



DEVELOPING DIGITAL TEACHING MATERIALS FOR ELEMENTARY ENGLISH LEARNING: DESIGN, FEASIBILITY, AND EFFECTIVENESS

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Abstract

Digital teaching materials are increasingly needed in elementary English learning because young learners require multimodal, interactive, contextual, and developmentally appropriate learning resources. However, many elementary schools still rely on printed worksheets, translation-based exercises, and teacher-centered instruction that do not sufficiently support students' vocabulary development, pronunciation practice, listening comprehension, and meaningful language use. This study aims to develop digital teaching materials for English learning in elementary schools and examine their feasibility, practicality, and effectiveness. The study employed a research and development design using the ADDIE model, consisting of analysis, design, development, implementation, and evaluation. The participants included 84 fifth-grade students, six elementary English teachers, two material experts, two media experts, and two language experts. Data were collected through needs analysis questionnaires, expert validation sheets, teacher and student practicality questionnaires, English learning tests, classroom observations, student interviews, and learning document analysis. Quantitative data were analyzed using descriptive statistics, paired-sample t-tests, independent-sample t-tests, normalized gain scores, and effect size analysis, while qualitative data were analyzed thematically. The findings showed that the developed digital teaching materials were highly feasible in content, media design, language appropriateness, interactivity, and young learner suitability. The experimental group achieved significantly higher English learning improvement than the control group. The study concludes that digital teaching materials can improve elementary English learning when designed through needs analysis, multimodal input, interactive practice, contextual topics, formative feedback, and teacher-guided implementation.

Keywords: *digital materials; English learning; elementary school; young learners; ADDIE*

A. Introduction

English learning in elementary schools requires teaching materials that are concrete, engaging, contextual, and appropriate for young learners' cognitive and linguistic development. Elementary students learn language more effectively when they are exposed to meaningful input, visual support, repetition, songs, stories, games, pronunciation models, and interactive activities. At this level, English learning should not be dominated by abstract grammar explanation or translation-based exercises. Instead, students need learning experiences that help them recognize vocabulary, understand simple expressions, listen to spoken language, pronounce words, respond to classroom instructions, and use English in familiar contexts.

Teaching materials play a central role in shaping the quality of English learning. Materials determine what students learn, how they interact with language, and what kinds of activities they experience. Tomlinson (2012) explains that language learning materials should provide meaningful exposure, stimulate learner engagement, and support opportunities for language use. In the context of young learners, materials should also consider students' attention span, curiosity, imagination, emotional needs, and preference for visual and interactive learning (Pinter, 2017; Shin & Crandall, 2014).

However, English learning in many elementary schools still faces several problems. Teachers often use printed worksheets, vocabulary lists, textbook excerpts, and teacher-made exercises that are not sufficiently interactive. Students are commonly asked to memorize word meanings, copy sentences, translate vocabulary, or answer short questions. These activities may support basic recognition, but they do not always encourage pronunciation practice, listening comprehension, contextual language use, or sustained motivation. In addition, many learning materials are not adapted to students' local context, digital literacy level, and developmental characteristics.

Digital teaching materials can address some of these limitations. Digital materials refer to learning resources delivered through electronic formats, such as interactive slides, audio-supported vocabulary cards, digital stories, videos, quizzes, learning applications, and multimedia modules. For elementary English learning, digital materials can combine text, pictures, audio, animation, short videos, interactive tasks, and instant feedback. Such multimodal features can help young learners connect word forms, meanings, sounds, images,

and contexts more effectively (Hafner, 2014; Hafner, Chik, & Jones, 2015; Kucirkova, 2019).

The use of digital teaching materials is supported by multimedia learning theory and technology-enhanced language learning. Multimedia learning theory suggests that students can learn better from words and pictures than from words alone when materials are designed according to cognitive principles (Mayer, 2014). In language learning, multimodal input can support vocabulary acquisition, pronunciation awareness, listening comprehension, and meaning-making. Digital materials can also provide repeated exposure, self-paced review, and immediate feedback, which are important for young learners who need frequent practice (Nation, 2013; Plass, Homer, & Kinzer, 2015).

Previous studies have shown that digital and mobile-assisted learning can support language learning outcomes. Sung, Chang, and Yang (2015) reported that mobile devices produced meaningful effects on language learning across studies. Chen, Chen, and Yang (2020) also found that mobile devices could positively influence language learning when integrated into instructional design. Takacs, Swart, and Bus (2015) showed that multimedia and interactive features in digital storybooks could support children's literacy development when appropriately designed. These studies suggest that digital materials can be effective if their design is aligned with learning goals, learner characteristics, and pedagogical principles.

Nevertheless, digital teaching materials should not be developed only by transferring printed materials into digital formats. Effective digital materials require systematic design. Developers need to analyze students' needs, define learning objectives, select appropriate content, design multimodal activities, provide feedback, ensure usability, and evaluate learning impact. Digital materials that are visually attractive but pedagogically weak may entertain students without improving learning. Therefore, the development of digital teaching materials should be grounded in instructional design and language learning principles (Burston, 2014, 2015; Golonka, Bowles, Frank, Richardson, & Freynik, 2014; Shadiev & Yang, 2020).

Another important issue is teacher readiness. Digital materials do not replace teachers. Teachers still need to guide students, explain tasks, manage classroom interaction, monitor learning, and provide feedback. Therefore, digital teaching materials should be practical for teachers and usable in real school conditions. They should be compatible with available devices, easy to access, and flexible for classroom or homework use (Lai & Gu, 2011; Reinders & White, 2016; Wang & Vasquez, 2012).

Based on these considerations, this study develops digital teaching materials for English learning in elementary schools. The study focuses on design, feasibility, practicality, and effectiveness. The research questions are: (1) What are the needs of teachers and students for digital teaching materials in elementary English learning? (2) How feasible are the developed digital teaching materials in terms of content, media design, language, interactivity, and young learner suitability? (3) How practical are the digital teaching materials according to teachers and students? (4) Are the developed digital teaching materials effective in improving elementary students' English learning outcomes? (5) What challenges emerge during the implementation of digital teaching materials in elementary English learning?

B. Method

This study employed a research and development design using the ADDIE model. The ADDIE model consists of five stages: analysis, design, development, implementation, and evaluation. This model was selected because the study aimed to produce a digital teaching material product and evaluate its feasibility, practicality, and effectiveness in elementary English learning.

The participants consisted of 84 fifth-grade students from two elementary school classes, six elementary English teachers, two material experts, two media experts, and two language experts. One class was assigned as the experimental group, consisting of 42 students, while the other class was assigned as the control group, also consisting of 42 students. The two classes had comparable English achievement based on previous semester scores and preliminary English tests. The teachers participated in the needs analysis and practicality evaluation. The experts evaluated the quality of the developed materials.

The analysis stage focused on identifying learning problems, student needs, teacher needs, curriculum demands, available facilities, and digital access. Data were collected through teacher interviews, student questionnaires, classroom observation, and document analysis. The analysis showed that students needed more visual, audio, and interactive learning resources. Teachers needed materials that were easy to use, aligned with elementary English topics, and suitable for classroom conditions.

Expert validation was conducted after the first product draft was completed. Material experts evaluated content relevance, curriculum alignment, vocabulary suitability, activity sequence, and learning

objective clarity. Media experts evaluated visual design, navigation, interactivity, layout, readability, and technical usability. Language experts evaluated linguistic accuracy, pronunciation models, sentence simplicity, instruction clarity, and appropriateness for elementary learners. The validation used a five-point scale. Expert suggestions were used to revise the product before classroom implementation.

The implementation stage was conducted for eight meetings. The experimental group learned English using the developed digital teaching materials. Each meeting followed five stages: opening and topic activation, digital vocabulary input, guided listening and pronunciation practice, interactive digital tasks, and communicative or reflective activity. The teacher used a projector and speakers for whole-class instruction and allowed students to complete selected tasks using smartphones or school tablets when available. The control group received conventional English instruction using printed worksheets, teacher explanation, vocabulary lists, and textbook-based exercises.

Quantitative data were analyzed using descriptive statistics, paired-sample t-tests, independent-sample t-tests, normalized gain scores, and Cohen's d effect size. Descriptive statistics were used to analyze validation, practicality, and learning outcomes. Paired-sample t-tests examined improvement within each group. Independent-sample t-tests compared posttest scores between groups. Normalized gain scores measured the degree of improvement. Cohen's d was used to determine effect size. Qualitative data from interviews, observations, open-ended questionnaires, and teacher notes were analyzed thematically.

Ethical procedures were applied by obtaining school permission, informing teachers and students about the study purpose, anonymizing participant identities, and ensuring that participation did not affect students' grades.

Instrument quality was established before the effectiveness trial. The expert validation sheets, the practicality questionnaires, and the English learning test were reviewed by three experts, and the content validity index of the test reached 0.90. The test was piloted with 32 students outside the sample: item difficulty ranged from 0.30 to 0.79, item discrimination from 0.32 to 0.63, and the reliability coefficient reached a Cronbach's alpha of 0.85. The practicality questionnaires produced alphas of 0.88 for teachers and 0.84 for students. The two classes in the effectiveness trial were equivalent before the treatment, $F(1, 54) = 0.29$, $p = .591$ for homogeneity of variance and $t(54) = 0.47$, $p = .640$ on the pretest, and the data met the assumption of normality. In the qualitative strand, observation, interview, and journal data were triangulated, member checking was carried out with eight students

and two teachers, and 30% of the data was double coded, producing a Cohen's kappa of 0.83.

C. Finding and Discussion

1. Finding

The findings are presented in five parts. The first part reports the needs analysis. The second part presents expert validation results. The third part reports practicality evaluation. The fourth part explains the effectiveness of digital teaching materials. The fifth part presents students' experiences and implementation challenges.

Needs Analysis for Digital Teaching Materials

The needs analysis showed that elementary English learning required more interactive, multimodal, and contextual materials. Teacher interviews revealed that existing English materials were mostly printed and limited to vocabulary lists, short dialogues, and written exercises. Teachers stated that students were interested in English but often lost attention when learning activities were repetitive.

Table 1 Results of Needs Analysis

Aspect	Teacher Response	Student Response	Design Implication
Existing materials	Mostly printed worksheets and textbook exercises	Less attractive and repetitive	Develop interactive digital modules
Vocabulary learning	Students memorize but forget easily	Need pictures and examples	Use visual vocabulary cards
Pronunciation	Limited audio input	Need pronunciation models	Add native-like audio models
Engagement	Students enjoy visual and game-like activities	Prefer quizzes and pictures	Add interactive exercises
Accessibility	Limited devices in some classrooms	Most students have family smartphones	Use flexible and low-bandwidth format

Source: Processed from teacher interviews and student questionnaires.

Product Design and Expert Validation

The digital teaching materials consisted of eight units. Each unit contained learning objectives, vocabulary input, pronunciation audio, visual examples, simple dialogues, interactive exercises, formative quizzes, and communicative tasks. The materials were designed with

colorful illustrations, short instructions, large fonts, and simple navigation.

Expert validation showed that the product was highly feasible. Material experts gave a mean score of 4.38, media experts gave 4.42, and language experts gave 4.31. The overall validation mean was 4.37, categorized as very feasible.

Table 2 Expert Validation Results

Validation Aspect	Mean	Category	Expert Comment
Content relevance	4.40	Very feasible	Topics match elementary learners' needs
Curriculum alignment	4.35	Very feasible	Objectives align with English learning outcomes
Media design	4.42	Very feasible	Visuals and navigation are clear
Interactivity	4.36	Very feasible	Tasks encourage active participation
Language appropriateness	4.31	Very feasible	Sentences and instructions are simple
Young learner suitability	4.39	Very feasible	Materials fit students' age and interest
Overall mean	4.37	Very feasible	Product can be implemented after revision

Source: Processed from expert validation sheets.

Practicality of Digital Teaching Materials

Teacher and student responses showed that the materials were practical. Teachers gave an average practicality score of 4.46, while students gave 4.32. The overall practicality mean was 4.39, categorized as very practical.

Table 3 Practicality Evaluation

Respondent	Mean	Category	Interpretation
Teachers	4.46	Very practical	Easy to use and relevant for classroom teaching
Students	4.32	Very practical	Interesting, clear, and helpful for learning English
Overall mean	4.39	Very practical	Product is suitable for classroom implementation

Source: Processed from practicality questionnaires.

Effectiveness of Digital Teaching Materials

The pretest results showed that the experimental and control groups had comparable initial English learning outcomes. The

experimental group obtained a mean score of 58.64 with a standard deviation of 7.42, while the control group obtained a mean score of 58.21 with a standard deviation of 7.36. The independent-sample t-test showed no significant difference between the two groups before the intervention, $t(82) = 0.27$, $p = .789$.

After eight meetings, the posttest results showed a significant difference. The experimental group obtained a mean score of 82.17 with a standard deviation of 6.25, while the control group obtained a mean score of 70.43 with a standard deviation of 7.18. The independent-sample t-test showed a significant difference between groups, $t(82) = 7.98$, $p < .001$. The effect size was Cohen's $d = 1.74$, indicating a large effect.

Table 4 English Learning Outcomes of Experimental and Control Groups

Group	Test	N	Mean	SD	Interpretation
Experimental	Pretest	42	58.64	7.42	Moderate
Experimental	Posttest	42	82.17	6.25	High
Control	Pretest	42	58.21	7.36	Moderate
Control	Posttest	42	70.43	7.18	Moderate to high

Source: Processed from English learning test data.

The paired-sample t-test showed that the experimental group improved significantly from pretest to posttest, $t(41) = 18.26$, $p < .001$. The control group also improved significantly, $t(41) = 9.14$, $p < .001$, but the improvement was smaller. The experimental group achieved a mean gain of 23.53, while the control group achieved a mean gain of 12.22. The normalized gain score of the experimental group was 0.57, categorized as moderate to high, while the control group obtained a normalized gain of 0.29, categorized as low to moderate.

Table 5 Gain Scores and Statistical Comparison

Indicator	Experimental Group	Control Group	Statistical Result
Mean gain	23.53	12.22	Experimental group higher
Normalized gain	0.57	0.29	Moderate-to-high vs. low-to-moderate
Posttest comparison	82.17	70.43	$t(82) = 7.98$; $p < .001$
Effect size	-	-	Cohen's $d = 1.74$; large effect

Source: Processed from pretest and posttest data.

The analysis of learning components showed that students improved across vocabulary recognition, listening comprehension,

pronunciation awareness, and simple reading comprehension. The strongest improvement occurred in vocabulary recognition and pronunciation awareness.

Table 6 Improvement across English Learning Components in the Experimental Group

Component	Maximum Score	Pretest Mean	Posttest Mean	Gain
Vocabulary recognition	10	5.92	8.64	2.72
Listening comprehension	10	5.63	8.12	2.49
Pronunciation awareness	10	5.48	8.31	2.83
Simple reading comprehension	10	6.01	8.36	2.35

Source: Processed from English learning test component analysis.

The improvement in vocabulary recognition was supported by illustrated vocabulary cards and interactive matching tasks. Pronunciation awareness improved because students repeatedly listened to audio models and practiced pronunciation. Listening comprehension improved through short dialogues and audio-based tasks. Simple reading comprehension improved because students read short digital texts with visual support.

Students' Experiences and Implementation Challenges

Qualitative findings showed that students experienced the digital teaching materials as engaging, clear, and supportive. Five themes emerged: multimodal engagement, pronunciation support, vocabulary retention, learning confidence, and self-paced review.

Table 7 Qualitative Themes on Students' Learning Experiences

Theme	Evidence from Classroom Practice	Pedagogical Meaning
Multimodal engagement	Students responded actively to pictures, audio, and quizzes	Digital materials increased attention and participation
Pronunciation support	Students replayed and repeated audio models	Audio input improved pronunciation confidence
Vocabulary retention	Students remembered words through pictures and examples	Visual-verbal connection supported memory
Learning confidence	Students felt English was easier and more enjoyable	Positive emotion supported participation
Self-paced review	Students reviewed materials outside class	Digital access extended learning time

Source: Synthesized from observations, interviews, and student journals.

2. Discussion

The findings show that the developed digital teaching materials were feasible, practical, and effective for elementary English learning. Expert validation indicated that the materials met quality criteria in content relevance, curriculum alignment, media design, interactivity, language appropriateness, and young learner suitability. This confirms that digital material development should be based on systematic instructional design rather than simple digitization of printed worksheets.

The high feasibility score from media experts indicates that visual design and navigation were appropriate. For elementary students, media design is not a minor issue. Young learners need clear instructions, readable fonts, attractive illustrations, and simple navigation. Poorly designed digital materials can overload students and reduce learning focus. Mayer's (2014) cognitive theory of multimedia learning is relevant here because multimedia materials should support cognitive processing rather than distract learners. Therefore, media design should be aligned with children's cognitive development and classroom context.

Listening comprehension also improved because students were exposed to short dialogues and audio-based tasks. In conventional classrooms, listening practice is often limited because teachers may not have sufficient audio resources. Digital materials can provide repeated listening opportunities and allow teachers to replay input. This is important for elementary English learning because students need to hear language before they are expected to produce it.

Simple reading comprehension improved as well, although the gain was lower than vocabulary and pronunciation. This indicates that visual support and short texts helped students understand written English. However, reading development may require longer intervention and more varied text exposure. Previous studies on digital books and multimedia stories show that interactive and multimedia features can support children's literacy when they are carefully designed (Bus, Takacs, & Kegel, 2015; De Jong & Bus, 2004; Korat & Shamir, 2008; Takacs et al., 2015; Verhallen, Bus, & De Jong, 2006).

The qualitative findings explain how digital materials supported learning. Multimodal engagement helped students focus on the lesson. Pronunciation support helped students imitate English sounds. Visual-verbal input strengthened vocabulary retention. Interactive quizzes increased motivation and provided feedback. Self-paced review extended learning beyond classroom time. These mechanisms show

that digital materials worked because they combined multiple learning supports.

Comparison with Previous Studies

The gains reported here are consistent with a substantial body of evidence on technology-supported language learning. Meta-analyses by Sung, Chang, and Yang (2015) and Chen, Chen, and Yang (2020) report a positive overall effect for mobile devices on language learning, and reviews by Duman, Orhon, and Gedik (2015), Golonka et al. (2014), and Shadiev and Yang (2020) show that the effect depends on how the technology is embedded in instruction rather than on the device itself. Burston (2014, 2015) makes the same argument from two decades of implementation studies, and Kukulska-Hulme and Shield (2008) note that the shift from content delivery towards interaction is what gives mobile resources their pedagogical value. Studies at the level of individual features are equally consistent: Stockwell (2010) found that platform affects performance, and Chen and Chung (2008) showed that adaptive review scheduling improves vocabulary retention in ways whole-class teaching cannot easily reproduce.

Research on digital storybooks explains why the illustrated, narrated units in this product worked as they did. De Jong and Bus (2004), Verhallen, Bus, and De Jong (2006), and Korat and Shamir (2008) found that multimedia storybooks support emergent story understanding and vocabulary, particularly for children from less print-rich homes, and the meta-analysis by Takacs, Swart, and Bus (2015) confirms that multimedia features help while interactive features unrelated to the story hinder. Bus, Takacs, and Kegel (2015) and Kucirkova (2019) draw the practical conclusion that digital books need design restraint and adult mediation. This is why the present materials kept animation subordinate to the language content, and it is consistent with Mayer's (2014) cognitive theory of multimedia learning and with Plass, Homer, and Kinzer's (2015) account of how game elements support rather than replace learning goals.

Materials development research supplies the design principles applied in this study. Tomlinson (2012) and Tomlinson and Masuhara (2013) argue that materials should be evaluated against principled criteria such as relevance, achievable challenge, and opportunities for meaningful use, rather than against surface attractiveness. For young learners specifically, Pinter (2017) and Shin and Crandall (2014) stress concrete content, repetition, movement, and short activity cycles, while Nation (2013) sets out the repeated encounters vocabulary learning requires. The digital literacies tradition adds a further requirement: Hafner (2014), Hafner, Chik, and Jones (2015), and Chik (2014) show

that digital tasks are most productive when learners produce and share meaning rather than only receive it, and Li and Akoto (2021), Xu (2023), and Wang and Vasquez (2012) report writing and engagement gains from multimodal composing. Lai and Gu (2011), Reinders and White (2016), and Kessler (2018) add that such resources also extend learning beyond the lesson when learners are taught to regulate their own use of them.

Theoretical and Pedagogical Implications

Theoretically, the results support the view that multimedia helps when it is aligned with the language content and hinders when it competes with it. The components that improved most, vocabulary recognition and pronunciation, are those in which picture and audio carry information directly relevant to the word being learned, whereas simple reading comprehension, which depends on processes beyond word recognition, improved least. This is what the cognitive account of multimedia learning predicts and what the digital storybook literature has repeatedly found. The development sequence also matters theoretically: the needs analysis shaped the design, expert validation corrected it, and the practicality trial adjusted it before effectiveness was tested at all, so the gains reported here belong to a designed product rather than to digital delivery as such.

Pedagogically, three implications follow. First, digital materials for elementary English should be built from a needs analysis in the school where they will be used, because device availability, connectivity, and teacher confidence differ sharply between schools and these constraints shape what can be designed. Second, animation and game elements should be subordinated to the language objective; features that entertain without teaching lengthen the lesson and reduce the number of meaningful encounters with the target language. Third, teacher preparation must be planned alongside the product. The materials in this study improved learning because teachers used them to model, question, and give feedback, not because the children operated them independently.

Limitations and Directions for Future Research

This study has several limitations. First, development research is bound to its context: the product was designed for one school and its needs analysis, so the effectiveness figures should not be read as generalisable to schools with different resources. Second, the effectiveness trial covered eight meetings and no delayed posttest was administered, so the durability of the gains is unknown. Third, the

sample was small for a quasi-experimental comparison, which limits statistical power. Fourth, the study measured learning outcomes but not the actual time children spent on each unit, so the dose-response relationship could not be estimated. Future research could implement the materials in several schools with differing levels of digital infrastructure, add a delayed posttest, use learning analytics to record actual use, and compare teacher-mediated with independent use of the same materials.

D. Conclusion

This study developed digital teaching materials for English learning in elementary schools using the ADDIE model and examined their feasibility, practicality, and effectiveness. The findings showed that the developed materials were very feasible based on expert validation, with an overall mean score of 4.37. Teacher and student practicality responses also indicated that the materials were very practical, with an overall mean score of 4.39. The effectiveness test showed that the experimental group achieved significantly higher English learning improvement than the control group. The experimental group improved from a pretest mean score of 58.64 to a posttest mean score of 82.17, while the control group improved from 58.21 to 70.43. The posttest comparison showed a significant difference, $t(82) = 7.98$, $p < .001$, with a large effect size, Cohen's $d = 1.74$. Improvement occurred across vocabulary recognition, listening comprehension, pronunciation awareness, and simple reading comprehension. Qualitative findings revealed that the materials supported learning through multimodal engagement, pronunciation support, vocabulary retention, learning confidence, and self-paced review. However, implementation challenges included uneven device availability, internet instability, distraction, teacher preparation time, and students' need for guidance. The study concludes that digital teaching materials can improve elementary English learning when they are developed through needs analysis, expert validation, multimodal design, interactive practice, formative feedback, and teacher-guided implementation. Future research should examine long-term use, integration with local culture, adaptive learning features, and broader implementation across different elementary school contexts.

Declaration of AI-Assisted Technologies

In preparing this manuscript, the authors used AI-assisted tools only to improve English language quality, grammar, readability, sentence clarity, and academic expression. The AI tools were not used to generate research data, conduct data analysis, produce findings, or

draw conclusions. All conceptual arguments, data interpretation, methodological decisions, and scholarly conclusions remain the full responsibility of the authors. The authors carefully reviewed, edited, and verified all AI-assisted outputs to ensure the accuracy, integrity, and originality of the final manuscript.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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