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A Comparative Analysis of Electronic (digital) versus Traditional Print Storybooks: Assessing their Impact on Vocabulary Acquisition among Adolescent EFL Learners of Different Genders

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Abstract

Vocabulary acquisition is a critical aspect of language learning, yet the effectiveness of different mediums, such as electronic and traditional storybooks, remains underexplored, particularly among beginner adolescent EFL learners. This study investigates the comparative impact of electronic versus traditional paper storybooks on vocabulary acquisition among 76 learners (16 boys, 60 girls) aged 11 to 15, highlighting a gap in understanding how technological enhancements affect language learning. Participants, selected through convenient sampling, were divided into two groups: one engaged with digital storybooks on phones and tablets, while the other used traditional paper storybooks. Vocabulary proficiency was assessed using a simplified PET Cambridge test, tailored to the participants' proficiency level, and administered pre- and post-15 instructional sessions. Each 60-minute session focused on vocabulary acquisition through story reading and exercises. Statistical analyses, including ANCOVA, T-tests, and ANOVA, revealed that while both formats significantly enhance vocabulary acquisition, electronic storybooks offer additional advantages due to multimedia features. Gender and age did not significantly influence the storybook format's effectiveness. This study underscores the potential of electronic storybooks in language instruction and recommends further research on long-term retention and impacts on other language skills across diverse learner demographics.

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Introduction

Recent studies highlight the advantages of electronic storybooks, which often feature multimedia elements like audio narrations, animations, and clickable definitions to engage learners through multimodal inputs (Nurjaya et al., 2024). For example, Boroughani et al. (2023) found that these interactive features capture learners' attention and enhance comprehension and retention of new vocabulary. Similar findings by Wu et al. (2019) support that such digital resources improve vocabulary retention, especially among young learners, by promoting sustained engagement through interaction. Studies suggest that interactivity and visual engagement of electronic storybooks can benefit learners with diverse learning preferences (Kucirkova et al., 2023; Alan, 2023). In today's rapidly evolving educational landscape, digital tools are increasingly integrated into language learning, underscoring the importance of selecting instructional materials that best support vocabulary acquisition. Moreover, research on mobile-assisted vocabulary learning (MAVL) tools that integrate spaced repetition with multimedia features further reinforces the effectiveness of electronic formats in supporting long-term vocabulary retention (Xodabande & Atai, 2022; Mohammadi et al., 2024). These tools also bridge educational disparities by offering equitable learning opportunities for students from varied socioeconomic backgrounds (Fathi et al., 2018).

On the other hand, traditional paper storybooks are valued for their tactile experience and the cognitive benefits of reading in print. Research indicates that physical interaction with paper books can enhance concentration and lead to deeper engagement, positively influencing vocabulary acquisition (Mangen, Walgermo, & Brønnick, 2013; Singer & Alexander, 2017). Baron (2021) also highlights that reading on paper fosters a more reflective reading process than digital formats, allowing learners to process information more deeply. For instance, Mangen and Kuiken (2014) suggest that print-based reading supports better focus due to its physicality, which can improve comprehension and retention. Baron (2015) also points out that the absence of digital distractions in print formats fosters a focused reading environment, which is particularly beneficial for younger learners. These findings are supported by more recent studies by Rosen and Dorr (2022) and Scholastic (2023), which further emphasise the role of print media in promoting sustained cognitive engagement without the potential distractions common in digital formats. Despite these benefits, direct comparisons of the impact of electronic versus traditional storybooks on vocabulary acquisition in English as a Foreign Language (EFL) settings remain limited.

Recent studies indicate that gender-based preferences in instructional formats may influence vocabulary acquisition in EFL contexts. Research by Rashidi and Hosseini (2021) found that male learners showed higher vocabulary gains when using interactive, multimedia-enhanced digital formats, benefiting from features like animations and

clickable definitions. In contrast, female learners tended to perform better with traditional storybooks, which fostered focused, immersive reading environments. Similarly, Reich et al. (2012) noted that boys responded more positively to digital formats, while girls found traditional books more conducive to vocabulary retention. These insights highlight the value of tailoring instructional materials to accommodate diverse learning preferences across genders.

Age-related cognitive and attentional differences may also influence learners' engagement with different formats. Chiong et al. (2012) found that younger learners, with their developing cognitive abilities and shorter attention spans, often gain more from the interactive features of digital formats, while older learners benefit from traditional formats due to their more advanced metacognitive strategies (Kucirkova et al., 2023). Plowman and McPake (2013) similarly noted that older learners are more adept at balancing interactivity with learning objectives in digital content. Recent literature underscores that learner preferences, gender, age, and cognitive development are critical factors in vocabulary acquisition with electronic and traditional storybooks (Nurjaya et al., 2024). However, variability in access to digital devices, potential distractions from non-educational content, and differences in digital literacy can further complicate comparisons of format effectiveness across demographics (Wu et al., 2019; Xodabande & Atai, 2022).

Addressing these variables is essential for understanding how digital and traditional formats serve different learner needs effectively. This study aims to address the gap in understanding by examining the influence of electronic versus traditional storybooks on vocabulary learning among adolescent EFL learners, with particular attention to gender and age. By analysing these factors, the research provides insights into optimising instructional materials to serve young learners' diverse needs better. However, comparing electronic and traditional storybook formats presents unique challenges. These differences stem from varying engagement dynamics and the potential digital distractions inherent in electronic devices. Additionally, learners' familiarity with technology, digital literacy, and access to digital resources can introduce variability in learning outcomes (Asadi & Ebadi, 2024). Cognitive processing also differs between digital and print formats, potentially influencing focus, especially among younger learners who may be more susceptible to distractions in digital environments (Nurjaya et al., 2024). Furthermore, individual preferences, learning styles, and age and gender differences complicate the assessment of format effectiveness (Alan, 2023). The following research questions are addressed in this study:

Is there a significant difference in vocabulary acquisition between students using electronic storybooks and traditional paper storybooks?

Do electronic and traditional paper storybooks significantly enhance vocabulary acquisition (from pre-test to post-test) within each group?

Is there a significant interaction between the modality (electronic vs. paper) and gender (male vs. female) in influencing vocabulary acquisition?

Does age moderate the relationship between vocabulary acquisition and the storybook format?

Literature review

Digital Storyboard

The integration of digital resources in language learning has garnered significant attention in recent years, particularly regarding the impact of electronic storybooks on vocabulary acquisition. Research has highlighted both the benefits and drawbacks of this format, contributing to a nuanced understanding of how these storybooks affect learners' vocabulary development. Research indicates that the multimedia features inherent in electronic storybooks, such as audio narration, interactive animations, and embedded word definitions, offer distinct advantages for vocabulary retention by engaging multiple sensory channels (Takacs & Bus, 2018). Takacs et al. (2015) found that these multimodal elements enhance learners' engagement, comprehension, and memory retention by facilitating connections between textual and visual stimuli. These elements have been shown to provide a more dynamic and interactive learning experience, which may be especially beneficial for learners who are more visually or auditorily oriented.

Recent studies continue to underscore the unique benefits of electronic storybooks for language learners. Li and Ma (2020) demonstrated that primary-aged EFL learners exposed to digital storybooks experienced significantly higher vocabulary gains compared to those using traditional paper formats. These results align with Mayer's Cognitive Theory of Multimedia Learning (Mayer, 2020), which posits that interactive features improve cognitive processing, resulting in a more engaging and effective learning experience. Furthermore, Smeets and Bus (2022) confirm that digital storybooks consistently lead to greater vocabulary development than print books, particularly for beginner learners who benefit from auditory and visual aids.

Additionally, electronic storybooks can help bridge vocabulary gaps for learners from diverse backgrounds. Nurjaya et al. (2024) found that the multimedia components of digital storybooks—such as interactive visuals and clickable word definitions—help engage learners and improve both their understanding and retention of new vocabulary. Asadi and Ebadi (2024) similarly emphasised that augmented reality and multimodal features in digital storybooks provide rich linguistic inputs that encourage vocabulary growth, especially for learners who benefit from dynamic, interactive learning environments.

However, despite their advantages, electronic storybooks have some potential drawbacks. One concern is that the multimedia elements while engaging, may lead to

cognitive overload if not carefully designed (Mayer, 2021; Sungkharat & Panjaburee, 2023). Research indicates that overuse of interactive features can detract from focused reading, potentially hindering deep comprehension and retention (Jeong, 2012). Suggate (2019) observed that poorly integrated multimedia features may overwhelm learners, especially those with limited prior knowledge, and prevent them from processing vocabulary meaningfully. Moreover, while digital storybooks can offer diverse learning experiences, they also introduce potential distractions. The constant presence of clickable elements, animations, and other interactive components may shift the learner's attention away from the primary focus of vocabulary acquisition. Research highlights that such features, if not designed thoughtfully, can interfere with sustained attention and reduce the depth of learning (Mayer, 2021; Sungkharat & Panjaburee, 2023).

Recent research has highlighted the potential influence of gender and age on how electronic storybooks impact vocabulary acquisition among EFL learners. Studies suggest that boys and girls may respond differently to this instructional format, which can affect their engagement and performance outcomes. Xie et al. (2021) found that boys showed stronger vocabulary gains from digital storybooks, likely due to their engagement with gamified and interactive features that encourage active participation. Age also appears to influence how learners respond to electronic storybooks. Lee and Lin (2021) found that younger learners, who are more drawn to visual and auditory stimuli, tend to benefit more from electronic storybooks with interactive features due to their shorter attention spans. Recent meta-analyses and systematic reviews have significantly expanded our understanding of how digital storybooks influence vocabulary acquisition, particularly in relation to gender and age.

Suggate (2019) conducted a comprehensive meta-analysis of studies comparing digital and traditional reading formats. The analysis found that with their multimodal features, digital storybooks generally promote better vocabulary acquisition by fostering engagement through interactive elements. However, Suggate (2019) also noted that these advantages were particularly evident for younger learners or those with lower initial vocabulary levels, as they benefit more from the enhanced visual and auditory stimuli. A systematic review by Liu and Hsiao (2021) examined the effects of electronic storybooks across different age groups and learner profiles. The review found consistent evidence that digital storybooks tend to be more effective in promoting vocabulary retention and engagement for younger learners, particularly those with shorter attention spans.

Chiong et al. (2022) reported that younger learners, particularly those under 10 years old, showed a stronger preference for and greater gains from digital storybooks with interactive elements. Kucirkova et al. (2017) further supported this, noting that older children exhibited better comprehension and retention of vocabulary when using traditional storybooks, likely due to their more advanced reading strategies..

Traditional Storyboard

Traditional paper storybooks have long been associated with cognitive and sensory benefits, including enhanced concentration and deeper engagement with texts. Mangen and Kuiken (2014) argued that the tactile experience of handling physical books aids focus and promotes cognitive immersion in reading, which positively impacts vocabulary acquisition. The physical act of turning pages and focusing on the text without digital distractions may facilitate deeper cognitive engagement and comprehension (Mangen & Kuiken, 2014). Traditional storybooks are also beneficial in fostering a linear, uninterrupted reading experience. Baron (2015) noted that these formats allow learners to engage with texts more deeply, forming stronger connections with words and their meanings. This uninterrupted experience helps learners focus on the content without the diversions that digital devices might introduce. Such findings suggest that traditional formats may offer a more focused learning environment, particularly for younger learners who may struggle with the constant interactive features in digital formats (Baron, 2015).

However, traditional paper storybooks are not without their drawbacks. One limitation is their lack of multimedia support, which may be particularly challenging for learners who benefit from visual and auditory stimuli. Younger learners often have shorter attention spans, so they may find it harder to remain engaged with paper-based storybooks compared to the more dynamic and interactive digital formats (Lee & Lin, 2021). Furthermore, traditional storybooks may not provide immediate feedback or support for vocabulary acquisition as digital formats with interactive definitions and multimedia cues can (Mayer, 2020). Additionally, traditional storybooks can be less accessible for learners from under-resourced backgrounds who may not have easy access to physical books, particularly if the texts are not available in sufficient quantity or quality for all learners. Digital storybooks can address this issue by offering easily accessible content that can be personalised to meet the needs of individual learners (Zhang & Zhang, 2020).

Gender and age appear to moderate the effectiveness of traditional storybooks as well. Studies suggest that girls tend to benefit more from traditional storybooks, where they engage more deeply with the narrative structure without the potential distractions multimedia content offers. Similarly, Plowman and McPake (2013) noted that older learners are better at balancing interactivity with educational objectives in digital content but still show a preference for the linear, focused engagement provided by traditional books.

Meta-analyses focusing on traditional storybooks have highlighted their cognitive benefits. Molinaro et al. (2020) conducted a meta-analysis focusing on print-based storybooks, highlighting their cognitive benefits. The analysis found that traditional paper storybooks facilitate deeper cognitive engagement through tactile experiences and uninterrupted focus, particularly for older learners or those requiring sustained attention to comprehend vocabulary in context. However, this advantage may be diminished for

younger learners or those with lower attention spans, who may struggle with the linearity of print books and benefit more from the multimodal support provided by digital formats. Molinaro et al. (2020) pointed out that traditional storybooks are less likely to engage learners in interactive learning experiences, which may limit their potential for active vocabulary acquisition in certain contexts. Liu and Hsiao (2021) concluded that while traditional formats may foster deep learning, they may not always match the immediate engagement and accessibility of digital storybooks for younger learners. Recent research underscores that older learners generally benefit more from traditional books, as their cognitive ability to focus and absorb vocabulary in a more linear and sustained manner has developed. Such findings suggest that while traditional storybooks provide unique benefits, their effectiveness may vary based on learners' cognitive maturity and learning preferences.

Both electronic and traditional storybooks offer unique advantages and disadvantages for vocabulary acquisition. While digital formats provide multimedia features that can enhance engagement and support vocabulary retention, traditional formats foster deeper cognitive engagement and sustained focus. Gender and age appear to moderate the effectiveness of these formats, with boys and younger learners benefiting more from digital storybooks. In comparison, girls and older learners perform better with traditional formats. This study aims to contribute to the growing body of literature by exploring how these formats influence vocabulary acquisition among adolescent EFL learners, with particular attention to gender and age as moderating factors. The results will inform teaching practices and curriculum development, offering a deeper understanding of how educational tools can be tailored to meet the needs of diverse learners. This study examines the differential impact of electronic versus traditional paper storybooks on vocabulary development among beginner EFL learners aged 11 to 15, focusing on potential gender differences.

Method

Design

This study employed a comparative experimental design to explore the impact of electronic versus traditional paper storybooks on vocabulary acquisition among beginner adolescent EFL learners. The method was selected because of the practical constraints inherent in working with pre-existing groups of students, as random assignment was not feasible. This design allows for the comparison of two naturally occurring groups while controlling for pre-existing differences, ensuring the investigation of the effects of the independent variable—storybook format (electronic vs. traditional)—on the dependent variable, vocabulary acquisition.

Participants

The study involved 76 beginner-level English as a Foreign Language (EFL) learners aged 11 to 15, recruited from a language institute in Iran through a convenient sampling method, drawing from readily accessible students enrolled in foundational English courses. The sample included 16 boys and 60 girls. Participants' initial vocabulary knowledge was assessed via a preliminary placement test during the registration process to ensure an even distribution of proficiency levels. Based on their test scores, participants were carefully allocated to one of two groups: one that engaged with electronic storybooks and another with traditional paper-based storybooks. This stratification was implemented to isolate the impact of storybook format on vocabulary acquisition, ensuring any observed effects were attributable to the storybook modality rather than differences in initial vocabulary proficiency.

Instruments

Storybooks

Both the electronic and traditional groups engaged with an identical selection of storybooks, carefully curated to align with the participants' language proficiency level. These storybooks introduced vocabulary appropriate for beginner EFL learners, focusing on frequently encountered English words relevant to everyday language use. The electronic storybooks were enhanced with multimedia features, such as audio for pronunciation accuracy, interactive clickable definitions, and dynamic visual animations to engage learners. In contrast, the traditional paper storybooks straightforwardly presented the text and illustrations without multimedia supplements.

Vocabulary Proficiency Test

Vocabulary proficiency was measured using a modified version of the PET Cambridge vocabulary test (1991), a recognised tool for assessing lexical knowledge in EFL contexts. To ensure suitability for the beginner proficiency level of adolescent participants (ages 11 to 15), simpler vocabulary items from the PET test were selected, focusing on accessible terms suited to young EFL learners. This adaptation accurately measured each participant's baseline vocabulary knowledge and subsequent progress. The vocabulary test was administered twice: as a pre-test to determine baseline vocabulary levels before the instructional sessions and as a post-test to evaluate vocabulary gains following the 15-session intervention. Each 60-minute session incorporated vocabulary activities within interactive story-based reading sessions, tailored separately for electronic and traditional storybook formats. This approach allowed for a reliable comparison between the two formats regarding their effectiveness in vocabulary acquisition.

Data collection procedure

The study was conducted over eight weeks with 15 instructional sessions of 60 minutes each. This timeframe is typical for vocabulary acquisition studies, as several weeks of consistent exposure are generally needed for observable learning gains. However, an extended duration may affect young participants' engagement, potentially influencing vocabulary outcomes. To address this, the electronic storybooks included engaging multimedia elements, aiming to sustain interest. Future studies might explore shorter or more intensive sessions to maintain motivation and optimise learning gains.

Each session began with a warm-up (10 minutes), where a brief review of previously covered vocabulary was conducted to reinforce retention and solidify understanding. This was followed by a reading activity (30 minutes), where participants engaged with their assigned storybooks: the electronic group used tablets or smartphones for digital storybooks, while the traditional group read from paper versions. Educators were present to offer support and ensure participants remained focused. Afterwards, a vocabulary reinforcement activity (15 minutes) took place, where learners participated in targeted exercises to practice and consolidate new words encountered in the storybooks. These exercises were uniformly applied to both groups for consistency in vocabulary reinforcement. Finally, each session concluded with a review and feedback (5 minutes), during which key vocabulary was recapped, and instructors provided feedback to facilitate learning further and address any questions.

Data analysis

The collected data from pre-tests and post-tests were analysed using a variety of statistical methods to evaluate the impact of storybook format on vocabulary acquisition. Paired Sample T-tests were conducted to examine within-group changes by comparing pre-test and post-test scores, allowing us to assess vocabulary growth over time for each group. Independent sample T-tests were conducted to compare the effectiveness of the two instructional formats. These tests compared the post-test scores of participants using electronic storybooks with those using traditional paper storybooks, highlighting the relative efficacy of each format. ANCOVA (Analysis of Covariance) was employed to control for pre-test scores and determine if there were significant differences in vocabulary acquisition between the digital and paper groups, isolating the effect of the storybook format from baseline differences in vocabulary knowledge. Additionally, ANOVA (Analysis of Variance) was performed to explore the interaction effects of modality (electronic vs. paper) with gender and age, investigating whether these variables influenced vocabulary acquisition. Finally, a Gender and Age Analysis was conducted to evaluate if male and female learners and younger and older participants showed differential benefits from the two storybook formats.

In adherence to ethical standards, all participants provided informed consent before initiating the study. The research was conducted in full compliance with ethical

guidelines, ensuring the confidentiality and anonymity of participants' data. The voluntary nature of participation was emphasised, and participants were debriefed regarding the study's objectives and their specific roles upon its conclusion. This methodological approach was meticulously crafted to systematically investigate the comparative impact of electronic versus traditional paper storybooks on vocabulary acquisition while also considering the potential influence of age and gender differences.

Before conducting the main analysis, the assumptions for the statistical tests are checked. The following steps are taken to test the normality of the data. The Shapiro-Wilk test examines whether the pre-test and post-test scores are normally distributed.

Results

The findings of this study provide a comprehensive overview of the impact of electronic versus traditional paper storybooks on vocabulary acquisition among male and female adolescent EFL learners.

Table 1

Results of Homogeneity of Regression Slopes Test Evaluating Interaction Between Pre-Test Scores and Grouping Variable (Modality)

Group		Kolmogorov-Smirnov			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Digital	Pre-Test Score	0.07	38	.200*	0.98	38	0.740
	Post-Test Score	0.09	38	.200*	0.97	38	0.476
Paper	Pre-Test Score	0.10	38	.200*	0.99	38	0.914
	Post-Test Score	0.09	38	.200*	0.97	38	0.526

The results of the normality tests, as shown in Table 1, indicate that both the Kolmogorov-Smirnov and Shapiro-Wilk tests did not reveal any significant deviations from normality for the pre-test and post-test scores in either the digital or paper groups. For the digital group, the Shapiro-Wilk test showed non-significant results for both the pre-test (W = 0.98, p = 0.740) and post-test (W = 0.97, p = 0.476) scores, suggesting normality. Similarly, for the paper group, the Shapiro-Wilk test results for the pre-test (W = 0.99, p = 0.914) and post-test (W = 0.97, p = 0.526) scores were also non-significant. The Kolmogorov-Smirnov test further confirmed that the distributions did not significantly differ from normality across all conditions (p > 0.200). Consequently, the assumption of normality for both pre-test and post-test scores in both groups is considered satisfied.

Table 2

Descriptive Statistics for Pre-Test and Post-Test Scores by Group (Digital vs. Paper)

Group		Mean	Median	Std. Deviation	Range	Minimum	Maximum
Pre-Test Score	Digital	20.26	21.00	8.84	34.00	3.00	37.00
	Paper	18.63	18.00	5.73	26.00	7.00	33.00
Post-Test Score	Digital	33.87	33.50	10.94	51.00	11.00	62.00
	Paper	25.24	24.50	7.84	33.00	11.00	44.00

Table 2 presents the descriptive statistics for pre-test and post-test vocabulary scores in both the digital and paper groups. The mean pre-test score for the digital group was 20.26 (SD = 8.84), with scores ranging from 3 to 37, while the paper group had a mean pre-test score of 18.63 (SD = 5.73), with scores ranging from 7 to 33. For the post-test, the digital group showed a higher mean score of 33.87 (SD = 10.94), with a range from 11 to 62, compared to the paper group's mean post-test score of 25.24 (SD = 7.84), with a range from 11 to 44. These descriptive statistics indicate that both groups improved from pre-test to post-test, with the digital group showing a greater increase in vocabulary acquisition.

Table 3

Results of ANCOVA for the Effect of Modality (Digital vs. Paper) on Post-Test Vocabulary Scores Controlling for Pre-Test Score

Parameter	B	Std. Error	t	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Intercept	6.06	1.89	3.21	0.002	2.30	9.83
Pre	1.03	0.09	11.62	<0.001	0.85	1.21
Digital vs. Paper	6.95	1.31	5.31	<0.001	4.34	9.56

Note: This parameter is set to zero because it is redundant. Dependent Variable: Post-Test Score

Table 3 presents the ANCOVA results, indicating the statistical analysis for the differences in post-test vocabulary scores between the two groups: the digital (electronic storybook) group and the paper (traditional storybook) group. The analysis reveals that the storybook modality significantly affects post-test scores, with the digital group outperforming the

paper group. The regression coefficient (B) for the storybook modality is 6.95, with a t-value of 5.31 and a p-value of less than 0.001, indicating a strong and significant effect of modality on vocabulary acquisition. Furthermore, the pre-test score significantly predicted post-test performance (B = 0.99, t = 11.06, p < 0.001), demonstrating that initial vocabulary knowledge strongly influenced post-test scores.

Figure 1

Mean Test Scores by Time (Pre and Post) for Digital and Paper Groups with 95% Confidence Intervals.
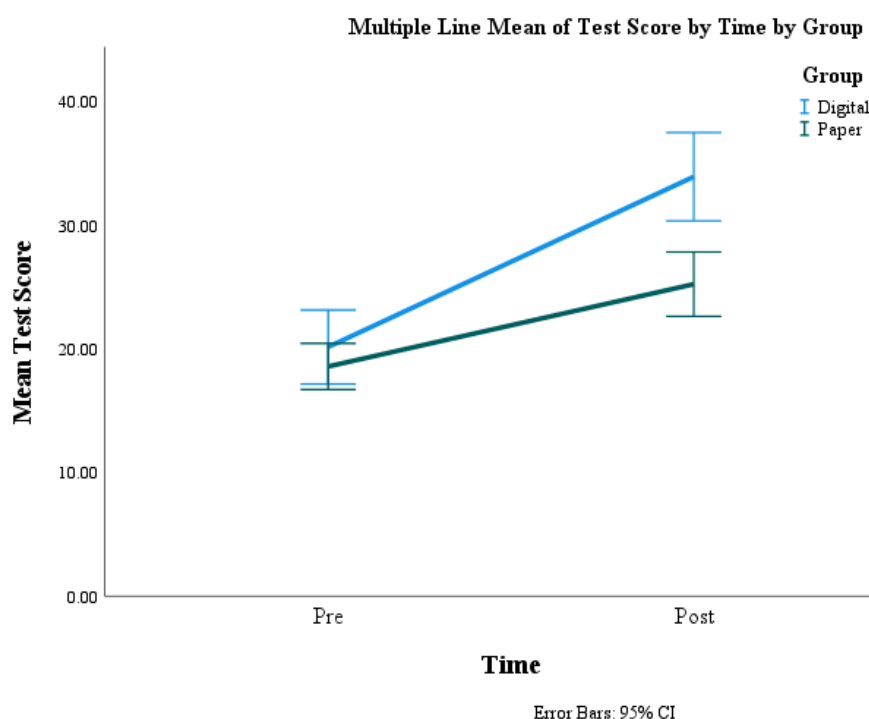

Figure 1 visually illustrates the post-test vocabulary scores for both groups. The digital group shows a significant increase in vocabulary acquisition, outperforming the paper group. This visual representation underscores the significant positive impact of electronic storybooks on vocabulary learning, as indicated by the ANCOVA results with a B value of 6.95 (p < 0.001).

Table 4

Paired T-Test Results for Improvement in Vocabulary Acquisition from Pre-Test to Post-Test in Digital and Paper Groups

Group		Mean	N	Std. Deviation	Paired Differences				P-value
					Mean	Std. Deviation	95% CI		
							Lower	Upper	
Digital	Pre-Test Score	20.26	38	8.84	-13.61	5.25	-15.33	-11.88	<0.001
	Post-Test Score	33.87	38	10.94					
Paper	Pre-Test Score	18.63	38	5.73	-6.61	6.01	-8.58	-4.63	<0.001
	Post-Test Score	25.24	38	7.84					

As shown in Table 4, the digital group experienced a significant increase in vocabulary acquisition from the pre-test (M = 20.26, SD = 8.84) to the post-test (M = 33.87, SD = 10.94), with a mean difference of -13.61 (p < 0.001). Similarly, the paper group also showed a significant improvement from the pre-test (M = 18.63, SD = 5.73) to the post-test (M = 25.24, SD = 7.84), with a mean difference of -6.61 (p < 0.001). The results indicate that both the electronic storybooks and traditional paper storybooks significantly improved vocabulary acquisition over time, with the digital group demonstrating a larger improvement.

If the interaction term (Group * Gender) has a p-value less than 0.05, it is concluded that there is a significant interaction between gender and modality.

Table 5

Results of ANOVA for the Interaction between Group (Modality) and Gender on Vocabulary Acquisition

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5770.638[a]	4	1442.66	43.66	<0.001
Intercept	792.85	1	792.85	23.99	<0.001
Pre	4063.12	1	4063.12	122.96	<0.001
Group	572.13	1	572.13	17.31	<0.001
Gender	6.50	1	6.50	0.20	0.659
Group * Gender	0.03	1	0.03	0.00	0.977
Error	2346.15	71	33.04		
Total	74492.00	76			

Corrected Total	8116.79	75			

Note: R Squared = .711 (Adjusted R Squared = .695). Dependent Variable: Post-Test Score

ANOVA was conducted to determine whether a significant interaction exists between modality (electronic vs. paper) and gender (male vs. female) in influencing vocabulary acquisition. As shown in the table, the interaction term between group and gender (Group * Gender) was not significant (F(1, 71) = 0.00, p = 0.977), indicating that there is no significant interaction between the modality and gender in influencing post-test vocabulary scores.

Table 6

Results of ANOVA for the Moderating Effect of Age on the Relationship between Modality and Vocabulary Acquisition

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5780.566[a]	4	1445.14	43.92	0.000
Intercept	131.85	1	131.85	4.01	0.049
Group	20.38	1	20.38	0.62	0.434
Pre	4267.21	1	4267.21	129.68	0.000
Age	16.04	1	16.04	0.49	0.487
Group * Age	2.73	1	2.73	0.08	0.774
Error	2336.22	71	32.90		
Total	74492.00	76			
Corrected Total	8116.79	75			

Note: R Squared = .712 (Adjusted R Squared = .700). Dependent Variable: Post-Test Score

ANOVA was conducted to assess whether age moderates the relationship between modality (digital vs. paper) and vocabulary acquisition. As shown in Table 6, the interaction term between age and group (modality) was not significant (F(1, 71) = 0.08, p = 0.774), indicating that age does not significantly moderate the effect of modality on vocabulary acquisition.

Table 7

Comparison of Age and Gender Distribution between Digital and Paper Groups

Variable	Levels	Total (n=76)	Group		P-value
			Digital (n=38)	Paper (n=38)	
Age	-----	12.52 ± 1.27	12.89 ± 1.04	12.14 ± 1.37	0.009
Gender	Female	60 (78.95)	30 (78.95)	30 (78.95)	1.000
	Male	16 (21.05)	8 (21.05)	8 (21.05)	

Table 7 compares the age and gender distributions between the digital and paper groups. The mean age of participants in the digital group was slightly higher (M = 12.89, SD = 1.04) compared to the paper group (M = 12.14, SD = 1.37; p-value=0.009). In contrast, the gender distribution was identical, with 78.95% female and 21.05% male in both the digital and paper groups (p = 1.000).

Overall, this study highlights the advantages of electronic storybooks over traditional paper formats in fostering vocabulary acquisition. While both formats are beneficial, electronic storybooks provide a more effective tool for enhancing vocabulary among adolescent EFL learners, irrespective of gender and age.

Discussion

The results of this study corroborate previous research on the effectiveness of electronic and traditional storybooks in fostering vocabulary acquisition among beginner EFL learners aged 11 to 15. Notably, electronic storybooks yielded a statistically significant improvement in vocabulary acquisition, supporting earlier studies by Takacs and Bus (2018), Smeets and Bus (2012), and Asadi and Ebadi (2024), who emphasised that digital formats, with their multimodal elements, enhance engagement and retention by stimulating multiple sensory channels. These features facilitate stronger associations between words and meanings, particularly benefiting younger learners with shorter attention spans (Chiong et al., 2022; Mayer, 2020; Asadi & Ebadi, 2024).

In contrast, traditional storybooks were also highly effective, especially among learners inclined toward sustained attention and focused engagement. Research by Mangen and Kuiken (2014), Baron (2015), and Wu et al. (2019) suggests that the tactile nature of print reading aids in maintaining focus and promoting deeper cognitive processing, which is crucial for vocabulary retention. Liu and Hsiao (2021) further support this, indicating that older children benefit more from the linear format of print books, which supports structured vocabulary learning. This is particularly relevant for learners who can manage prolonged engagement with textual material (Molinaro et al., 2020; Suggate, 2019; Xodabande & Atai, 2022).

Regarding gender, no significant differences were found in vocabulary acquisition between male and female learners, contrasting with previous research. For instance, Xie et al. (2021) and Zhu et al. (2022) observed gender-specific preferences, with boys responding better to multimedia-based learning, while girls showed a preference for print-based learning due to its structured nature. However, this study suggests that the interactive features of electronic storybooks did not favor one gender over the other.

The study also explored age as a moderating factor, finding that while younger learners in the electronic storybook group made significant vocabulary gains, age did not significantly moderate the effect of modality on vocabulary acquisition. These results align with studies by Lee and Lin (2021), Kucirkova et al. (2013), and Kucirkova et al.

(2023), which suggested that digital formats are particularly effective for younger learners, helping them engage more easily through multimedia features. Mayer's (2020) Cognitive Theory of Multimedia Learning supports this by suggesting that digital formats improve learning by activating multiple cognitive channels. However, older learners—who have developed stronger metacognitive skills—showed greater vocabulary acquisition when using traditional storybooks. These learners benefit from uninterrupted reading experiences that allow them to process vocabulary more deeply (Suggate, 2019; Molinaro et al., 2020; Tan et al., 2023).

While electronic storybooks demonstrated significant advantages in vocabulary retention, it is important to acknowledge the potential for cognitive overload with excessive multimedia elements. Studies by Suggate (2019), Molinaro et al. (2020), and Cao and Lu (2023) note that poorly integrated interactive features can detract from deep learning and potentially hinder vocabulary acquisition. Furthermore, limited access to digital devices and the risk of non-educational distractions underscore the need for balance in digital tool use, particularly for younger learners. Scholars such as Boroughani et al. (2023) and Wang and Ma (2022) advocate for moderation in digital tool use to optimise educational benefits.

Overall, this study provides valuable insights for educators in selecting appropriate storybook formats based on learners' needs. The findings suggest that electronic storybooks are particularly beneficial for younger beginner learners, helping to improve vocabulary retention through multimedia engagement. Conversely, traditional storybooks may be more suitable for older or more advanced learners who benefit from sustained attention and focused cognitive processing. Incorporating considerations of age and gender when selecting reading formats could enhance curriculum design, supporting diverse learning preferences among adolescent EFL learners. This study contributes to developing future pedagogical frameworks that leverage both digital and traditional formats to optimise vocabulary acquisition across various learner demographics.

Conclusion

This study underscores the significant impact of storybook modality on vocabulary acquisition among adolescent EFL learners, offering crucial insights into effective pedagogical strategies. The findings demonstrate that both electronic and traditional print storybooks are instrumental in enhancing vocabulary knowledge; however, electronic storybooks yielded a greater overall improvement. This enhanced effectiveness may be attributed to the multimodal features of electronic storybooks, such as animations, audio, and interactive elements, which engage multiple sensory channels and facilitate deeper cognitive processing. These results advance the field by providing robust empirical evidence supporting the integration of digital tools in EFL pedagogy, particularly highlighting the benefits of multimedia engagement in fostering vocabulary retention and learner motivation.

The implications of these findings are substantial, extending beyond individual classroom practices to broader educational frameworks. Educators and curriculum designers can leverage electronic storybooks to create more engaging and effective language learning environments, particularly for younger learners who thrive in dynamic and interactive settings. At the same time, the observed effectiveness of traditional storybooks for learners who benefit from sustained attention and tactile engagement underscores the importance of a balanced and inclusive approach in educational material selection. This dual approach ensures that diverse learning styles and preferences are accommodated, maximising the potential for vocabulary acquisition across varied learner profiles. Furthermore, these insights can inform other areas of educational research, such as content-based instruction, literacy development, and the use of technology-enhanced learning tools in various disciplines. For instance, exploring how digital storytelling can be integrated into interdisciplinary learning projects could simultaneously open new avenues for developing critical thinking, creativity, and language skills.

Despite its contributions, the study is not without limitations. The small sample size, consisting of only 16 male participants, restricts the generalizability of the findings across genders and broader populations. Additionally, the study did not delve into factors such as socioeconomic disparities in access to digital resources or the potential distractions posed by multimedia tools, which could significantly influence learning outcomes. These limitations highlight the need for more comprehensive research designs that account for demographic diversity and contextual variables. Future research should address these limitations by conducting studies with larger, more diverse samples that include balanced gender representation and learners from different socioeconomic backgrounds. Examining the role of digital literacy and accessibility in shaping the effectiveness of electronic storybooks would also be valuable. Moreover, investigating how varying interactivity and multimedia complexity levels in electronic storybooks influence vocabulary acquisition and learner engagement could provide deeper insights. Longitudinal studies assessing the durability of vocabulary retention across different modalities would further enrich our understanding of their long-term educational impact.

Regarding policy implications, the findings call for reevaluating resource allocation and instructional practices in language education. Educational institutions should integrate both electronic and print storybooks into their language programs to cater to diverse learner needs and preferences. Policymakers must prioritise initiatives to bridge the digital divide, ensuring equitable access to technological resources in underprivileged areas. Such measures would enable all learners to benefit from the advancements in digital education tools and contribute to reducing educational inequities. By systematically analysing the impact of storybook modality on vocabulary acquisition, this study contributes valuable insights to the field of language education. It provides a strong foundation for further research and practical applications, emphasising the transformative potential of combining traditional and modern pedagogical approaches to optimise learning outcomes.

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