# NEEDS ANALYSIS OF DIGITAL COMICS FOR SUSTAINABLE DEVELOPMENT GOALS (SDG) EDUCATION AND DIGITAL LITERACY IN ELEMENTARY SCHOOLS

Ika Sulistyarini
*Department of English Language Education, Faculty of Cultures and Languages, Universitas Islam Negeri Raden Mas Said Surakarta, Indonesia*
Corresponding author: ika.sulistyarini@staff.uinsaid.ac.id

**Abstract**

Integrating Sustainable Development Goals (SDGs) and digital literacy into primary English Language Teaching (ELT) is vital for developing young learners' global communication competencies, yet teachers frequently struggle with limited engaging digital resources. This study aimed to examine the pedagogical, structural, and technical needs for developing interactive digital comics tailored to SDG education and digital literacy in primary school English classrooms. Employing a descriptive qualitative research design reinforced by thematic analysis, data were gathered using validated 5-point Likert-scale questionnaires and semi-structured interviews with 15 primary school English teachers instructing upper-grade students (Grades 4-6, aged 9–11) in Central Java, Indonesia. Data analysis involved thematic coding and interactive qualitative analysis. The findings revealed that although 93% of teachers acknowledged the necessity of contextualizing SDG topics such as climate action and responsible consumption in ELT, 87% faced a severe shortage of suitable digital learning media. Furthermore, while students regularly accessed digital devices, their literacy was confined to passive media consumption rather than active language practice. Consequently, both teachers and students strongly demanded interactive digital comics incorporating locally grounded storylines, simplified target language with audio-visual scaffolding, and reflective comprehension quizzes. This study highlights an urgent need for SDG-focused digital comics and provides empirical design parameters to guide curriculum developers, instructional designers, and primary ELT educators.

**Keywords:** Digital comics; Digital literacy; Primary education; Sustainable Development Goals (SDGs); Needs analysis

## INTRODUCTION

Primary English Language Teaching (ELT) is undergoing a structural paradigm shift, moving away from repetitive structural grammar drills toward fostering comprehensive global communicative capabilities (Garton & Copland, 2019). At the core of this transition lies the embedding of global citizenship education, which relies heavily on the United Nations Sustainable Development Goals (SDGs) framework (UNESCO, 2017). Incorporating sustainability concepts—such as climate action, responsible consumption, and social equity—into young learners' language instruction provides authentic, context-rich input while cultivating critical reflection and environmental mindfulness from early childhood (Kioupi & Voulvoulis, 2019; Malihah et al., 2025). Simultaneously, the swift digital shift in basic education demands deliberate efforts to nurture digital literacy among young students (Pegrum et al., 2022). Modern primary ELT is thus charged with a dual objective: building functional target language proficiency while boosting digital competencies and global awareness (Hockly, 2023).

Despite strong theoretical consensus supporting the insertion of sustainability themes and digital literacy in early language classrooms, a persistent execution gap separates theoretical assumptions from daily instructional practices (Azizah et al., 2026; Copland et al., 2014). Previous literature within ELT material development consistently underscores the utility of multimodal instructional tools—including visual narratives, interactive software programs, and animated content—in elevating motivation, classroom engagement, and vocabulary retention among young learners (Tomlinson, 2016; Yunus et al., 2021). Specifically, recent empirical investigations into digital comics emphasize their capacity to strengthen vocabulary acquisition, reading comprehension skills, and narrative abilities (Golding & Verrier, 2020; McTaggart, 2021; Yunus et al., 2021). Nevertheless, the overwhelming majority of SDG-related ELT research remains focused on secondary and tertiary academic levels (Kioupi & Voulvoulis, 2019; Leal Filho et al., 2023; Malihah et al., 2025), leaving the primary education context largely overlooked. Although scholars praise multimodal technology tools and sustainability framework models separately, very few empirical inquiries have examined the intersection of these two areas within primary English classrooms, nor have they systematically audited the specific instructional requirements of primary teachers when designing such integrated learning tools.

This study resolves this empirical and methodological gap by performing an in-depth needs analysis aimed at developing interactive digital comics designed specifically for SDG instruction and digital literacy enrichment in elementary schools. The unique contribution of this research lies in its dual-axis framework: pairing global sustainability concepts with digital multimodal affordances tailored for young English language learners (Grades 4-6, aged 9 to 11). Rather than viewing digital devices as mere passive delivery instruments or treating SDGs as abstract theoretical ideas, this research systematically investigates practical teaching obstacles, material shortages, and structural preferences among elementary English educators. Specifically, this study answers two core research questions:

1. What are primary school English teachers' perceptions and current practices regarding the integration of SDG topics and digital literacy into ELT?

2. What specific pedagogical, structural, and technical requirements are needed to develop interactive digital comics that effectively support SDG education and digital literacy in elementary classrooms?

By establishing a robust empirical baseline, these insights offer practical material design criteria for language teachers, instructional designers, and curriculum developers seeking to foster ecological mindsets together with digital capabilities in primary ELT settings.

## LITERATURE REVIEW

### Conceptual Foundations and Theoretical Frameworks of Interactive Multimodal Learning

Modern English Language Teaching (ELT) tailored for young learners is experiencing a structural paradigm shift, moving away from isolated grammar memorization toward building holistic global communication competencies and critical thinking (Garton & Copland, 2019; Richards & Pun, 2023). Under UNESCO's (2017) global directives, contemporary language instruction is encouraged to align learning resources with global citizenship principles, primarily through the United Nations Sustainable Development Goals (SDGs) framework. Threading sustainability themes—such as climate action and responsible consumption—into elementary language lessons offers contextualized learning experiences for young pupils, building ecological awareness and critical inquiry early in life (Kioupi & Voulvoulis, 2019; Malihah et al., 2025). Parallel to this, the rapid digitization of elementary classrooms mandates targeted cultivation of digital literacies (Pegrum et al., 2022). Consequently, primary ELT practitioners encounter a dual objective: enhancing target language fluency while steering young learners toward productive interactions with digital technologies (Hockly, 2023).

The conceptual foundation of this study relies on Mayer's (2021) Cognitive Theory of Multimedia Learning (CTML) combined with Kress's (2010) Multimodal Social Semiotics perspective. CTML explains that human cognitive architecture processes visual and auditory information through separate processing channels. When educational tools strategically align visual storytelling with synchronized audio input, learner mental load is significantly reduced, accelerating reading comprehension and vocabulary retention (Golding & Verrier, 2020; Mayer, 2021; McTaggart, 2021). Interactive digital comics

directly apply these multimodal advantages by merging panel illustrations, dialogue text, native-speaker audio tracks, and pop-up vocabulary glossaries built around the cognitive capacities of children aged 9 to 11 (Golding & Verrier, 2020; McTaggart, 2021; Yunus et al., 2021).

Concurrently, the theoretical framing of digital literacy within primary schooling has expanded. As highlighted by Pegrum et al. (2022) as well as Bawden and Robinson (2020), digital proficiency goes far beyond basic hardware handling to include critical evaluation, visual interpretation, and proactive digital involvement. Practical observation shows that primary pupils generally engage with electronic devices through passive activities, such as video streaming or casual gaming (Pegrum et al., 2022). Inserting interactive scaffolding—including embedded audio-visual supports and reflective quizzes inside digital comics—acts as an essential pedagogical lever, converting passive screen viewing into active, meaningful target language usage (Dudeney et al., 2021; Hockly, 2023).

**Critical Analysis of Prior Scholarship and Identification of Research Gaps**

Research over the past decade repeatedly confirms that multimodal visual tools elevate young learners' motivation, emotional involvement, and language retention (Golding & Verrier, 2020; Tomlinson, 2016; Yunus et al., 2021). McTaggart (2021) and Yunus et al. (2021) specifically demonstrated that dual-coded text-picture structures in digital comics provide effective cognitive support, facilitating the decoding of complex reading materials for young language learners.

Nonetheless, a detailed synthesis of current literature reveals two primary research gaps:

- **Educational Level Imbalance:** The vast majority of empirical studies investigating SDG incorporation within ELT focus on higher education or secondary school settings (Azizah et al., 2026; Kioupi & Voulvoulis, 2019; Leal Filho et al., 2023; Malihah et al., 2025). The primary education sector remains noticeably underrepresented, despite broad consensus that sustainable values and core language capabilities are established most effectively during childhood (Copland et al., 2014; Garton & Copland, 2019).
- **Thematic Fragmentation:** Existing studies generally examine digital media capabilities (Tomlinson, 2016; Yunus et al., 2021) and SDG framework

applications (UNESCO, 2017) as separate topics. Very few studies empirically analyze how global sustainability concepts interact with multimodal digital comic features in primary ELT settings, nor do they explore the practical material requirements of primary educators when building integrated instructional resources.

**Conceptual Synthesis and Analytical Framework**

To bridge these theoretical and empirical gaps, this research formulates the Sustainable Development Goals - Interactive Digital Comic Framework (SDG-IDCF) as an analytical guide for interpreting field data:

- **Contextual SDG Content:** Framing abstract sustainability goals (such as local waste handling and campus energy saving) inside recognizable community narrative settings (Malihah et al., 2025; UNESCO, 2017).
- **Multimodal Cognitive Scaffolding:** Applying CTML principles (Mayer, 2021) through simplified dialogue scripts, visual cues, native-speaker voice recordings, and pop-up vocabulary lists to optimize cognitive load management (Golding & Verrier, 2020; McTaggart, 2021; Yunus et al., 2021).
- **Active Digital Interactivity:** Shifting device engagement from passive media consumption toward active learning through gamified reflection quizzes that evaluate language mastery alongside environmental awareness (Hockly, 2023; Pegrum et al., 2022).

This analytical framework serves as a theoretical foundation to guide the interpretation of empirical needs in primary language education. Existing literature underscores a critical instructional paradox: while educators widely recognize the imperative of embedding Sustainable Development Goals (SDGs) into language curricula, they face a severe scarcity of contextually appropriate multimodal digital resources (Azizah et al., 2026; Malihah et al., 2025). By bridging this gap, the proposed framework offers evidence-informed design parameters for instructional designers, language educators, and curriculum developers seeking to cultivate environmental awareness alongside digital competencies in primary ELT settings.

**RESEARCH METHOD**

**Research Design**

This research employed a qualitative descriptive design to systematically examine the pedagogical requirements, perceptions, and instructional difficulties encountered by elementary English educators regarding SDG integration and digital media creation. A descriptive qualitative strategy was selected because it facilitates an in-depth understanding of teachers' authentic experiences and preferences without manipulating research variables (Creswell & Creswell, 2018).

**Participants and Research Context**

The research sample comprised 15 primary English teachers (4 males, 11 females) recruited via purposive sampling across public and private elementary schools in Central Java, Indonesia. Selection criteria specified that candidates must have: (1) a minimum of three years teaching experience in upper-grade primary ELT (Grades 4–6, teaching learners aged 9–11), (2) basic functional competence with digital instructional tools, and (3) experience applying digital devices during classroom instruction. Ethical approvals and informed consent were secured from all participants prior to data collection, ensuring data privacy and anonymous handling of transcripts.

**Data Collection Instruments and Procedure**

Data gathering relied on a two-pronged instrument approach to ensure empirical triangulation:

- **Structured Likert-Scale Questionnaire:** A 15-item questionnaire featuring a 5-point Likert scale (ranging from 1 = Strongly Disagree to 5 = Strongly Agree) was deployed to capture baseline metrics on teacher perceptions, resource access, and media structural choices. The questionnaire underwent content validation by two senior specialists in ELT materials design.
- **Semi-Structured Interviews:** Semi-structured interviews were conducted to explore pedagogical preferences, classroom operational constraints, contextual SDG topics, and desired comic features.

**Data Analysis and Trustworthiness**

Data processing followed the qualitative data analysis framework of Miles et al. (2014), which includes data reduction, data display, and conclusion verification steps. Quantitative survey metrics were evaluated using basic descriptive statistics (percentage rates) to highlight main patterns, whereas qualitative interview records were evaluated

using thematic coding. To verify data trustworthiness (Creswell & Creswell, 2018), member checking was conducted by sharing transcript summaries back to key respondents, alongside researcher triangulation during thematic coding.

## RESULTS AND DISCUSSION

The empirical findings of this investigation are structured into two fundamental analytical sections. First, the study delineates the prevailing baseline conditions, instructional paradoxes, and practical impediments experienced by primary English educators regarding the integration of Sustainable Development Goals (SDGs) and digital literacy. Second, it establishes a comprehensive, theoretical, and empirical design framework—the Sustainable Development Goals - Interactive Digital Comic Framework (SDG-IDCF)—to guide the structural engineering of multimodal digital comics tailored for young language learners (aged 9–11).

### Pedagogical Realities, Instructional Paradoxes, and Resource Scarcity

#### *Quantitative Baseline on Educator Attitudes and Resource Availability*

The quantitative survey administered to primary English teachers across Central Java revealed a stark juxtaposition between pedagogical awareness and material accessibility. Table 1 summarizes the baseline descriptive metrics across four core instructional indicators.

**Table 1: Primary English Teachers' Perceptions on SDG Integration and Media Availability ($N = 15$)**

| No | Survey Indicator | Strongly Disagree (%) | Disagree (%) | Neutral (%) | Agree (%) | Strongly Agree (%) |
|---|---|---|---|---|---|---|
| 1 | Necessity and pedagogical value of embedding SDG topics in primary ELT | 0% | 0% | 7% | 40% | 53% |
| 2 | Availability of age-appropriate, SDG-aligned digital ELT instructional media | 27% | 40% | 20% | 13% | 0% |
| 3 | Learners' active linguistic engagement with existing electronic devices | 0% | 7% | 13% | 47% | 33% |

| No | Survey Indicator | Strongly Disagree (%) | Disagree (%) | Neutral (%) | Agree (%) | Strongly Agree (%) |
|---|---|---|---|---|---|---|
| 4 | Instructional demand for interactive digital comics with multimodal scaffolding | 0% | 0% | 0% | 27% | 73% |

An overwhelming 93% of surveyed educators expressed affirmative consensus (40% agreed, 53% strongly agreed) regarding the instructional necessity of integrating global sustainability themes into early English language teaching. Educators recognized that threading real-world ecological challenges—such as climate change, waste management, and resource conservation—into primary language lessons transforms abstract vocabulary drills into authentic, context-rich communicative experiences (Kioupi & Voulvoulis, 2019; Malihah et al., 2025).

However, this positive disposition is severely constrained by an acute shortage of instructional resources. A total of 87% of respondents indicated a non-affirmative status (27% strongly disagreed, 40% disagreed, and 20% remained neutral) regarding the current availability of SDG-aligned digital learning media suitable for primary school contexts. This empirical gap confirms that while global directives (e.g., UNESCO, 2017) urge basic education to adopt global citizenship frameworks, language teachers are left without practical, contextually validated digital tools (Azizah et al., 2026; Copland et al., 2014).

***The Digital Literacy Paradox: Passive Media Consumption vs. Active Language Learning***

A secondary empirical pattern identified in Table 1 relates to students' interactions with digital hardware. While 80% of teachers confirmed that upper-grade primary students (aged 9–11) exhibit high daily engagement with electronic devices such as smartphones and tablets, qualitative interview data revealed that this engagement is functionally superficial.

Teachers highlighted a persistent instructional paradox: although young learners operate digital interfaces with high fluency, their digital literacy remains largely passive

and recreational rather than productive or linguistically enriching. As articulated by multiple interview participants:

*"Our students are very familiar with gadgets, but they mostly watch cartoons or play offline games. When we ask them to read English texts on screens, they easily get bored because the existing e-books are plain PDF pages without interactive sound or supportive visuals."* (Teacher 4, Female)

*"Children operate devices effortlessly, but operating a device is not the same as learning through a device. When given standard English digital worksheets, they passively scroll past paragraphs without comprehending the core ecological concepts or target language structures."* (Teacher 9, Male)

These findings strongly align with conceptual frameworks proposed by Pegrum et al. (2022) as well as Bawden & Robinson (2020), which differentiate raw technical operation from critical, active digital literacy. In primary language classrooms, static digitized formats (such as standard PDF files or scanned textbook pages) fail to capitalize on digital affordances. They lack interactive feedback loops, audio narration, and visual cues needed to reduce cognitive friction, resulting in low learner motivation and premature reading fatigue (Dudeney et al., 2021; Hockly, 2023).

**Theoretical and Architectural Framework: SDG-IDCF**

To bridge the empirical divide between theoretical recommendations and classroom execution, data gathered from teacher interviews and material audits were synthesized into the **Sustainable Development Goals - Interactive Digital Comic Framework (SDG-IDCF)**. Table 2 outlines the multi-dimensional design blueprint derived from this synthesis, detailing specific structural features along with their pedagogical and theoretical justifications.

**Table 2: Comprehensive Design Blueprint for SDG-Based Interactive Digital Comics**

| Dimension | Specific Feature Requirements | Pedagogical Rationale & Theoretical Alignment |
|---|---|---|
| **Content & Context** | Localized narrative arcs focusing on SDG 12 (*Responsible Consumption*) and SDG 13 (*Climate Action*); Indonesian community & school settings | Enhances contextual authenticity, bridges abstract global goals with relatable local realities, and fosters early ecological |

| Dimension | Specific Feature Requirements | Pedagogical Rationale & Theoretical Alignment |
|---|---|---|
| | | mindfulness (Malihah et al., 2025; UNESCO, 2017) |
| **Linguistic Level** | Strict calibration to CEFR A1–A2 standards; controlled density of 10–15 target vocabulary items per chapter; simplified syntax | Prevents cognitive overload, manages working memory capacity, and lowers the affective filter for young EFL learners aged 9–11 (Mayer, 2021) |
| **Multimodal Scaffolding** | Interactive tap-to-read comic panels, native-speaker audio narrations, visual glossaries, pop-up vocabulary cards | Operationalizes dual-coding principles of CTML and Social Semiotics; optimizes visual and auditory cognitive channels (Kress, 2010; Mayer, 2021; Yunus et al., 2021) |
| **Technical Interactivity** | Gamified reflection quizzes (drag-and-drop, interactive matching), offline functionality, cross-platform Android/Web UI | Converts passive screen viewing into active target language usage; guarantees technological equity across varied infrastructural settings (Hockly, 2023; Pegrum et al., 2022) |

## In-Depth Analysis of Design Dimensions

### *Dimension 1: Content Localization and Contextualized Sustainability (SDG 12 & SDG 13)*

The primary requirement emphasized by language educators is the critical need for localized storytelling. Teachers reported that presenting global environmental concepts—such as greenhouse gas emissions, macro-sustainability, or global thermal shifts—in abstract, high-level terms induce cognitive disconnect among elementary students aged 9 to 11.

### Pedagogical Scaling and Ecological Storytelling

To make sustainability meaningful, abstract concepts must undergo *pedagogical scaling*: translating complex global phenomena into concrete, everyday scenarios that children directly experience in their immediate surroundings. Teachers specifically requested narrative arcs anchored in familiar Indonesian contexts, such as schoolyard waste segregation, single-use plastic reduction at local traditional markets (*pasar*), and energy conservation within classroom environments.

*"Conceptually, explaining cause-and-effect in environmental destruction is difficult for elementary students because they do not yet grasp long-term consequences. We must negotiate this by providing immediate visual storytelling—showing a character dropping plastic into a drain, followed by a comic panel illustrating the blocked drainage and localized flooding. This visual cause-and-effect makes the concept relatable without overwhelming them with scientific jargon."* (Teacher 2, Female)

By embedding SDG 12 (*Responsible Consumption and Production*) and SDG 13 (*Climate Action*) within localized comic narratives, the instructional tool bridges the gap between global directives and local action (Malihah et al., 2025; UNESCO, 2017). Target vocabulary (e.g., *recycle*, *litter*, *preserve*, *waste*, *clean energy*) is introduced not as isolated lexical items to be memorized, but as functional communication tools embedded within authentic visual narratives. This contextualized approach fulfills the core tenets of communicative language teaching (CLT) while simultaneously instilling environmental mindfulness from an early age (Garton & Copland, 2019; Kioupi & Voulvoulis, 2019).

***Dimension 2: Linguistic Calibration and Cognitive Load Management***

Linguistic analysis of primary ELT materials frequently reveals a structural mismatch between text readability and student proficiency. Interviewed educators noted that commercially available English storybooks addressing environmental issues are overwhelmingly produced for native English speakers, featuring complex clause structures, low-frequency vocabulary, and dense narrative blocks that exceed the cognitive processing limits of young EFL learners.

[Scientific / Scientific SDG Concept]
  │ (e.g., "Resource Sustainability & Ecological Balance")
  ▼
[Pedagogical Scaling & Linguistic Simplification]
  │ (CEFR A1-A2 Standards: Short S-V-O Sentences)
  ▼
[Relatable Child-Centered Definition]
  │ (e.g., "Sustainability means taking care of our Earth so there is enough for everyone.")
  ▼
[Reduced Working Memory Load / High Reading Comprehension]

**CEFR A1–A2 Standardization and Density Control**

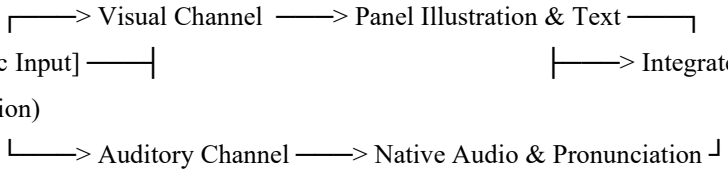
To resolve these linguistic hurdles, the SDG-IDCF mandates strict structural calibration to Common European Framework of Reference (CEFR) A1–A2 standards, specifically designed to meet the cognitive and language development levels of Grades 4-6 elementary students. Sentences are constrained to short, subject-verb-object (S-V-O) patterns, avoiding compound-complex clauses that cause cognitive processing bottlenecks. Furthermore, the framework imposes a strict density limit of 10 to 15 key target vocabulary terms per comic module.

*"When designing English instructional materials for primary students, our biggest challenge is lexical choice. We are used to academic or teenage English, so choosing words suitable for 9-year-olds requires deliberate filtering. Complex terms like 'sustainability' cannot be translated directly. Instead, we define it functionally as 'taking care of our Earth so resources last.' We break the concept into simple, actionable steps rather than abstract definitions."* (Teacher 11, Female)

This controlled lexical deployment directly operationalizes Mayer's (2021) Cognitive Theory of Multimedia Learning (CTML). Human working memory possesses limited capacity for processing new sensory information. By eliminating non-essential vocabulary (*extraneous cognitive load*) and structuring core target words within scaffolded contexts (*essential cognitive load*), the digital comic enables young learners to devote cognitive resources to reading comprehension and schema construction (Golding & Verrier, 2020; McTaggart, 2021).

***Dimension 3: Multimodal Scaffolding and Dual-Channel Processing***

The third core requirement identified in the empirical needs analysis is the inclusion of dynamic visual and auditory scaffolding. Standard static e-books or print materials rely exclusively on the visual processing channel, forcing young learners to decode text and infer meaning without auditory reinforcement.




**Dual-Coding Architecture in Action**

In accordance with CTML (Mayer, 2021) and Multimodal Social Semiotics (Kress, 2010), interactive digital comics utilize dual-channel cognitive processing. Panel

illustrations provide non-verbal visual context, speech bubbles deliver printed target text, native-speaker audio narrations reinforce phonological awareness, and tap-to-open vocabulary cards offer immediate semantic clarification.

*"Traditional print comics help visually, but in an EFL context, children often hesitate because they don't know how the English words sound. Having a 'tap-to-listen' feature where a native audio voice reads the dialogue bubble allows students to connect written text directly with correct pronunciation. It removes their fear of reading aloud."* (Teacher 7, Male)

This multimodal integration provides structural scaffolding that supports diverse learning modalities (McTaggart, 2021; Yunus et al., 2021). Visual cues contextualize narrative actions, reducing dependence on native-language translation. Meanwhile, pop-up glossaries provide immediate vocabulary support without interrupting the narrative flow, preserving reading engagement and promoting independent learning (Golding & Verrier, 2020; Tomlinson, 2016).

***Dimension 4: Technical Interactivity, Gamification, and Infrastructure Equity***

The final dimension addresses technical architecture and operational delivery. Teachers underscored that interactive elements must extend beyond basic page-turning animations to include active learning mechanics.

**Gamified Reflection Quizzes**

The blueprint embeds gamified assessment modules—such as drag-and-drop sorting activities (e.g., categorizing items into organic vs. recyclable bins) and interactive decision-making prompts—at the end of each comic chapter.

[Passive Consumption: Static PDF Reading] ——> Boredom & Low Retention

VS.

[Active Engagement: Interactive Comic] ——> Tap Panels + Audio Scaffolding + Gamified Quiz ——> High Retention & Digital Literacy

Embedding these interactive tasks directly addresses the digital literacy paradox described in Section 1.2. Instead of consuming media passively, learners must apply target English vocabulary to solve environmental challenges within the game environment. This active involvement builds both linguistic mastery and digital competence (Dudeney et al., 2021; Hockly, 2023; Pegrum et al., 2022).

**Mitigating Infrastructural Constraints**

From an operational perspective, teachers identified software costs, software complexity, and unstable internet connectivity as significant barriers to digital adoption. *"When creating digital learning media, we often run into paywalls or complex editing tools. To make these digital comics viable for daily classroom use, the final product must run smoothly offline and be accessible on basic Android smartphones, as many students do not have high-end tablets or continuous internet access at home."* (Teacher 5, Female)

To ensure equitable access across diverse primary school settings, the framework specifies that interactive digital comics must be delivered via responsive, cross-platform user interfaces (Android app and lightweight Web-HTML5) featuring full offline operational capability. Offline functionality ensures that schools in resource-constrained or rural environments can deploy the media without performance degradation due to internet bandwidth limitations (Pegrum et al., 2022).

**Synthesis and Cross-Study Comparison**

The empirical findings of this study reinforce and extend current literature in early childhood language education, multimodal design, and ecopedagogy. While prior investigations into digital comics (e.g., Golding & Verrier, 2020; McTaggart, 2021; Yunus et al., 2021) focused primarily on general vocabulary acquisition or narrative reading skills, this research demonstrates that digital comics can simultaneously serve as vehicles for global sustainability education and active digital literacy.

Furthermore, while existing studies on SDG integration in ELT (e.g., Azizah et al., 2026; Leal Filho et al., 2023; Malihah et al., 2025) focus predominantly on secondary and higher education contexts, this study addresses the primary education sector. By establishing empirical design criteria—spanning localized narrative framing, CEFR A1–A2 linguistic control, dual-channel CTML scaffolding, and offline technical delivery—this research provides a concrete, evidence-based framework for instructional designers and primary language educators seeking to foster ecological awareness alongside English language proficiency.

## CONCLUSIONS

### Conclusion

This research emphasizes a pressing instructional need to create interactive digital comics that integrate Sustainable Development Goals (SDGs) and digital literacy into

elementary ELT. Although elementary educators strongly endorse the pedagogical value of global sustainability themes, their efforts are hindered by an acute scarcity of age-appropriate multimodal digital media. The empirical evidence provides concrete design parameters, prioritizing localized story arcs, audio-visual scaffolding, and interactive reflection exercises.

**Pedagogical and Policy Implications**

The findings from this study offer practical guidance for primary ELT practice. Curriculum developers are encouraged to integrate global sustainability themes directly into early language learning frameworks, ensuring target language acquisition occurs within authentic context settings. Additionally, learning material developers should utilize dual-channel audio-visual features within digital comics to transform passive device interaction into active language acquisition.

**Limitations and Future Research Directions**

This research is bound by its qualitative framework and sample size of 15 primary English educators in Central Java. Future investigations should focus on prototyping, classroom testing, and empirical evaluation (such as experimental trials) of these digital comics to quantitatively measure their impact on young learners' language growth, digital literacy skills, and sustainability mindsets across various regional contexts.

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