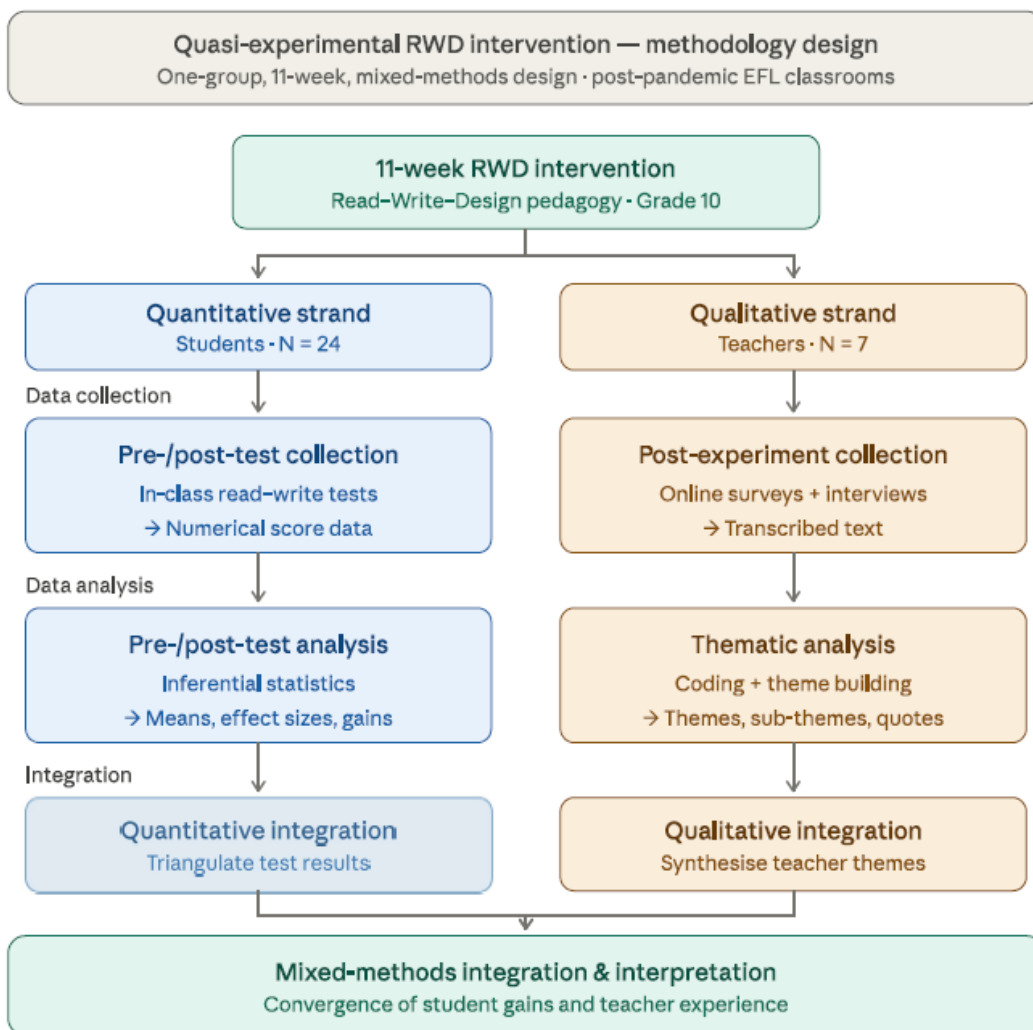


Figure 2

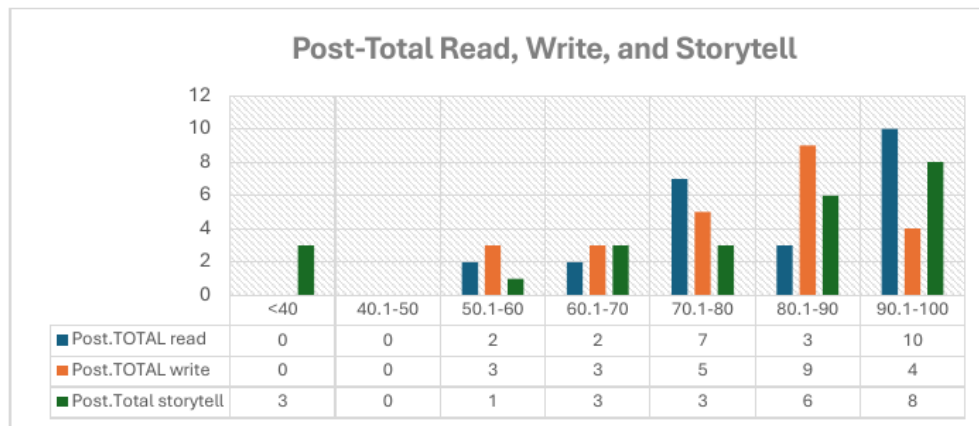
The Cycle 2 Explanatory Sequential Design



Note. A single-group pretest–posttest strand with students ($N = 24$) followed by post-intervention teacher interviews ($N = 7$), integrated through triangulation. Cycle 2 is the prospective, post-pandemic intervention cycle of the larger programme.

Figure 3

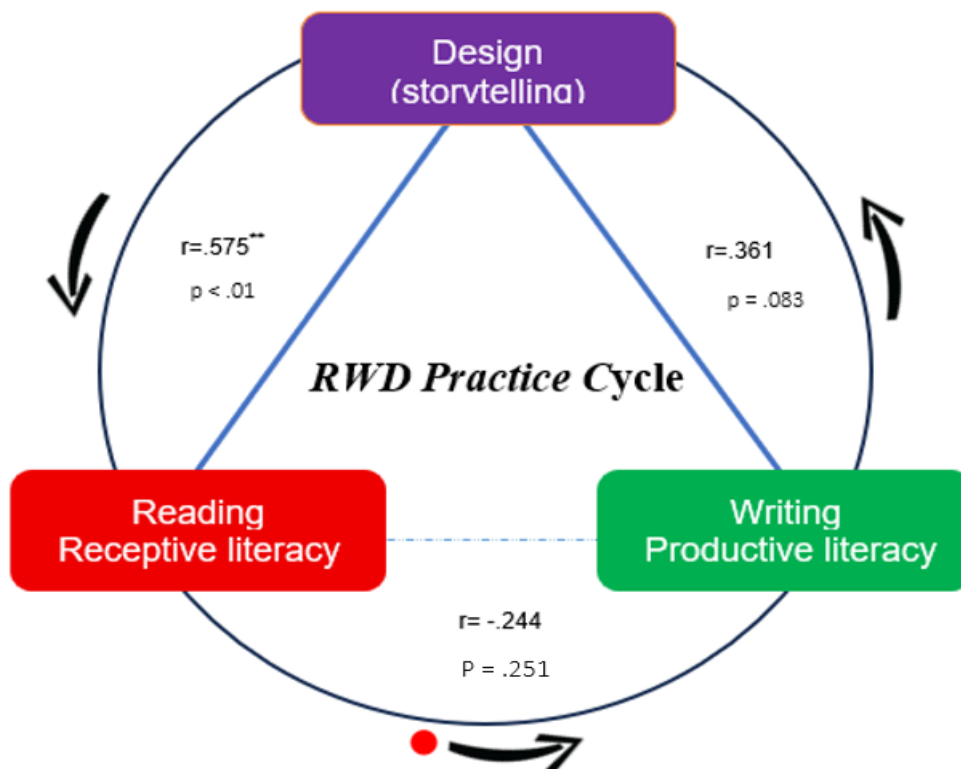
Post-Intervention Score Distributions for Reading, Writing, and Digital Storytelling



Note. Bars show the number of students (of 24) in each post-test percentage band. Parallel upward trends across the Read-Write-Design Skills Triad. The three students in the lowest storytelling band did not complete the storyboard task (see text).

Figure 4

Correlations Among Reading, Writing, and Design across the RWD Practice Cycle



Note. RWD correlations: Reading $\leftrightarrow$ Design ($r = .575^{**}$), Writing $\leftrightarrow$ Design ($r = .361$, $p = .083$, n.s.), Reading $\leftrightarrow$ Writing ($r = -.244$, $p = .251$, n.s.); Design labelled “integrative bridge” in recursive RWD cycle; the correlational pattern is exploratory and does not by itself establish that role. Correlations with overall literacy are reported in Table 7.

Design as Literacy: Unlocking EFL Reading and Writing Through the Read–Write–Design Framework

SUPPLEMENTAL MATERIAL S1/APPENDIX A. THE 11-WEEK RWD OPERATIONALISATION

Implementation timeline

The intervention ran for eleven weeks (November 2023 – February 2024) across five phases (Table A1). Weeks 3–8 formed the main instructional block, delivered as four iterative RWD cycles that enacted the four knowledge processes.

Table A1. *RWD implementation timeline*

Phase	Weeks	Focus
Orientation and training	1	Teacher professional development on multiliteracies theory, the RWD framework, and supporting technologies; distribution of scaffolds; communication channels established.
Baseline assessment	2	Reading and writing pre-tests administered under standard classroom conditions.
Main implementation	3–8	Four iterative read–write–design cycles enacting the knowledge processes through ReadWorks reading, structured book reports, and storyboarded digital stories. Ongoing formative support and platform-analytics monitoring.
Post-testing	9–10	Post-tests of reading and writing; post-only assessment of digital-storytelling design against the multimodal rubric.
Recognition and reflection	11	Public sharing of student digital stories; student and teacher reflection; interview scheduling.

Note. A two-week winter break fell within the main-implementation window; the four instructional weeks of teaching were preserved, with the break used for asynchronous refinement and revision.

Each phase was scaffolded by the Learning-by-Design knowledge processes (experiencing, conceptualising, analysing, applying; Kalantzis & Cope, 2005) and built on a curriculum-aligned Film and Media unit drawn from the UAE Bridge to Success programme. Reading materials and authoring tools were curriculum-aligned and pitched at students' proficiency levels; AI-assisted features were used to support drafting and design within teacher-set parameters.

Read (experiencing / analysing). Multimodal reading of levelled ReadWorks texts with audio support; comprehension, vocabulary, and text-features tasks; pre-test administration.

Read-into-Write (conceptualising). Naming and theorising genre, organisation, and narrative elements; guided analysis of model texts; planning a written response grounded in the reading.

Write-into-Design (applying appropriately). Drafting and revising the written composition; storyboarding a digital story that re-expresses the writing through image, narration, and sequence.

Design (applying creatively). Authoring the digital story using Book Creator and related tools; peer feedback; iterative revision across modes; cycling back to the source text.

Consolidation and assessment. Presentation of digital stories; post-test administration; teacher reflection interviews.

Learning element and knowledge-process objectives

The RWD unit was operationalised through a curriculum-aligned learning element on narrative comprehension and multimodal re-expression. Knowledge-process objectives are summarised below.

Experiencing (the known and the new). Discussing narrative theme and connecting it to prior text, self, and world experiences; multimodal reading of print and video texts on the unit theme; experiencing the creation of multimodal artefacts (plot summaries, storytelling videos) as an aid to comprehension.

Conceptualising (by naming and by theorising). Identifying story features — setting, characters, plot, point of view, style, tone, theme, conflict, resolution; naming the generic features of a critical review and a plot summary; theorising how modes work together to convey theme and how visual and video presentation aid comprehension.

Analysing (functionally and critically). Analysing multimodal texts for how modes make meaning; identifying the genre and rhetorical structure in which an author's message is presented; applying critical strategies ("Think Aloud", "Questioning the Author") to interrogate authorial choices and audience positioning; analysing the affordances of authoring tools that support multimodal comprehension.

Applying (appropriately and creatively). Writing a plot summary and critical review grounded in the reading; producing a storyboard and voice-narrated digital story; presenting the digital story to peers and teachers; cycling back to the source text for revision.

Reading materials

Reading was delivered through ReadWorks, which provided differentiated levelled texts with audio narration, embedded vocabulary support, and comprehension question sets. The main-implementation reading set comprised paired fantasy narrative series ("family ghost" and "alien kids" arcs, six and five instalments respectively) that supported modal transduction from print to multimodal composition, together with supplementary fiction and non-fiction on the unit theme. Text difficulty across the set ranged from Lexile ~510L to ~1340L (Flesch-Kincaid grade-level equivalents 2.4–9.9), spanning the mixed-proficiency range of the participating Grade 10 cohort.

Authoring tools and pedagogical scaffolds

Book Creator was selected as the primary multimodal authoring environment for its embedded content-creation tools supporting authentic authorship. ReadWorks provided the differentiated reading foundation. Additional tools — Canva, AutoDraw, StoryboardThat, and (where teachers judged appropriate) generative-AI drafting and image tools — supported illustration and storyboard production within teacher-set parameters. Pedagogical scaffolds included multiliteracies lesson plans, evaluation checklists, and tutorials aligned to the four knowledge processes. Teacher professional development in orientation week covered the multiliteracies framework, the knowledge processes, and platform tutorials; a persistent communication Telegram channel was maintained across the intervention for troubleshooting and formative support.

SUPPLEMENTAL MATERIAL S2/APPENDIX B. MULTIMODAL LITERACY ASSESSMENT RUBRICS

Reading and writing were assessed identically at pre- and post-test using analytic rubrics; digital-story design was assessed at post-test only using a multimodal rubric. All rubrics were aligned to the national assessment framework and reviewed for content validity before use. Rubric criteria and level descriptors are given below.

I. Reading multiliteracies (25 points)

Criteria	Measurable elements	1 — Beginning	2 — Developing	3 — Proficient	4 — Exemplary
1. Multimodal reading / digital reading (7 pts)	Extract meaning from different text types; interpret information across genres and modalities; analyse how modes contribute to meaning	Comprehends basic written content; struggles with visual or audio elements; needs support with multimodal texts.	Identifies key information from different modes but may miss connections; describes basic multimodal features with guidance.	Integrates information from written, visual, and audio sources; makes meaningful connections between modes.	Sophisticated analysis of how modes enhance meaning; evaluates effectiveness of multimodal elements and their relationships.
2. Critical reading (7 pts)	Identify claims and evaluate evidence; recognise bias and credibility issues; critique multimodal and digital texts	Accepts information at face value with minimal questioning; struggles to identify author's purpose or bias.	Identifies obvious bias and basic claims; beginning to question texts but may need prompting to evaluate credibility.	Regularly questions texts; identifies perspectives and evaluates evidence; recognises implicit bias and considers source credibility.	Consistently applies sophisticated critical analysis; evaluates subtle bias and contextual influences; explores power relationships in texts.
3. Text analysis (6 pts)	Evaluate author's purpose, audience, and message in multimodal text; identify genre features and structure; analyse rhetorical strategies and organisational patterns	Identifies basic text elements but struggles to recognise organisational patterns or genre features.	Recognises common text structures and genre elements; identifies main themes with guidance.	Analyses how text structure contributes to meaning; identifies rhetorical strategies and evaluates their effectiveness.	Insightful analysis of complex text structures across genres; evaluates how organisational and generic choices impact meaning and audience.
4. Intertextual connections (5 pts)	Connect texts to personal experience; identify relationships between texts; synthesise information across sources	Makes simple text-to-self connections; views texts in isolation.	Makes basic connections between texts and personal experience; beginning to identify simple relationships between texts.	Regularly connects texts to other texts, personal experiences, and broader contexts; identifies patterns across sources.	Constructs sophisticated connections across diverse texts; uses these connections to develop new insights and deeper understanding.

Reading subtotal: /25

II. Writing multiliteracies (30 points)

Criteria	Measurable elements	1 — Beginning	2 — Developing	3 — Proficient	4 — Exemplary
5. Rhetorical awareness (6 pts)	Adapt writing for purpose and audience; select appropriate genres; use suitable tone and register	Limited awareness of audience or purpose; writing lacks adaptation to rhetorical situation.	Developing awareness of audience and purpose; makes some adaptations to tone and style.	Clear understanding of audience and purpose; makes effective rhetorical choices in structure, style, and evidence.	Sophisticated rhetorical awareness with nuanced adaptations; anticipates audience response and crafts highly effective communication.
6. Authenticity of ideas (6 pts)	Produce original writing with clear purpose; engage readers with expressive style; maintain authentic voice	Writing lacks originality and distinct voice; relies heavily on source material.	Emerging voice and some original elements; beginning to engage readers with developing style.	Clear authorial voice with original ideas; effectively engages readers with expressive style.	Convincing, authentic voice throughout; consistently engages readers with sophisticated style while maintaining originality.
7. Evidence integration (6 pts)	Incorporate relevant evidence; blend text evidence through summary, paraphrase, and quotation; cite sources ethically	Uses minimal evidence or relies on personal opinion; citations missing or incorrectly formatted.	Incorporates some relevant evidence; may struggle to blend quotations smoothly; citations present but inconsistent.	Integrates relevant evidence from credible sources to support claims; effectively blends quoted material with own writing.	Synthesises evidence from multiple genres with sophisticated integration; seamlessly incorporates quoted material while maintaining flow.
8. Structure and coherence (7 pts)	Use varied sentence structures; maintain paragraph coherence; use transitions to connect ideas; maintain consistent style and tone	Simple sentence structures with limited variety; paragraph organisation inconsistent; weak transitions.	Some sentence variety; paragraphs generally organised around main ideas but transitions may be mechanical.	Well-built sentences with appropriate variety; coherent paragraphs with clear topic sentences and effective transitions.	Sophisticated sentence variety; cohesive paragraphs with seamless transitions and consistent style throughout.
9. Mechanics and presentation (5 pts)	Sound spelling and grammar; neat and effective presentation; format conventions	Frequent spelling, punctuation, and grammatical errors that impede understanding; disorganised presentation.	Some errors in spelling, punctuation, and grammar; presentation adequate but inconsistent.	Sound spelling, punctuation, and grammar with minor errors; work presented neatly and effectively.	Near-perfect mechanics; work presented professionally with attention to formatting details.

Writing subtotal: /30

III. Digital design multiliteracies (25 points)

Criteria	Measurable elements	1 — Beginning	2 — Developing	3 — Proficient	4 — Exemplary
10. Visual communication (7 pts)	Apply design principles; select appropriate visual elements; create effective visual hierarchy	Basic visual elements with limited design awareness; visuals may be decorative rather than meaningful.	Visual elements generally support the message; developing awareness of basic design principles.	Effective visual elements that enhance the message; design principles applied consistently to support communication.	Sophisticated visual compositions that significantly enhance communication; mastery of design principles and visual rhetoric.
11. Digital tool use (6 pts)	Select appropriate digital tools; use technology effectively for composition; leverage tool features to enhance work	Basic digital tools used with limited functionality; heavy reliance on templates with minimal customisation.	A range of digital tools used with increasing independence; some customisation of basic templates.	Digital tools selected and used strategically; features customised to enhance communication effectiveness.	Sophisticated use of digital tools; leverages advanced features to create innovative communications.
12. Multimodal text creation (7 pts)	Integrate text with other modes purposefully; create cohesion across modes; use multimedia to clarify complex concepts	Products rely primarily on one mode with minimal integration; limited awareness of modal affordances.	Attempts to integrate multiple modes with developing awareness of how they work together; connections between modes may be unclear.	Effectively integrates multiple modes to create cohesive messages; each mode contributes meaningfully to the overall communication.	Sophisticated multimodal compositions where modes work synergistically; mastery in leveraging modal affordances.
13. Digital-tool navigation (5 pts)	Use authoring and AI features effectively; evaluate and select generated content; modify and customise outputs	Uses tools with minimal direction; accepts default outputs with little critical evaluation or customisation.	Provides basic direction; makes some modifications but may rely heavily on generated content.	Directs tools with clear intent; critically evaluates and substantially modifies outputs to suit communication goals.	Sophisticated, iterative direction of authoring and AI tools; transforms outputs through extensive modification and integration.

Design subtotal: /25

Total: /80. Digital-storytelling subskills (ICT mastery, task completion, authenticity, clarity, pronunciation, fluency, relevance, creativity and innovation) are reported separately in the manuscript on a summed scale that includes a ten-point ICT-mastery component (see Materials and methods).

SUPPLEMENTAL MATERIAL S1/APPENDIX C. POST-INTERVENTION TEACHER INTERVIEW SCHEDULE

The schedule structured semi-structured interviews with the seven participating teachers after the intervention. Questions were organised by research question and by the constructs that guided the qualitative strand (value, confidence, practice, challenges and remedies, preference). The instrument was adapted from Ganapathy and Kaur (2013).

Framing

RQ2. How does the post-pandemic RWD multiliteracies intervention influence EFL reading and writing teaching and learning? (*Answered jointly by the quantitative and qualitative strands; the interview addressed RQ2a and RQ2c below.*)

RQ2a — Pedagogical changes

Value. How have teachers' perceptions of multiliteracies pedagogy in EFL reading and writing instruction evolved following the intervention?

1. In your opinion, how can the elements of multiliteracies pedagogy — situated practice (experiencing), overt instruction (conceptualising), critical framing (analysing), and transformed practice (applying) — transform your regular teaching of EFL reading and writing?
2. In your opinion, how effective is the integration of multiple modes of a text — linguistic, visual, audio, gestural, spatial, and multimodal combinations — in supporting students' meaning-making?
3. Do you think the knowledge-process sequence of a multiliteracies design helps students develop traditional linguistic literacy alongside twenty-first-century literacies such as digital literacy? Please explain.

Confidence. How have teachers' confidence levels regarding the implementation of multiliteracies approaches and multimodal technologies evolved through the intervention?

4. Following the intervention, have you developed confidence using a range of content-authoring tools to design engaging multimodal reading and writing activities? Please explain.

Practice. What specific adaptations have teachers made to their reading and writing practices after experiencing the RWD framework?

5. Do you now tend to design reading and writing assignments that encourage students to responsibly use ICT tools to critically interact with, and creatively produce, "visualised" multimodal texts — for example, team-based tasks involving e-posters, storyboards, oral presentations, picture books, infographics, slide decks, blogs or vlogs, animations, video clips, podcasts, or original music?
6. Which specific knowledge processes — experiencing, conceptualising, analysing, applying — can your students develop more effectively? Which is most challenging?
7. Which content-authoring tools or platforms do you and your students most often use to design (or respond to) a collaborative multimodal reading and writing activity — for example, slide tools, Canva, Powtoon, Padlet, StoryboardThat, Book Creator, Flip, or generative-AI applications?

8. How does the design component function, within the integrated multiliteracies framework, to enhance traditional reading and writing skills?

Challenges and remedies. What challenges did teachers face, and what adaptive strategies did they develop, in implementing the intervention?

9. What challenges did you face in implementing the multimodal, design-based reading and writing assignment?
10. Which specific knowledge process(es) was most challenging for students to develop?
11. What adaptive strategies did you develop to mitigate those challenges?

RQ2c — Pedagogical preferences

Preference.

12. What pedagogical preferences for EFL literacy teaching have evolved for you through the multiliteracies intervention?
13. To what extent are you willing to integrate multiliteracies pedagogy into your regular EFL reading and writing instruction?

Elaboration.

14. Do you have any further comments or questions about the implementation of multiliteracies approaches in reading and writing classrooms?

Note. Instrument adapted from Ganapathy and Kaur (2013). Interviews were collected via MS form, some audio-recorded, depending on availability, with participant consent and transcribed verbatim; excerpts reported in the manuscript use pseudonyms.