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Scaffolding Structural Thinking in Critical Reading: A Quasi-Experimental Study on CTL-Based Liveworksheets for Popular Scientific Text

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Abstract: Scaffolding Structural Thinking in Critical Reading: A Quasi-Experimental Study on CTL-Based Liveworksheets for Popular Scientific Text. Objective: Students' reading skills in Indonesia remain low, as evidenced by the 2022 PISA scores, partly due to the limitations of static print media in facilitating critical thinking required by the Merdeka Curriculum. This study aims to determine the effectiveness of interactive digital Liveworksheets based on Contextual Teaching and Learning (CTL) compared to printed worksheets in improving Grade VIII students' critical reading skills on popular scientific articles. **Methods:** This study employed a quantitative, quasi-experimental, posttest-only control-group design. The sample consisted of 68 eighth-grade students at SMP Negeri 1 Padang, selected via cluster random sampling and divided into an experimental class (N=34) using CTL-based Liveworksheets and a control class (N=34) using printed worksheets. Data were collected using a validated objective test (30 items, Alpha 0.878) measuring text content, structure, and linguistic features, combined with a qualitative analysis of students' written responses to assess cognitive engagement. Data analysis included descriptive statistics, normality and homogeneity tests, an independent samples t-test, and Cohen's d effect size calculation. **Findings:** The results indicated a significant difference in learning outcomes. The experimental class achieved a higher mean score (88.04) compared to the control class (83.04). The t-test confirmed this significance with a p-value of 0.046 ($p < 0.05$). Furthermore, the effect size calculation ($d=0.49$) indicated a moderate practical impact. Specifically, the experimental group demonstrated superior performance in analyzing text structure compared to the control group. **Conclusion:** The integration of CTL components, specifically modeling and constructivism, within the interactive features of Liveworksheets proved effective in enhancing students' reading competencies. Therefore, this media serves as a viable alternative to support digital literacy and critical reading instruction in secondary schools.

Keywords: critical reading skills, liveworksheets, contextual teaching and learning, popular scientific articles, digital literacy.

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INTRODUCTION

Bahasa Indonesia subjects have a strategic position as compulsory subjects taught from elementary school to university. Language learning aims to enable students to master a range of language skills, including listening, speaking, reading, and writing. Among these four skills, reading as a receptive skill is essential for understanding all subject areas (Tlonaen et al., 2025). With good reading skills, students can relate texts to their prior knowledge to think critically and create new knowledge in line with

the demands of the 21st century (Nurrahmah et al., 2025).

In the context of the current curriculum, namely the Merdeka Curriculum, learning reading skills is a means of developing a culture of literacy and literary literacy. This means that literacy is a major requirement for students. Through reading literacy activities, students will read texts with a good understanding, analyze, evaluate, and reflect on information from various types of texts to solve everyday problems (Indrayadi et al., 2020; Kim et al., 2020). Without good reading and critical thinking skills, students will find it difficult to achieve the learning outcomes targeted at their level of education (Adzidzah & Yudiawan, 2024; Talwar et al., 2023).

However, field research has found that students' reading and numeracy literacy skills in Indonesia are in the low category (Sari et al., 2020). According to the 2022 Programme for International Student Assessment (PISA), Indonesian students' reading skills tend to be lower than those of students in other OECD countries (OECD, 2023). Indonesia only scored an average of 359 points, while other OECD countries scored an average of 476 points. Based on this data, there is a very significant difference, with Indonesia lagging by 117 points (Wijayanti, 2020). This low level of critical reading skills is also influenced by changes in digital lifestyles (Vázquez-Cano et al., 2020). Massive use of gadgets and instant access through artificial intelligence make students complacent, thereby reducing their willingness to analyze texts deeply and critically (Nosaka et al., 2021).

Low reading skills have a direct impact on the quality of student learning outcomes (Cargando & Jacela, 2025). Reading skills directly improve students' speed of understanding, learning outcomes, communication skills, and creativity (Khellab et al., 2022; Li et al., 2022; Wijayanti, 2020). Various studies also confirm that reading skills are positively correlated with students' ability to develop ideas for writing, which is a productive language skill (Mirizon et al., 2021; T.M. et al., 2020).

One of the reading skills considered low among students is the critical reading of popular scientific articles (Kim et al., 2020; Villarente & Moral, 2021). In these texts, students will use their reading skills to identify the information contained in the text. At the same time, reading skills will hone students' critical thinking abilities by requiring them to evaluate arguments, distinguish between facts and opinions, and consider various points of view (Magableh & Abdullah, 2021; Mousa, 2025). After that, students will be able to sort information and express what they have learned through writing and speaking. However, without good reading skills, students will not be able to optimally meet these academic demands (Dugasa et al., 2022; Kim et al., 2020).

Field evidence shows a gap between the demands of the Merdeka Curriculum and students' reading abilities in schools. Based on observations and preliminary studies at SMP Negeri 1 Padang, it was found that students' reading comprehension skills were still not optimal. This is supported by data on students' average daily test scores on popular scientific articles, which only reached 67.23, still below the criteria for learning completeness. Interviews with teachers revealed that these low scores were due to students' difficulty understanding implied meaning, a lack of interest in reading, and a limited variety of learning media. In addition, it was found that the learning models and methods used were still not interactive and did not facilitate critical thinking among students (Sambayon et al., 2023; Tegmark et al., 2022).

One of the most effective learning media for improving scientific article reading skills is Liveworksheets. Liveworksheets is an engaging, clear, easy-to-understand, and interactive platform (Le & Prabjandee, 2023).

Liveworksheets is considered interactive because it can be supplemented with videos, images, sounds, practice questions, and automated assessment features that foster independent learning in students (Sholikha & Nurhayati, 2024). Not only that, but this medium is also practical because it can be accessed for free on websites via mobile devices (Sholikha & Nurhayati, 2024). With these features and advantages, the use of Liveworksheets is more cost-efficient and environmentally friendly because students do not need to print media using paper (Mhlongo et al., 2023; Paculdar, 2025).

Currently, classroom learning is still dominated by printed student worksheets. Therefore, the use of printed worksheets is no longer efficient at this time (Furenes et al., 2021). Although print media is easily accessible without electricity, it has limitations in accommodating the learning styles of students in the digital generation, who require dynamic visualization and instant feedback in their learning process (Tegmark et al., 2022). Printed worksheets tend to be static and one-dimensional, so they cannot present content in dynamic formats such as video or audio (Furenes et al., 2021). However, this type of media remains important for helping students build a contextual understanding of popular scientific articles. Thus, integrating technology into learning is important to address these shortcomings while maintaining the core of the learning process (Alneyadi et al., 2023; Yusuf & Ali, 2022). As stated by Haleem et al. (2022), the use of interactive digital devices in education is no longer optional but an urgent necessity to improve skills relevant to 21st-century learning, such as analytical thinking and problem-solving. Next, teachers only need to determine the learning method to be used (Käsper et al., 2020; Phuong, 2022). As a series of activities, the key to effective learning is the application of the right strategy.

No matter how sophisticated the media is, its effectiveness will depend on the learning method used (Afnita et al., 2025; Furenes et al., 2021). One learning method that can be integrated with Liveworksheets is Contextual Teaching and Learning (CTL) (Indrayadi et al., 2020; Sholikha & Nurhayati, 2024). This learning method aims to connect the subject matter with students' lived experiences. For example, when studying popular scientific articles, educators can present articles related to their experiences (Wekerle et al., 2022), which, in turn, helps students understand the texts and information presented (Nasution & Suyanto, 2023). Thus, Liveworksheets is the right tool to complement the CTL learning method, especially for popular scientific article material.

In teaching popular scientific articles, teachers can use digital worksheets to present articles that are relevant to students' experiences and environment. The CTL approach itself has been proven to be appropriate and effective for teaching reading skills (Subaedah et al., 2023; Yapp et al., 2023). The application of CTL must attend to seven main components: constructivism, inquiry, questioning, learning community, modeling, reflection, and authentic assessment (Afnita et al., 2025). First, constructivism is the foundation of CTL thinking, in which teachers facilitate students in building their knowledge little by little through meaningful experiences, rather than simply accepting ready-made concepts. Second, inquiry is the core activity of CTL. Students are encouraged to discover knowledge about a concept on their own, so that the learning outcomes are more lasting and emotionally satisfying. Furthermore, productive learning always begins with questioning, whether initiated by students or posed by teachers. Fourth, learning communities encourage reciprocal interaction not only between teachers and students, but also among students. The application of group work allows students to utilize learning resources from their peers. Fifth, teachers utilize various information and technologies as models to

stimulate student understanding, overcoming the limitations of teachers as the sole source of information. Sixth, activities involve digesting, comparing, and internalizing newly acquired knowledge with previous experiences. Students are trained to apply knowledge to the real world. Seventh, the final stage is to assess student understanding and serve as evaluation material for teachers (Do et al., 2023; Topping et al., 2022).

Several previous studies have been conducted. A study by Wahab et al. (2025) examined the effect of the CTL learning model assisted by Liveworksheets on learning outcomes. Previous research has focused on the colligative properties of solutions, while future research will investigate their effect on reading ability. Furthermore, Nuha (2024) conducted research on the development of digital worksheets with Liveworksheet-based CTL as a medium for learning scientific article reading skills. However, this study stopped at the validity testing stage and has not been tested for effectiveness in the classroom. This integration offers theoretical innovation that goes beyond mere digitalization. The synergy between Liveworksheets and CTL is established by mapping technological features to the seven main CTL components (Subaedah et al., 2023). First, in the Modeling component, multimedia features in Liveworksheets present authentic, multisensory social phenomena that static print media cannot accommodate. This helps students build a cognitive bridge between the text and reality. Second, Inquiry and Constructivism are facilitated by interactive features such as drag-and-drop and fill-in-the-blank with automatic feedback. These features allow students to engage in trial-and-error when organizing text structures or analyzing arguments without fear of failure, thereby fostering active and independent knowledge construction. Finally, the efficiency of automatic grading allows teachers and students to focus on the Learning Community, where class discussions can be conducted immediately based on error analysis displayed in real time. It is this specific theoretical relationship that is predicted to generate a unique impact compared to conventional media (Abdel et al., 2023; Topping et al., 2022). This research reveals a knowledge gap regarding whether this medium is proven to be superior and more effective for learning reading skills compared to the conventional media currently used by teachers in schools.

Based on these explanations, research testing the effectiveness of CTL-based Liveworksheets in improving junior high school students' critical reading skills for popular scientific articles is important to conduct. This study aims to determine differences in reading skills between students who use interactive digital Liveworksheets based on CTL as a learning medium for reading popular scientific articles and those who use printed worksheets. This study is expected to inspire teachers to use learning media to improve students' reading skills in popular scientific articles. To answer the objectives of this study, the research hypothesis is formulated as follows:

H_0 : There is no significant difference in the ability to read popular scientific articles between students who learn using CTL-based Liveworksheets and students who use print media.

H_1 : There is a significant difference in the ability to read popular scientific articles between students who learn using CTL-based Liveworksheets and students who use print media.

METHOD

Preliminary Study

Before conducting the main experiment, a preliminary study was performed to identify the root causes of students' low reading skills. Data were collected through classroom observations

and semi-structured interviews with two Indonesian language teachers at SMP Negeri 1 Padang. Thematic analysis of the interview transcripts revealed two main barriers: (1) printed teaching materials lacked relevance to students' daily context (contextual barrier), and (2) minimal media interactivity caused students to be passive during the text analysis process (pedagogical barrier). These findings served as the empirical basis for developing the intervention using CTL-based Liveworksheets in this study.

Participants

The population in this study consisted of all eighth-grade students enrolled at SMP Negeri 1 Padang in the 2024/2025 academic year, totaling 237 students. Sampling was conducted using a cluster-randomized design, with study groups randomized within clusters. Resulting in two groups, namely class VIII B (*N=34*) as the experimental group and class VIII A (*N=34*) as the control group. The experimental group received treatment through interactive digital Liveworksheets based on Contextual Teaching and Learning, while the control group used conventional printed worksheets. Before treatment, both classes were assumed to have equivalent initial abilities based on the homogeneity test of Indonesian language daily test scores on the previous material, which showed homogeneous variance.

Research Design and Procedures

This study used a quantitative, quasi-experimental design. The research design used was a posttest-only control group design. The use of this design aims to observe the differences between the experimental and control classes caused by the interference provided, rather than by pre-existing characteristics. This study measured the effect of the independent variable, namely the use of interactive digital Liveworksheets based on CTL, on the dependent variable, namely students' critical reading skills on popular scientific articles. This posttest-only design has limitations because it lacks pretest data to accurately measure initial abilities. Therefore, strict controls were implemented during the learning process to minimize bias.

The research procedure was conducted in four meetings. Three meetings were for learning materials, and one meeting was for evaluation activities. The research procedure is presented in Table 1.

Table 1. Learning procedures activities in experimental and control classes

Meeting / Topic	Experimental Class	Control Class
Meeting 1 (Structure of Scientific Articles)	1. Modeling & Questioning: Students view a video about social phenomena integrated into Liveworksheets and submit their questions using the comment feature. 2. Inquiry: Students utilize an interactive, drag-and-drop activity within the digital worksheet to recognize different text structures.	1. Lecturing: The teacher explains the text structure using a whiteboard. Passive 2. Reading: Students read a printed text example and listen to the teacher's explanation without interactive media support.
Meeting 2 (Linguistic Features)	3. Constructivism: Liveworksheets utilizes audio cues to help students associate grammatical principles with how they naturally speak and write. 4. Learning Community: Students work	3. Individual Work: Students work on grammar exercises in the printed LKS individually. 4. Delayed Feedback: Answers are discussed

	in pairs to solve interactive grammar quizzes with immediate feedback scores.	classically at the end of the lesson.
Meeting 3 (Comprehending Content)	5. Authentic Assessment: Students analyze a complete article and submit their responses digitally. 6. Reflection: Students write a reflection on the digital wall provided in the platform.	5. Written Assignment: Students respond to essay prompts on paper, demonstrating their understanding of the article's material. 6. Teacher Summary: Students respond to essay prompts on paper, demonstrating their understanding of the article's material.
Meeting 4 (Evaluation)	7. Posttest: Students take the objective reading test.	7. Posttest: Students take the objective reading test.

Instruments

The main data collection instrument was an objective multiple-choice reading skills test with four answer choices. This instrument was developed by the researchers, referring to the Learning Outcomes of Phase D in the Merdeka Curriculum. This instrument consisted of 30 valid items designed to measure three aspects of comprehension: text content, text structure, and the linguistic rules of popular scientific articles. Examples of the items include (1) for the content aspect, students are asked to identify the main idea of a specific paragraph; (2) for the structure aspect, students must identify which paragraph constitutes the reiteration or thesis statement; and (3) for the linguistic aspect, students analyze the accuracy of conjunctions used in a sentence. The test was administered to a selected sample group consisting of eighth-grade students at SMP Negeri 1 Padang. The outline for the reading test is shown in Table 2 below.

Before use, the instrument underwent validity testing using the Point Biserial correlation formula. The results showed that 30 items were declared valid ($r_{count} > r_{table}$), with correlation coefficients ranging from 0.345 to 0.789. Furthermore, reliability testing was conducted using Cronbach's Alpha, yielding a coefficient value of 0.878. This value indicates that the instrument falls into the very high reliability category and is consistent for use in data collection.

Table 2. Outline for reading comprehension test of popular scientific articles

No	Understanding Aspects	Number of Questions
1	Understanding the Content of Popular Scientific Articles	17
2	Understanding the Structure of Popular Scientific Articles	2
3	Understanding the language of popular scientific articles	11
	Total	30

In addition to the objective test, secondary instruments included documentation of student work embedded within the Liveworksheets. Specifically, these consisted of the argumentation writing prompts and student self-reflection logs. These qualitative records were used to support the quantitative data and provide insight into students' cognitive processes during the learning activities.

Data Analysis

The data analysis technique used was parametric statistics assisted by SPSS version 26.0. The methodology was performed in five phases. *First,* descriptive statistics, including means, medians, standard deviation (SD), minimum, and maximum scores, were used to describe the data distribution. *Second,* a series of dependent-samples t-tests was conducted on the posttest data from both the experimental and control groups, along with prerequisite tests for parametric test assumptions (Lilliefors normality test) and homogeneity (Levene's test). *Third,* a hypothesis was tested using an independent-samples t-test at the 0.05 significance level. Also, Cohen's d was calculated to assess the clinical significance of the treatment. *Fourth,* an error analysis was conducted to investigate students' cognitive processes. This was done by identifying the most frequent incorrect answer types in both groups, specifically on items requiring high-level analysis, such as distinguishing between facts and opinions and determining text structure. This analysis aims to map the specific difficulties students encounter when reading critical scientific articles. *Fifth,* qualitative data from students' essays and reflections were analyzed descriptively to interpret the cognitive processes and engagement levels during the intervention.

■ RESULT AND DISCUSSION

Implementation of CTL-based Livework sheets

Before discussing the statistical results, it is crucial to describe the intervention media that distinguishes the experimental class. The learning process utilized Liveworksheets, a web-based platform that transforms static PDF worksheets into interactive web pages. Unlike conventional printed media used in the control class, this digital media integrates specific features that support the Contextual Teaching and Learning (CTL) approach.

The specific innovation lies in the multimodal visualization and real-time interactivity. In the Modeling stage, the worksheet does not merely present text but also embeds a 2-minute introductory video depicting a local environmental issue in Padang, providing context to stimulate students' background knowledge. In the Inquiry stage, the media features a drag-and-drop activity in which students physically move text paragraphs into the correct structural boxes. This kinetic interaction helps concretize abstract structural concepts. The visualization of these interactive features is presented in Figure 1.

Figure 1. Display of CTL-based liveworksheets interface

Furthermore, student engagement was significantly higher in the experimental class. Students received immediate feedback (automatic scoring) upon completing tasks, a feature unavailable in the printed format, where feedback is delayed. The interface was designed with a user-friendly UI, featuring bright colors and intuitive navigation icons that encourage students to repeat exercises until they achieve a perfect score.

Effect of Intervention on Reading Skills

The posttest data were analyzed to describe students' reading skills in both classes. This analysis aims to provide a clear overview of the data distribution and central tendency measurements for each group. A comprehensive summary of these descriptive statistics is presented in Table 3 below.

Table 3 shows the performance differences between the two classes. The experimental class achieved a higher mean score of 88.04. In contrast, the control class obtained a lower mean score of 83.04. The standard deviation in the experimental class is 8.69. This value is smaller than the control class's standard deviation of 11.47. This indicates that the scores in the experimental class are more uniform.

Table 3. Summary of descriptive statistics for posttest scores

Statistic	Experimental Class	Control Class
N	34	34
Mean	88.04	83.04
Std. Deviation	8.69	11.47
Minimum	66.67	60.00
Maximum	100.00	100.00

The scores were further analyzed to view student achievement in detail. To provide a comprehensive comparative view, the data were categorized into frequency distributions based on specific reading indicators. The visualization of these proficiency levels is shown in Figure 2 below.

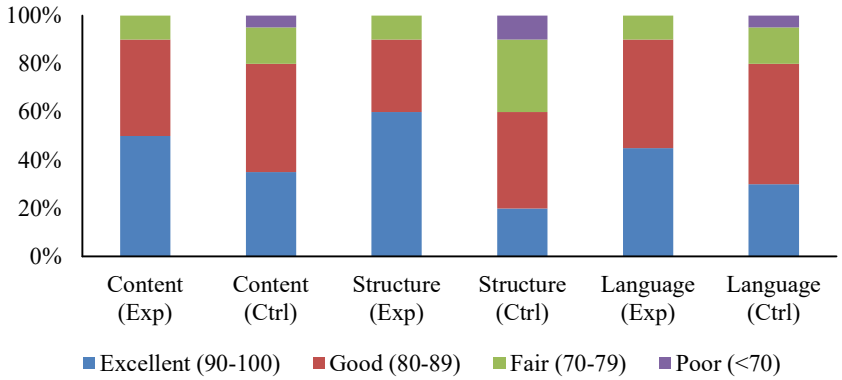

Figure 2. Distribution of student reading proficiency levels by indicator

Figure 2 presents the distribution of reading proficiency levels across three specific indicators. The categorization criteria (Poor <70) were established based on the school's Minimum Completeness Criteria (KKM). As illustrated, the Experimental class demonstrates a dominant Excellent proportion in the Structure indicator (60%), vastly outperforming the Control class (20%). This visual evidence confirms that the interactive intervention specifically boosted students' mastery of complex text structures.

Prerequisite analysis was conducted to ensure the data met the assumptions for parametric testing. The Lilliefors normality test

yielded p-values of 0.200 for the experimental class and 0.185 for the control class. Since both values are greater than 0.05 *(p > 0.05),* the data in both groups are normally distributed. Furthermore, the homogeneity test yielded a p-value of 0.062 (p > 0.05), confirming that the variances of the two groups were homogeneous. With these assumptions met, the data were eligible for hypothesis testing using the Independent Samples t-test.

The Independent Samples t-test was used to test the hypothesis. This test determines if the difference between the two groups is significant. The results of this analysis are shown in Table 4 below.

Table 4 shows that the significance value (Sig. 2-tailed) is 0.046. The obtained value is less than the 0.05 significance level. Therefore, H_0 is rejected, and H_1 is accepted. This statistical evidence shows a significant difference in reading

Table 4. Results of the independent samples t-test

Group	N	Mean	t-value	df	Sig. (2-tailed)	Mean Difference
Experimental	34	88.04	2.026	66	0.046	5.00
Control	34	83.04				

skills between students who learned with CTL-based Liveworksheets and those who used printed worksheets.

The practical impact of the treatment was also calculated. Cohen's d formula was used to compute the effect size, yielding a result of 0.49. According to Cohen's guidelines, this indicates a medium effect. This indicates that the use of Liveworksheets has a moderate but meaningful positive impact on improving students' reading skills in a practical setting.

Error Analysis on Critical Reading Indicators

To identify the difficulties students encountered, an analysis of error patterns on the answer sheets was conducted. The data revealed that students in the control class committed the most frequent errors in the Text Structure indicator. Specifically, 45% of students in the control group failed to correctly distinguish between the thesis statement and arguments. In contrast, only 18% of the experimental class students made errors in this section. Furthermore, regarding the Content indicator, the control group showed a higher error rate on questions that required distinguishing between facts and opinions. This error analysis confirms that the intervention specifically addressed students' cognitive weaknesses in analyzing text structure and evaluating arguments

Student mastery of three reading indicators was compared. These indicators are Understanding Content, Structure, and Language. The following describes these three indicators in the experimental and control classes, as shown in Figure 3 below.

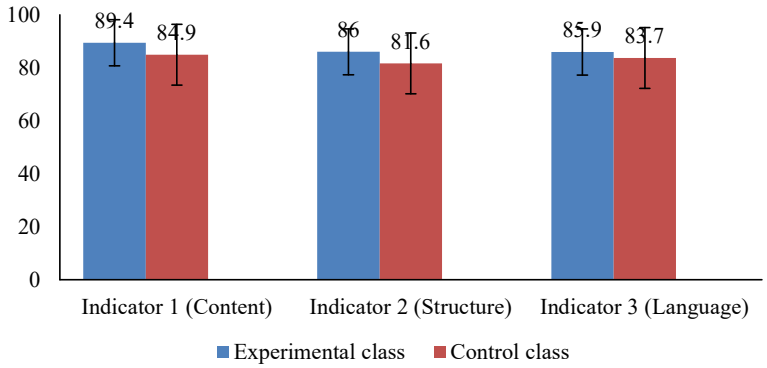

Figure 3. Comparison of student scores per indicator

Figure 3 shows that the experimental class achieved higher scores across all three indicators. Both classes demonstrated their greatest strength in comprehending the material, as reflected in their highest scores on the content understanding assessment. Nevertheless, a significant difference emerged in their understanding of the material's structure, with the experimental group scoring 86.0 and the control group 81.6.

Qualitative Analysis of Student Responses

To support the quantitative findings, a qualitative analysis of students' written responses from the Inquiry and Reflection stages was conducted to trace the cognitive processes that occurred during the learning activities. During the inquiry stage, where students were asked to write a short argument about environmental issues, the analysis revealed significant differences in the quality of arguments produced. The majority of students in the control class tended to write arguments based solely on personal opinion, without supporting data, and often used simple sentence structures that lacked cohesive devices. In contrast, students in the experimental class demonstrated more complex cognitive processes. Facilitated by the drag-and-drop structure in Liveworksheets, their written arguments followed a logical pattern: Thesis, Argument, and Reiteration. Student responses indicated that these interactive features successfully scaffolded their structural thinking, enabling them to construct more coherent arguments than the control group (Nuha, 2024; Wekerle et al., 2022).

Furthermore, the analysis of student reflection data revealed a stark contrast in engagement levels and metacognition. Reflections from the control class were mostly brief, with comments such as "The lesson was difficult" or "I am tired of writing," suggesting a passive learning experience. Conversely, reflections submitted via the digital platform showed higher metacognitive awareness. Students frequently noted how the instant feedback feature helped them realize errors in their initial attempts and correct them immediately. This confirms that the real-time feedback feature in Liveworksheets actively engaged students' self-correction and evaluation skills, which are core components of critical reading (Wisniewski et al., 2020). Additionally, the user-friendly digital interface was found to reduce learning anxiety, encouraging students to repeat the exercises enthusiastically until they achieved mastery (Le & Prabjandee, 2023).

Discussion

Based on the data analysis, there is a statistically significant difference between the experimental and control classes, with a p-value of 0.046 ($p < 0.05$). Beyond statistical significance, this study also demonstrated practical significance through the Effect Size calculation, which indicated a medium effect size ($d = 0.49$). These findings confirm that integrating digital technology with a contextual approach can providea tangible positive impact on student learning outcomes compared to conventional methods. This aligns with the findings of Alshammary & Alhalafawy (2023), who found that Liveworksheets are effective in improving learning outcomes because they present material in a more engaging and interactive manner.

The superiority of the experimental class can be attributed to the capability of Liveworksheets features in facilitating the main components of the CTL approach, specifically the Modeling and Constructivism stages. In the control class using printed media, the modeling of phenomena was limited to static reading texts, which did not sufficiently stimulate students' initial schemata. Conversely, Liveworksheets allowed for the presentation of multimodal models in the form of videos and audio relevant to the students' real-life context before they entered the core material.

This learning medium, which combines audio and visual elements, enables students to develop a solid, basic understanding grounded in constructivist theory, making it easier for them to relate new information to their personal experiences (Furenes et al., 2021). Nuha (2024) emphasizes that this type of digital interaction is crucial for maintaining students' focus and thinking activities as they learn to read.

Furthermore, the interactive nature of the media significantly influenced students' Inquiry process. When learning from print media, students often adopt a passive attitude and are reluctant to experiment because mistakes in handwriting are difficult to correct. This condition creates psychological barriers that hinder students' ability to discover new knowledge. However, Liveworksheets, as a digital medium, offers a more comfortable learning space, allowing students to move and rearrange answers without worrying about damaging the worksheet's appearance. This convenience motivates students to be more active in exploring various interpretations of the text. These findings align with research by Le & Prabjandee (2023), which shows that easy-to-use digital platforms can reduce student anxiety and increase enthusiasm for independent learning.

A deeper analysis of the reading indicators reveals an interesting pattern: the Understanding Text Structure indicator had a lower average score than the Understanding Text Content indicator in both groups. This indicates that analyzing text structure, which demands abstract, logical thinking to identify theses and arguments, is cognitively more difficult for students than merely finding explicit information in the text. Nevertheless, the experimental class proved significantly superior on this structure indicator (86.0) compared to the control class (81.6). This ability arises from the interactive drag-and-drop feature in Liveworksheets, which provides students with a visual representation for rearranging text in a regular manner (Wekerle et al., 2022). Print media does not offer this kind of interactive visual aid, which makes it more difficult for students in the control group to understand complex text structures. This quantitative finding is strongly corroborated by the qualitative analysis of students' essays. The structural scaffolding in the Liveworksheets evidently helped students transition from abstract ideas to concrete, logically ordered arguments, whereas control students struggled to organize their thoughts coherently without visual aids.

Popular scientific articles pose challenges beyond text structure, namely the ability to distinguish between facts and opinions. This genre requires strong critical thinking skills to assess the validity of the author's arguments. The application of Contextual Teaching and Learning (CTL) through digital features, particularly the Learning Community component, helps students overcome these challenges. Students can discuss and mark parts of the text they consider arguments directly on the screen, then compare their identifications with those of their classmates. This easier visualization of text elements has been shown to improve students' ability to analyze article arguments compared to students who read the text sequentially.

Apart from the material content factor, the difference in learning outcomes is also strongly influenced by the feedback mechanism between the two media. In the control class, feedback was delayed because the teacher had to manually check student work after the lesson ended, so students' misconceptions could not be corrected immediately. In contrast, Liveworksheets provides an automatic grading feature that gives students real-time feedback immediately after completing a task. Wisniewski et al. (2020) contend that providing feedback immediately leads to significantly better retention than delaying it, because it enables learners to address misunderstandings in real time. This mechanism supports the Authentic Assessment and Reflection

components in CTL, enabling students to immediately evaluate their mistakes and make independent improvements. This finding strengthens the argument of Furenes et al. (2021) that printed media have limitations in meeting students' need for rapid independent evaluation. Qualitative data from student reflections further validates this mechanism. Students explicitly reported that immediate notifications of errors triggered an instant self-correction process, fostering a higher level of metacognitive awareness that print media failed to provoke.

However, the use of print media in the control class remained relatively high, indicating that traditional media still plays an important role in learning. However, with the demands of digital literacy and higher critical thinking skills in the Merdeka Curriculum, the lack of interactive simulations in print media is a major challenge. Research by Praheto et al. (2025) also shows that learning that relies solely on passive activities without interactive media is less effective at improving reading skills. Thus, the transition from regular worksheets to interactive digital worksheets is necessary to maximize students' critical thinking potential. This study recommends the use of CTL-based Liveworksheets as an effective media option for schools with adequate technological facilities.

■ CONCLUSION

Based on the results and discussion, it can be concluded that the use of Liveworksheet interactive digital worksheets based on Contextual Teaching and Learning is more effective than print-based worksheets in improving students' reading skills. The effectiveness of media use is in the moderate category with a p-value <0.05. Students taught with Liveworksheets demonstrated a higher level of mastery of the three indicators of scientific article-reading skills tested, especially in the first indicator: understanding content. In addition, it was also found that students taught with Liveworksheets demonstrated better understanding of the second indicator, which is understanding text structure, than students taught with printed worksheets.

This study shows that integrating CTL components into the Liveworksheets feature can help students read critically. The most dominant supporting components are modeling and interactive authentic assessment. The interactivity displayed by Liveworksheets overcomes the limitations of static printed worksheets, making reading and learning more active and meaningful. Therefore, Liveworksheets can be an alternative medium for schools to support the development of reading skills, as it promotes digital literacy and critical thinking competencies in accordance with the Merdeka Curriculum.

As a suggestion for further research, additional testing of this medium is needed by measuring other variables that may affect learning effectiveness. Future research could also test the effectiveness of Liveworksheets across other text genres and at different educational levels to generalize these findings. Teachers who plan to implement this media should provide clear guidance to students before using it. In addition, student access to the internet and the use of devices by students need to be considered to maximize the potential of this media in classroom learning.

■ REFERENCES

Abdel, A., Ibrahim, A., Ahmed, K., Al, A., Enrique, M., Zuta, C., & Bayat, S. (2023). Collaborative learning , scaffolding based instruction , and self assessment/ : impacts on intermediate EFL learners ' reading comprehension , motivation , and anxiety. *Language Testing in Asia*, *13*(6), 1–33. https://doi.org/10.1186/s40468-023-00229-1

Adzidzah, N., & Yudiawan, A. (2024). Hots-

Based formative assessment: the key to improving the quality of learning. *Journal of Quality Assurance in Islamic Education (JQAIE)*, *4*(2), 109–120. https://doi.org/10.47945/jqaie.v4i2.1670

Afnita, Efrianto, Ansoriyah, S., Lubis, F., Ifnaldi, Zulfikarni, JR, V. T. D., Mamat, S., Ulya, R. H., Rachman, A., & Nurrahmah, F. (2025). Developing CTL-Based digital media e-worksheet for second language learning. *Forum for Linguistic Studies*, *7*(6), 103–121. https://doi.org/10.30564/fls.v7i6.9665

Alneyadi, S., Abulibdeh, E., & Wardat, Y. (2023). The impact of digital environment vs. traditional method on literacy skills; reading and writing of emirati fourth graders. *Sustainability*, *15*(4). https://doi.org/10.3390/su15043418

Alshammary, F. M., & Alhalafawy, W. S. (2023). Digital platforms and the improvement of learning outcomes: evidence extracted from meta-analysis. *Sustainability*, *15*(2). https://doi.org/10.3390/su15021305

Cargando, R. V, & Jacela, Z. A. P. (2025). Teachers' difficulties in teaching reading. *International Multidisciplinary Journal of Research for Innovation, Sustain ability, and Excellence (IMJRISE)*, *2*(9), 11–26. https://doi.org/10.5281/zenodo.17015273

Do, H., Do, B. N., & Nguyen, M. H. (2023). 3How do constructivism learning environments generate better motivation and learning strategies/ ? The Design Science Approach. *Heliyon*, *9*(12), e22862. https://doi.org/10.1016/j.heliyon.2023.e22862

Dugasa, G., Olana, T., & Ali, S. (2022). Effects of explicit reading strategy instruction on grade 9 students' achievement in reading comprehension. *Education Research International*, *13*(1), 7872840. https://doi.org/10.1155/2022/7872840

Furenes, M. I., Kucirkova, N., & Bus, A. G. (2021). A comparison of children's reading on paper versus screen: a meta-analysis. *Review of Educational Research*, *91*(4), 483–517. https://doi.org/10.3102/0034654321998074

Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: a review. *Sustainable Operations and Computers*, *3*(February), 275–285. https://doi.org/10.1016/j.susoc.2022.05.004

Indrayadi, T., Yandri, H., & Kamil, D. (2020). The effect of contextual teaching and learning on reading comprehension. *Indonesian Research Journal in Education*, *4*(2), 569–583. https://doi.org/10.22437/irje.v4i2.9017

Käsper, M., Uibu, K., & Mikk, J. (2020). The effects of teaching strategies on primary school students' reading outcomes and interest in reading. *Educational Studies in Language and Literature*, *20*(1), 1–24. https://doi.org/10.17239/L1ESLL-2020.20.01.12

Khellab, F., Özcän Demirel, & Mohammad zadeh, B. (2022). Effect of teaching metacognitive reading strategies on reading comprehension of engineering students. *Sage Open*, *12*(4), 1–19. https://doi.org/10.1177/21582440221138069

Kim, Y.-S. G., Lee, H., & Zuilkowski, S. S. (2020). Impact of literacy interventions on reading skills in low- and middle-income countries: a meta-analysis. *Child Development*, *91*(2), 638–660. https://doi.org/10.1111/cdev.13204

Le, V. H. H., & Prabjandee, D. (2023). A review of the website liveworksheets.com. *Computer Assisted Language Learning Electronic Journal CALL-EJ*, *24*(1), 269–279. https://www.semanticscholar.

org/paper/A-Review-of-the-Website-Liveworksheets.com-Huynh-Le/29002f5ca9ed5d8d0817551bde81f1f12f22ffab?utm_source=direct_link

Li, H., Gan, Z., Leung, S. O., & An, Z. (2022). The impact of reading strategy instruction on reading comprehension, strategy use, motivation, and self-efficacy in chinese university efl students. *Sage Open*, *12*(1), 21582440221086660. https://doi.org/10.1177/21582440221086659

Magableh, I. S. I., & Abdullah, A. (2021). The impact of differentiated instruction on students' reading comprehension attainment in mixed-ability classrooms. *Interchange*, *52*, 255–275. https://doi.org/10.1007/s10780-021-09427-3

Mhlongo, S., Mbatha, K., Ramatsetse, B., & Dlamini, R. (2023). Challenges, opportunities, and prospects of adopting and using smart digital technologies in learning environments/ : an iterative. *Heliyon*, *9*(6), e16348. https://doi.org/10.1016/j.heliyon.2023.e16348

Mirizon, S., Vianty, M., Rosmalina, I., & Erlina, E. (2021). Secondary school students' english literacy achievement based on pisa reading literacy test 2009. *Englisia: Journal of Language, Education, and Humanities*, *12*(1), 68–81. https://doi.org/10.22373/ej.v9i1.9459

Mousa, M. P. (2025). The impact of cultural familiarity with stories on learners' reading comprehension. *RumeliDE Dil ve Edebiyat Araþtýrmalarý Dergisi*, *47*, 221–229. https://doi.org/10.5281/zenodo.16748518

Nasution, K., & Suyanto, S. (2023). A comparison of students' mathematical communication ability taught by contextual teaching and learning versus problem based learning. *Jurnal Pendidikan Progresif*, *13*(2), 255–267. https://doi.org/10.23960/jpp.v13.i2.202309

Nosaka, Y., Shinohara, M., Nomura, K., Sarugaku, T., & Yamada, M. (2021). Analysis of gaze time spent at the gazing point that is required during reading. *Advances in Science, Technology and Engineering Systems Journal*, *6*(1), 726–734. https://doi.org/10.25046/aj060179

Nuha, A. (2024). *Pembuatan E-LKPD interaktif liveworksheet berbaasis CTL sebagai media pembelajaran keterampilan membaca teks artikel ilmiah populer siswa kelas VIII SMP* [Developing interactive E-LKPD liveworksheets based on CTL as a learning media for reading skills of popular scientific article texts for grade viii junior high school students]. Universitas Negeri Padang.

Nurrahmah, F., Syahrul, R., Tressyalina, & Afnita. (2025). *Model pembelajaran PECARA (peta cerita rakyat) berbasis literasi digital dan budaya untuk meningkatkan minat baca siswa* [The PECARA (folklore map) learning model based on digital literacy and culture to increase students' interest in reading]. *JRIP: Jurnal Riset Dan Inovasi Pembelajaran*, *5*(2), 806–819. https://doi.org/10.51574/jrip.v5i2.3142

OECD. (2023). *PISA 2022 Results (Volume I): the state of learning and equity in education*. OECD Publishing. https://doi.org/10.1787/53f23881-en

Paculdar, L. J. C. (2025). The effectiveness of interactive reading resources in developing word recognition reading skills. *International Journal of Social Science and Human Research ISSN*, *8*(3), 1579–1598. https://doi.org/10.47191/ijsshr/v8-i3-34

Phuong, N. T. L. (2022). Teachers' strategies in teaching reading comprehension.

International Journal of Language Instruction, *1*(1), 19–28. https://doi.org/10.54855/ijli.22113

Praheto, B. E., Cahyandaru, P., & Wagan Aguilar, M. G. (2025). The effects of interactive multimedia on students' reading skills. *Bahastra*, *45*(1), 1–8. https://doi.org/10.26555/bs.v45i1.1353

Sambayon, J. T., Luceñara, D. P., Luceñara, C. P., Bayron, Q. M., Peñaloga, R. A., & Larombe, E. A. (2023). Effectiveness of contextualized learning materials in improving the reading skills and comprehension level of the students. *Psychology and Education: A Multidiciplinary Journal*, *7*(1), 435–444. https://doi.org/10.5281/zenodo.7702258

Sari, M. H., Susetyo, Noerhamzah, Wardhana, D. E. C., & Kusumaningsih, D. (2020). Understanding the level of students' reading comprehension ability. *Universal Journal of Educational Research*, *8*(5), 1848–1855. https://doi.org/10.13189/ujer.2020.080521

Sholikha, D. A., & Nurhayati, E. (2024). Development of interactive digital worksheets (LKPD) using liveworksheet to improve the reading skills of javanese script. *International Journal for Multidisciplinary Research (IJFMR)*, *6*(6), 1–16. https://doi.org/10.36948/ijfmr.2024.v06i06.30097

Subaedah, S., Bundu, P., & Yahya, M. (2023). Development of theme - based english learning model with contextual teaching and learning (CTL) approach to improve students' reading skills. *Asian Journal of Education and Social Studies*, *45*(1), 28–39. https://doi.org/10.9734/AJESS/2023/v45i1975

T.M., S., Bogaerds-Hazenberg, Evers-Vermeul, J., & Bergh, H. van den. (2020). A meta-analysis on the effects of text structure instruction on reading comprehension in the upper elementary grades. *Reading Research Quarterly*, *57*(3), 435–462. https://doi.org/10.1002/rrq.311

Talwar, A., Magliano, J. P., Higgs, K., Santuzzi, A., Tonks, S., O'Reilly, T., & Sabatini, J. (2023). Early academic success in college: examining the contributions of reading literacy skills, metacognitive reading strategies, and reading motivation. *Journal of College Reading and Learning*, *53*(1), 58–87. https://doi.org/10.1080/10790195.2022.2137069

Tegmark, M., Alatalo, T., Vinterek, M., & Winberg, M. (2022). What motivates students to read at school? student views on reading practices in middle and lower-secondary school. *Journal of Research in Reading*, *45*(1), 100–118. https://doi.org/10.1111/1467-9817.12386

Tlonaen, Z. A., Jaha, D. A. J., Ena, Z., & Dewi, R. F. (2025). Enhancing students ' extensive reading learning outcomes/ : integrating motivation, technology, and collaborative active learning. *Jurnal Pendidikan Progresif*, *15*(3), 1989–2006. https://doi.org/10.23960/jpp.v15i3.pp1989-2006

Topping, K. J., Douglas, W., Robertson, D., & Ferguson, N. (2022). Effectiveness of online and blended learning from schools/ : a systematic review. *Review of Education*, *10*(2), 1–41. https://doi.org/10.1002/rev3.3353

Vázquez-Cano, E., Gómez-Galán, J., Infante-Moro, A., & López-Meneses, E. (2020). Incidence of a non-sustainability use of technology on students' reading performance in pisa. *Sustainability*, *12*(2). https://doi.org/10.3390/su12020749

Villarente, M. D., & Moral, R. V. (2021). Teaching strategies and their effect on reading comprehension performance of

junior high school students in inclusive classroom setting. *Journal of Effective Teaching Methods (JETM)*, *2*(1), 134–149. https://doi.org/10.59652/jetm.v2i1.138

Wahab, F. A., Malabar, S., & Isa, A. H. (2025). Enhancing elementary literacy through flip pdf: developing interactive reading materials for engaged learning. *International Journal of Science and Research Archive*, *14*(01), 570–575. https://doi.org/10.30574/ijsra.2025.14.1.0125

Wekerle, C., Daumiller, M., & Kollar, I. (2022). Using digital technology to promote higher education learning: the importance of different learning activities and their relations to learning outcomes. *Journal of Research on Technology in Education*, *54*(1), 1–17. https://doi.org/10.1080/15391523.2020.1799455

Wijayanti, S. H. (2020). Indonesian students' reading literacy. *Proceedings of the International Conference on Research and Academic Community Services (ICRACOS 2019)*, *390*, 61–65. https://doi.org/10.2991/icracos-19.2020.13

Wisniewski, B., Zierer, K., & Hattie, J. (2020). The power of feedback revisited: a meta-analysis of educational feedback research. *Frontiers in Psychology*, *10*(January), 1–14. https://doi.org/10.3389/fpsyg.2019.03087

Yapp, D., Graaff, R. De, & Bergh, H. van den. (2023). Effects of reading strategy instruction in english as a second language on students ' academic reading comprehension. *Language Teaching Research*, *27*(6), 1456–1479. https://doi.org/10.1177/1362168820985236

Yusuf, F., & Ali, A. (2022). Exploring students' perception on using live worksheet as self-directed learning of listening skills in online education. *Journal of Ultimate Research and Trends in Education*, *4*(3), 255–266. https://doi.org/10.31849/utamax.v4i3.11449