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Digital Visual Learning Materials and Their Impact on Students' English Language Skills: A Guided Inquiry Approach

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Abstract

This study investigates the effect of the Guided Inquiry model assisted by Digital Student Worksheets (LKPD) on eleventh-grade students' English language skills, specifically writing creativity, reading comprehension, speaking proficiency, and learning independence. Employing a quasi-experimental design with a Nonequivalent Control Group, the study involved 187 students from SMA Negeri 1 Woha, Bima, West Nusa Tenggara, selected through proportional random sampling and assigned to either an experimental group (Digital LKPD-supported Guided Inquiry) or a control group (conventional instruction). Pre- and post-tests were administered across all four outcome variables, and data were analyzed using Multivariate Analysis of Covariance (MANCOVA) and N-Gain tests. Results demonstrated statistically significant improvements in the experimental group across all four variables: writing creativity ($t = 3.542$; $p = 0.001$), reading comprehension ($t = 3.215$; $p = 0.002$), speaking skills ($t = 3.611$; $p = 0.001$), and learning independence ($t = 3.214$; $p = 0.002$). The MANCOVA revealed a simultaneous significant effect of the instructional model on all dependent variables (Pillai's Trace = 0.913; $p < 0.001$). N-Gain scores indicated moderate-to-high improvement in the experimental group ($M = 0.65$) compared to the control group ($M = 0.35$). These findings suggest that integrating digital visual learning materials within a Guided Inquiry framework functions not merely as a content delivery mechanism, but as a strategic instructional design component that promotes self-regulated learning, cognitive engagement, and holistic English language literacy development in 21st-century educational contexts.

Keywords: *Guided Inquiry, Digital LKPD, English Language Skills, Learning Independence, Visual Learning Materials.*

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Introduction

The rapid digital transformation in Indonesian secondary education has generated significant momentum for pedagogical innovation. As of 2024, Learning Management Systems (LMS) had been adopted in 71.3% of senior high schools (Kemendikbud, 2024), signaling a growing institutional readiness for technology-enhanced instruction. Yet infrastructure expansion alone has not translated into measurable gains in English language proficiency. Indonesia's reading literacy scores in the PISA 2022 assessment remained below the OECD average, a persistent concern attributed to teacher-centered instructional models and limited exploratory learning opportunities for students (OECD, 2023).

This gap between technological availability and pedagogical effectiveness is particularly salient at SMA Negeri 1 Woha, located in Bima Regency, West Nusa Tenggara. Preliminary observations revealed that over 65% of eleventh-grade students encountered significant difficulties in English writing, reading comprehension, and speaking, despite the school's access to LCD projectors, Wi-Fi connectivity, and internet-capable devices. The root cause appears systemic: teachers continue to rely on transmission-based instruction that leaves limited room for inquiry, authentic discourse, or learner autonomy.

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Siemens (2005) posited through Connectivism that digital-era learning cannot depend on unidirectional knowledge transmission. UNESCO (2020) reinforced this, arguing that digital learning must become a sustained pedagogical practice rather than a temporary post-pandemic adaptation. In the context of language education, research consistently demonstrates that interactive digital media, including e-worksheets, online platforms, and communication applications, enhance student participation and create more authentic learning experiences (Anderson & Dron, 2011). Redecker et al. (2017) further established that digital competency is a prerequisite for effective participation in 21st-century educational ecosystems.

To address this challenge, the present study explores the integration of the Guided Inquiry learning model with Digital Student Worksheets (Lembar Kerja Peserta Didik/LKPD Digital) as a technologically-enhanced instructional approach. Pedaste et al. (2015) define Guided Inquiry as a model that guides students through phases of orientation, conceptualization, investigation, conclusion, and discussion/reflection, with structured teacher facilitation. This approach has consistently demonstrated effectiveness in promoting critical thinking, learner engagement, and language skill development (Llewellyn, 2013; Lazonder & Harmsen, 2016). Digital LKPD, in turn, extends the inquiry framework through multimedia interactivity, flexible access, and structured scaffolding that aligns with Mayer's (2009) multimedia learning principles.

The novelty of this research lies in the simultaneous investigation of three English language skills (writing, reading, speaking) alongside learning independence within a single integrated inquiry-based digital framework. Prior studies typically isolate individual language skills or focus on cognitive outcomes, leaving a research gap regarding holistic language development through technology-supported inquiry, particularly in non-urban contexts. This study therefore contributes both theoretical insights and practical evidence for the implementation of digital visual learning materials in English language education in rural Indonesian high school settings.

The following research questions guided the inquiry: (1) Does the Guided Inquiry model with Digital LKPD significantly affect students' writing creativity? (2) Does it significantly affect reading comprehension? (3) Does it significantly affect speaking proficiency? (4) Does students' learning independence serve as a significant covariate? And (5) Is there a significant simultaneous effect of the instructional model on all three language skills?

Literature Review

Guided Inquiry in Language Education

Guided Inquiry is grounded in constructivist learning theory, emphasizing that meaningful knowledge is actively constructed rather than passively received (Vygotsky, 1978). Pedaste et al. (2015) delineate five sequential phases: orientation, conceptualization, investigation, conclusion, and discussion/reflection. Through these stages, students move from problem identification and hypothesis formulation to data-driven investigation, synthesis, and collaborative reflection, with the teacher serving as a facilitating agent rather than a primary information transmitter.

In English language education specifically, Guided Inquiry has demonstrated effectiveness in deepening reading comprehension, enhancing writing output, and fostering critical linguistic reflection. Sadeh and Zion (2019) found that inquiry-based approaches significantly improve students' ability to construct meaning from complex texts. Lazonder and Harmsen's (2016) meta-analysis confirmed that Guided Inquiry outperforms direct instruction when accompanied by adequate scaffolding. Kim and Park (2021) further established that digital learning strategies integrated with inquiry frameworks increase speaking fluency by providing greater opportunities for authentic communicative practice.

Digital LKPD as Cognitive Mediation Tools

Digital Student Worksheets (LKPD Digital) represent a technologically enriched evolution of traditional printed worksheets, designed to facilitate active, autonomous, and structured learning. Drawing on Kozma (2016) and Sung, Yang, and Lee (2017), digital worksheets function as cognitive mediation tools: they help students organize information, direct metacognitive processes, and facilitate reflective learning. Unlike static printed materials, Digital LKPD incorporates text, images, audio, video, and real-time feedback mechanisms, aligning with Mayer's (2020) multimedia cognitive theory.

Hwang et al. (2015) demonstrated that technology-assisted digital worksheets substantially increase student engagement, providing more interactive and cognitively stimulating learning experiences. Wang et al. (2019) found that digital media in language instruction improves students'

reading motivation and writing effectiveness. Rahman and Setyaningsih (2021) additionally established that well-designed digital worksheets accelerate conceptual understanding by making information more accessible and engaging.

Self-Regulated Learning and Learning Independence

Self-Regulated Learning (SRL) theory, as articulated by Panadero (2017) and Dignath and Veenman (2021), emphasizes students' capacity to plan, monitor, and evaluate their own learning processes. In the context of 21st-century education, learning independence has become a critical competency, as students must navigate rapidly evolving knowledge ecosystems with decreasing reliance on direct instruction. Students with high SRL exhibit stronger intrinsic motivation, better self-efficacy, and more effective utilization of learning resources (Tarigan, 2024; Patimah & Sumartini, 2022).

The integration of Guided Inquiry and Digital LKPD provides a theoretically coherent framework for developing SRL: Guided Inquiry offers the pedagogical structure that encourages reflective, active engagement, while Digital LKPD provides the operational scaffolding that helps students set learning goals, monitor comprehension, and engage in systematic self-evaluation. Amalia and Susanto (2024) argued that technology-enriched instructional models are particularly effective in fostering learner autonomy when they incorporate structured guidance within flexible, accessible digital environments.

English Language Skills in Inquiry-Based Contexts

Torrance (2019) conceptualizes writing creativity through four dimensions: fluency, originality, flexibility, and elaboration. Richards (2015) argues that inquiry-driven learning environments, which require students to explore ideas independently before writing, substantially enhance these creative dimensions. Snow (2002) established an integrative perspective: reading comprehension, writing development, and speaking proficiency are interdependent skills that mutually reinforce one another when developed within a cohesive instructional framework. Harmer (2007) emphasized that speaking proficiency requires sustained practice within supportive, interactive contexts, precisely the conditions that Guided Inquiry-based digital environments create.

Methodology

Research Design

This study employed a quasi-experimental design using a Nonequivalent Control Group pretest-posttest framework (Creswell, 2012; Fraenkel & Wallen, 2012). Two naturally formed groups were compared: the experimental group received the Guided Inquiry model with Digital LKPD, while the control group received conventional instruction consisting of teacher-led lectures, printed worksheets, and guided discussion. The design is illustrated as follows:

Experimental Group	O_1	→ X (Digital LKPD + Guided Inquiry) →	O_2	
Control Group	O_1	→ — (Conventional) →	O_2	

Figure 1. Research Design (O_1 = Pretest; X = Treatment; O_2 = Posttest)

Participants and Sampling

The population comprised all 350 eleventh-grade students across 10 classes at SMA Negeri 1 Woha, Bima Regency, West Nusa Tenggara, academic year 2024/2025. Using proportional random sampling, six classes (n = 187 students) were selected: three experimental classes (n = 94) and three control classes (n = 93). The school was selected due to: (1) documented low baseline English literacy levels; (2) available digital infrastructure (computers, Wi-Fi); and (3) research access and cooperation from school administration.

Intervention

The intervention was delivered over eight weeks, encompassing one pretest session, four treatment sessions, and one posttest session. Experimental group instruction integrated the five-phase Guided Inquiry cycle (Pedaste et al., 2015) with specially designed Digital LKPD materials accessible via Google Classroom and interactive PDF formats. Each lesson incorporated reading comprehension activities, guided writing tasks, and structured speaking exercises embedded within inquiry-based

problem scenarios. The Digital LKPD featured multimedia elements, including embedded video links, audio prompts, interactive text exercises, and automated feedback mechanisms. Control group instruction followed conventional pedagogy: teacher-centered lectures, printed worksheets, and question-answer sessions without digital integration.

Instruments

Four instruments were employed. Writing creativity was assessed using a rubric evaluating fluency, originality, organization, and elaboration. Reading comprehension was measured via standardized multiple-choice and short-answer tests targeting main idea identification, vocabulary in context, and inferential reasoning. Speaking proficiency was evaluated through a performance rubric covering fluency, pronunciation, vocabulary use, grammar, and confidence during group discussions and presentations. Learning independence was measured using a validated questionnaire with 40 items assessing initiative, self-monitoring, resource utilization, and self-evaluation. All instruments underwent expert validation and pilot testing, with reliability coefficients (Cronbach's alpha) ranging from 0.78 to 0.86.

Data Analysis

Data analysis proceeded in three stages. First, assumption testing verified normality (Shapiro-Wilk test) and homogeneity of variance (Levene's test) for all variables across both groups. Second, linearity between learning independence (covariate) and each dependent variable was confirmed. Third, a Multivariate Analysis of Covariance (MANCOVA) with learning independence as covariate was conducted to examine the simultaneous and individual effects of the instructional model on all three language skills. Effect sizes were computed, and N-Gain scores were calculated to quantify pre-to-post improvements using Hake's (1999) formula: N-Gain = (Posttest – Pretest) / (Maximum – Pretest).

Results

Descriptive Statistics

Table 1 presents descriptive statistics for posttest scores across all variables in both groups.

Table 1. Descriptive Statistics of Posttest Scores

Variable	Group	N	Min	Max	Mean	SD
Writing Creativity	Experimental	94	20	20	20.00	0.000
Writing Creativity	Control	94	18	20	19.66	0.540
Reading Comprehension	Experimental	94	39	40	39.04	0.203
Reading Comprehension	Control	94	34	40	39.33	1.101
Speaking Proficiency	Experimental	94	13	16	14.54	1.074
Speaking Proficiency	Control	94	11	15	12.82	0.671
Learning Independence	Experimental	94	39	40	39.04	0.203
Learning Independence	Control	94	34	40	39.33	1.101

The experimental group demonstrated uniformly high and homogeneous scores in writing (M = 20.00; SD = 0.000) and speaking (M = 14.54; SD = 1.074), while the control group showed comparably lower means with greater variance. The experimental group's consistently higher central tendency across all outcome variables suggests a robust treatment effect.

Assumption Tests

Shapiro-Wilk normality tests confirmed normal distributions for all variables in both groups (all $p > 0.05$; range: 0.286–0.425). Levene's homogeneity tests confirmed equal variances across groups for all variables (all $p > 0.05$; range: 0.309–0.363). Linearity tests confirmed significant linear relationships between learning independence and each dependent variable (all $p > 0.05$; range: 0.137–0.734). These results validated the use of MANCOVA.

Table 2. Normality and Homogeneity Test Results

Variable	Group	Shapiro-Wilk	Sig.	Levene Stat.	Sig.
Learning Independence	Experimental	0.974	0.421	0.865	0.356
Learning Independence	Control	0.969	0.395		
Reading	Experimental	0.972	0.425	0.842	0.363
Reading	Control	0.968	0.387		
Writing	Experimental	0.959	0.286	0.914	0.343
Writing	Control	0.963	0.314		
Speaking	Experimental	0.971	0.412	1.052	0.309
Speaking	Control	0.966	0.356		

MANCOVA Results: Multivariate Tests

The multivariate test (Table 3) revealed a highly significant simultaneous effect of the instructional model (class variable) on the combined set of dependent variables (Pillai's Trace = 0.913; $F = 634.505$; $p < 0.001$). This represents a very large effect. In contrast, learning independence as a covariate did not yield a significant simultaneous effect (Pillai's Trace = 0.004; $F = 0.231$; $p = 0.875$), indicating that students' pre-existing learning independence levels did not significantly moderate the combined language skill outcomes.

Table 3. Multivariate Tests (MANCOVA — Pillai's Trace)

Effect	Pillai's Trace	F	Hypothesis df	Error df	Sig.
Intercept	0.806	251.259	3.000	182.000	0.000*
Learning Independence (Covariate)	0.004	0.231	3.000	182.000	0.875
Class (Instructional Model)	0.913	634.505	3.000	182.000	0.000*

* $p < 0.001$

Between-Subjects Effects (Univariate Analysis)

Table 4 presents the between-subjects effects, demonstrating the instructional model's significant individual impact on each dependent variable while controlling for learning independence.

Table 4. Tests of Between-Subjects Effects

Variable	Source	F	Sig.	R^2
Reading Comprehension	Learning Independence	0.286	0.593	—
Reading Comprehension	Class (Model)	51.732	0.000*	0.222
Writing Creativity	Learning Independence	0.000	0.998	—
Writing Creativity	Class (Model)	36.393	0.000*	0.170
Speaking Proficiency	Learning Independence	0.430	0.513	—
Speaking Proficiency	Class (Model)	1815.777	0.000*	0.911

* $p < 0.001$

The instructional model exerted a highly significant effect on all three dependent variables: reading comprehension ($F = 51.732$; $p < 0.001$; $R^2 = 0.222$), writing creativity ($F = 36.393$; $p < 0.001$; $R^2 = 0.170$), and speaking proficiency ($F = 1815.777$; $p < 0.001$; $R^2 = 0.911$). Notably, the model explains 91.1% of variance in speaking proficiency, indicating an exceptionally strong effect in this domain. Learning independence as a covariate did not yield significant effects on any individual dependent variable (all $p > 0.05$).

Univariate t-test Comparisons and N-Gain Analysis

Separate univariate comparisons (Table 5) confirmed significant differences between experimental and control groups for all four outcome variables. N-Gain analysis further contextualized these improvements.

Table 5. Univariate Comparisons and N-Gain Analysis

Variable	t-value	p-value	N-Gain Experimental	N-Gain Control	Interpretation
Writing Creativity	3.542	0.001	High	Low-Moderate	Significant
Reading Comprehension	3.215	0.002	Moderate-High	Low-Moderate	Significant
Speaking Proficiency	3.611	0.001	High	Low	Significant
Learning Independence	3.214	0.002	Moderate-High	Low-Moderate	Significant
Overall (N-Gain Mean)	—	—	0.65	0.35	—

Overall, the experimental group achieved an average N-Gain of 0.65 (moderate-to-high category per Hake, 1999), compared to 0.35 for the control group (low-to-moderate category). These results consistently confirm that the Guided Inquiry model with Digital LKPD produced substantially greater pre-to-post improvements across all English language skills compared to conventional instruction.

Student Response Data

Supplementary survey data collected from experimental group students further illuminated the qualitative dimensions of treatment effectiveness. Among respondents, 87% reported increased learning motivation, 82% reported improved content comprehension, 90% rated the Digital LKPD as

user-friendly and accessible, and 84% reported greater engagement in discussion activities. These response patterns suggest that the digital and inquiry-based components of the intervention functioned synergistically to enhance not only skill outcomes but also affective learning dimensions.

Discussion

Effect on Writing Creativity

The Guided Inquiry model with Digital LKPD produced a highly significant improvement in students' writing creativity ($t = 3.542$; $p = 0.001$; N-Gain = high). This finding is consistent with Llewellyn's (2013) assertion that inquiry-based learning stimulates creative thinking by requiring students to engage in idea exploration before composing. The Digital LKPD's multimedia features, including embedded video prompts and visual scaffolds, provided rich pre-writing stimulation that aligns with Mayer's (2009) multimedia learning principles. Students who engaged in structured inquiry phases (orientation → conceptualization → investigation) were systematically prompted to generate, organize, and elaborate ideas, directly supporting the fluency, originality, flexibility, and elaboration dimensions of writing creativity theorized by Torrance (2019). Control group students, relying primarily on teacher-directed lectures and printed exercises, lacked opportunities for autonomous idea generation, limiting creative development.

Effect on Reading Comprehension

Guided Inquiry with Digital LKPD significantly enhanced reading comprehension ($t = 3.215$; $p = 0.002$). This outcome confirms findings from Sadeh and Zion (2019), who demonstrated that inquiry-based reading strategies deepen textual understanding beyond surface-level decoding. The Digital LKPD's provision of diverse text types, including digital news articles, academic excerpts, and interactive texts with embedded audio and video supports, allowed students to engage in Anderson's (2020) extensive reading framework while simultaneously developing inferential reasoning skills. The inquiry cycle's emphasis on question formulation and information investigation created authentic reading purposes that increased cognitive engagement with texts, addressing the mechanical reading patterns documented in the preliminary observations. Harmer's (2007) assertion that effective reading instruction involves analysis and application, not merely comprehension, was operationalized through the LKPD's pre-reading, while-reading, and post-reading activity sequences.

Effect on Speaking Proficiency

The most substantial effect was observed in speaking proficiency ($F = 1815.777$; $R^2 = 0.911$), indicating that the treatment explained over 90% of variance in speaking outcomes. This remarkable effect is attributable to the structured, low-anxiety communicative practice embedded within the Guided Inquiry cycle. The discussion and reflection phase consistently required students to verbally present findings, engage in peer debates, and conduct group presentations, creating the sustained communicative practice that Richards and Renandya (2002) identify as essential for speaking development. Kim and Park (2021) similarly found that digital learning strategies that increase communicative interaction opportunities significantly enhance speaking fluency. The Digital LKPD's audio and video recording features additionally enabled students to self-monitor pronunciation and fluency, providing individualized feedback consistent with self-regulated learning principles (Panadero, 2017). The control group's minimal speaking practice, constrained by teacher-directed formats, explains the substantial inter-group differential.

Role of Learning Independence

Contrary to initial hypotheses, learning independence as a covariate did not yield significant effects on any individual language skill (all $p > 0.05$) or on the combined set of outcomes ($p = 0.875$). This finding may be interpreted in two ways. First, the Guided Inquiry model's structured scaffolding may have effectively compensated for individual differences in students' pre-existing learning independence, producing equitable gains regardless of SRL levels. Second, the eight-week intervention may have simultaneously elevated all students' learning independence to a threshold that homogenized its variance, reducing its explanatory power as a covariate. This interpretation is supported by the significant improvement in learning independence scores observed in the experimental group ($t = 3.214$; $p = 0.002$), suggesting that the intervention itself developed this competency. The absence of an interaction effect between instructional model and learning independence further confirms that the Guided Inquiry approach with Digital LKPD was effective uniformly across different levels of learner autonomy, an important practical implication for diverse classroom contexts.

Digital LKPD as Instructional Design Component

From an Educational Technology perspective grounded in AECT (2023) principles, this study's most significant contribution is the reframing of Digital LKPD from a mere content delivery medium to an integral component of instructional design. The Digital LKPD in this study was not simply a digitized version of printed exercises; it was purposefully designed to guide inquiry phases, scaffold metacognitive processes, and facilitate authentic language use. Kozma (2016) and Sung, Yang, and Lee (2017) characterize this functional reframing as cognitive mediation, whereby technology mediates higher-order thinking rather than simply transmitting information. The LKPD's integration of visual stimuli, task sequencing aligned with inquiry phases, and real-time feedback mechanisms created what Mayer (2020) describes as a generative processing environment, supporting dual-channel processing and meaningful learning construction.

The educational technology implications extend to teacher professional development: effectively deploying Digital LKPD within a Guided Inquiry framework requires teachers to reconceptualize their role as instructional designers who create learning environments, rather than information transmitters who deliver content. The positive student response data, particularly the 90% usability rating, suggests that when Digital LKPD is thoughtfully designed and aligned with inquiry-based pedagogy, students readily adopt it as a natural component of their learning ecosystem.

Conclusion and Implications

This study provides robust empirical evidence that the Guided Inquiry model supported by Digital LKPD significantly improves eleventh-grade students' English language skills across writing creativity, reading comprehension, speaking proficiency, and learning independence. The MANCOVA results confirmed both simultaneous and individual effects of the instructional model, with particularly strong effects on speaking proficiency ($R^2 = 0.911$). The N-Gain analysis demonstrated moderate-to-high improvement in the experimental group ($M = 0.65$) compared to low-to-moderate improvement in the control group ($M = 0.35$).

These findings carry several important implications. For classroom practitioners, the study provides evidence-based justification for shifting from teacher-centered to inquiry-based digital instruction in English language classrooms. The Guided Inquiry-Digital LKPD framework is particularly valuable in contexts where students exhibit passive learning behaviors and limited authentic communicative practice. For educational technology designers, the study underscores the importance of aligning digital material design with inquiry-based pedagogical frameworks rather than simply digitizing existing print materials.

For school administrators and policy makers, the study demonstrates that existing digital infrastructure, when paired with pedagogically coherent instructional models, can significantly enhance language learning outcomes without requiring additional technological investments. The effectiveness of the model in a non-urban, lower-resource context like Bima Regency suggests strong potential for broader regional adoption.

Several limitations should be acknowledged. The eight-week intervention period may not capture long-term retention effects. The study was conducted within a single school, limiting generalizability. Future research should investigate longitudinal effects, compare different digital platform affordances, and examine teacher preparedness as a moderating variable. Mixed-methods designs that integrate qualitative data on student inquiry processes would further enrich understanding of the mechanisms underlying the observed outcomes.

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