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The Effects of Deep Learning-Based Teaching and Reading Interest on EFL Reading Comprehension: A 2 × 2 Factorial Study

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Abstract
Reading comprehension remains a persistent concern in Indonesian EFL classrooms, particularly when learners are expected to interpret, integrate, and evaluate information from texts. This study investigated the main effects of Deep Learning-Based Teaching (DLBT) and students' reading interest, as well as their interaction, on EFL reading comprehension. The study employed a quantitative experimental design with a 2 × 2 factorial structure involving teaching method (DLBT and conventional instruction) and reading interest (high and low). Sixty eighth-grade students at SMP Negeri 2 Banyuasin I participated in the study. Data were collected through a 20-item reading interest questionnaire and a 25-item reading comprehension test administered before and after the instructional intervention. Post-test data were analysed using descriptive statistics, planned independent-samples t-tests, and two-way ANOVA after the assumptions of normality and homogeneity had been examined. The results showed significant differences between DLBT and conventional instruction among high-interest students, $t(18.113) = 10.068$, $p < .001$, and low-interest students, $t(28) = 3.635$, $p = .001$. The two-way ANOVA showed significant main effects of teaching method, $F(1, 56) = 85.984$, $p < .001$, and reading interest, $F(1, 56) = 57.110$, $p < .001$. The teaching method × reading interest interaction was also significant, $F(1, 56) = 13.818$, $p < .001$, indicating that the magnitude of the instructional difference varied across reading-interest levels. The findings suggest that meaningful, learner-centred reading instruction should be considered together with students' motivational characteristics when designing EFL reading instruction.

Keywords: Deep Learning-Based Teaching; EFL Reading Comprehension; Reading Interest; 2 × 2 Factorial Design; Merdeka Curriculum

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1. Introduction

Reading comprehension plays a central role in English language learning because it enables learners to interpret information, construct meaning, and apply ideas obtained from written texts in various academic situations. In English as a Foreign Language (EFL) classroom, successful reading extends beyond understanding vocabulary and grammatical structures. Learners are expected to interpret explicit and implicit information, relate textual

Borneo Educational Journal (Borju)
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Volume 9, Issues 1, February,2027
EISSN : 2655-9323
Section : Research Article
Page : 1-18
DOI : 10.24903/bej.v9i1.2492

ideas to their prior knowledge, evaluate arguments presented by the author, and develop coherent understanding across different parts of a text. These abilities are fundamental to academic learning because reading serves as a gateway to acquiring knowledge across disciplines while fostering analytical and critical thinking skills (Grabe & Stoller, 2020).

Although reading is regarded as a key component of language proficiency, many Indonesian junior secondary school students continue to experience difficulties in achieving satisfactory reading comprehension. Classroom observations and large-scale educational assessments indicate that students frequently encounter problems identifying main ideas, interpreting implied meanings, synthesizing information across passages, and making logical inferences from texts. Similar concerns are reflected in the Programme for International Student Assessment (PISA) 2022, which reported that Indonesian students' reading literacy remained below the OECD average. The report suggests that a considerable proportion of students have not yet developed the level of reading proficiency required to process written information critically or to use reading effectively as a tool for learning in academic contexts (OECD, 2023). These findings reinforce the need for instructional practices capable of supporting deeper comprehension and more meaningful engagement with reading activities.

Efforts to improve students' literacy have become one of the major priorities in Indonesian education, particularly following the implementation of the Merdeka Curriculum. This curriculum encourages schools to shift from teacher-dominated instruction toward learning experiences that actively engage students in constructing knowledge. Rather than emphasizing the memorization of content, the curriculum promotes inquiry, collaboration, creativity, critical thinking, reflection, and authentic problem-solving as essential components of classroom practice. Within English language education, these principles require teachers to design instructional activities that encourage students to interact meaningfully with texts, exchange ideas, and develop understanding through active participation (Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi, 2022).

Borneo Educational Journal (Borju)
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EISSN : 2655-9323
Section : Research Article
Page : 1-18
DOI : 10.24903/bej.v9i1.2492

The emphasis on meaningful learning in Indonesian education is closely related to the current Deep Learning approach promoted by the Ministry of Primary and Secondary Education. In this context, Deep Learning is understood as a pedagogical approach that promotes mindful, meaningful, and joyful learning and moves students beyond memorisation toward deeper understanding, higher-order thinking, reflection, and application of knowledge in meaningful contexts (Andayanie et al., 2025; Hattie & Donoghue, 2016; Setyoningsih et al., 2025). In the present study, the term Deep Learning-Based Teaching (DLBT) refers specifically to the classroom implementation of this approach through inquiry-based activities, collaboration, authentic reading tasks, discussion, and reflection. Thus, DLBT is treated as an instructional condition rather than as a technology-related form of artificial intelligence or machine learning.

The theoretical rationale for DLBT is consistent with constructivist and information-processing views of learning, in which learners develop understanding through active processing, connection of new information with prior knowledge, and reflection on meaning. Learner-centred, active instruction has also been shown to produce higher achievement than predominantly lecture-based teaching (Freeman et al., 2014). Andayanie et al. (2025) similarly describe deep learning as learning that develops students' ability to apply knowledge through authentic, collaborative, and purposeful experiences. In EFL reading, these principles are particularly relevant because comprehension is not limited to retrieving explicit information. Readers must construct meaning, integrate ideas, make inferences, evaluate information, and connect textual information with prior knowledge (Grabe & Stoller, 2020). Accordingly, instruction that requires students to interpret evidence, discuss alternative meanings, and reflect on their understanding provides a theoretically plausible pathway to deeper reading comprehension.

Reading interest provides a complementary learner-characteristic perspective. Reading interest refers to a learner's tendency to experience positive engagement, curiosity, and willingness to interact with reading materials. Research on reading motivation indicates that

Borneo Educational Journal (Borju)
https://jurnal.fkip-uwgm.ac.id/index.php/Borju
Volume 9, Issues 1, February,2027
EISSN : 2655-9323
Section : Research Article
Page : 1-18
DOI : 10.24903/bej.v9i1.2492

intrinsic forms of reading motivation are positively related to reading behaviour and reading competence, including comprehension (Y. Li et al., 2024; Ma & Zhao, 2025; Schiefele et al., 2012; Wigfield et al., 2016). Interest can support sustained attention and effort, which are important because comprehension of EFL texts often requires readers to persist through unfamiliar vocabulary, complex relationships among ideas, and inferential processing. Therefore, students with higher reading interest may be more ready to take advantage of instructional activities that require active reading, discussion, and reflection.

The two perspectives together provide the theoretical basis for examining an interaction between teaching method and reading interest. DLBT creates learning opportunities that demand active cognitive engagement, whereas reading interest represents a learner characteristic that may influence the extent to which students participate in and benefit from those opportunities. From this perspective, the effect of DLBT need not be identical for all learners: students with stronger reading interest may engage more consistently with inquiry, discussion, and reflection, while students with lower interest may participate less readily but can still benefit from structured, meaningful instruction. A 2 × 2 factorial design is therefore appropriate because it permits the simultaneous examination of the main effect of teaching method, the main effect of reading interest, and whether the effect of teaching method differs across reading-interest levels (Andrade, 2024).

Although learner-centred instruction and reading interest have both been discussed in previous EFL research (Abdel-Al Ibrahim et al., 2023; H. Li et al., 2022; Yapp et al., 2023), they are often examined separately. The present study addresses this gap by treating teaching method and reading interest as two factors within the same experimental framework. This design makes it possible to move beyond asking whether DLBT or reading interest is associated with reading comprehension and instead examine whether the instructional effect varies according to learners' level of reading interest.

Accordingly, the study investigates three questions: (1) Is there a significant difference in reading comprehension between students receiving DLBT and those receiving conventional

Borneo Educational Journal (Borju)
https://jurnal.fkip-uwgm.ac.id/index.php/Borju
Volume 9, Issues 1, February,2027
EISSN : 2655-9323
Section : Research Article
Page : 1-18
DOI : 10.24903/bej.v9i1.2492

instruction? (2) Is there a significant difference in reading comprehension between students with high and low reading interest? and (3) Is there a significant interaction between teaching method and reading interest in relation to reading comprehension?

Based on the theoretical framework, the study tests three corresponding hypotheses. First, students receiving DLBT are expected to demonstrate higher reading comprehension than students receiving conventional instruction. Second, students with high reading interest are expected to demonstrate higher reading comprehension than students with low reading interest. Third, the effect of teaching method is expected to differ according to students' level of reading interest.

By examining these relationships through a balanced 2 × 2 factorial design, the study aims to contribute empirical evidence to EFL reading research and to provide a more precise explanation of how instructional approach and learner characteristics operate together within the Indonesian educational context.

2. Method

2.1 Research Design

The study employed a quantitative experimental research design using a 2 × 2 factorial structure. Factor A was teaching method, consisting of Deep Learning-Based Teaching and conventional instruction. Factor B was students' reading interest, measured before the instructional intervention and classified into high and low categories. Reading comprehension achievement, represented by the post-test score, was the dependent variable. The factorial structure allowed the study to examine the main effect of teaching method, the main effect of reading interest, and the teaching-method × reading-interest interaction.

2.2 Research Setting and Participants

The research was conducted at SMP Negeri 2 Banyuasin I, South Sumatra, Indonesia, during the 2025/2026 academic year. The population consisted of 163 eighth-grade students enrolled at the school. One class was designated as a try-out class for

Borneo Educational Journal (Borju)
https://jurnal.fkip-uwgm.ac.id/index.php/Borju
Volume 9, Issues 1, February,2027
EISSN : 2655-9323
Section : Research Article
Page : 1-18
DOI : 10.24903/bej.v9i1.2492

instrument evaluation and was excluded from the main study, leaving 133 eligible students.

The main participants were selected using simple random sampling. Before the instructional intervention, the eligible students completed the reading interest questionnaire and were classified into high- and low-reading-interest categories. Forty-two students were classified as having high reading interest and 91 as having low reading interest. To obtain a balanced 2 × 2 factorial sample, 30 students were randomly selected from each category. Within each reading-interest category, students were randomly assigned to either the DLBT or conventional-instruction condition, resulting in 15 students in each of the four cells.

A total of 60 students participated in the experiment. The balanced distribution consisted of 15 high-interest students in the DLBT group, 15 high-interest students in the conventional-instruction group, 15 low-interest students in the DLBT group, and 15 low-interest students in the conventional-instruction group.

Table 1 Research Design (2 × 2 Factorial Design)

Teaching Method	High Reading Interest	Low Reading Interest
Deep Learning-Based Teaching	High Interest (n = 15)	Low Interest (n = 15)
Conventional Instruction	High Interest (n = 15)	Low Interest (n = 15)

2.3 Research Instruments

Data collection relied on two research instruments.

2.3.1 Reading Interest Questionnaire

The first instrument was a reading interest questionnaire adapted from Guthrie and Wigfield (2000). It contained 20 five-point Likert-scale items and was administered before the instructional intervention. The questionnaire scores were used to classify participants into high- and low-reading-interest categories for the factorial analysis.

2.3.2 Reading Comprehension Test

Borneo Educational Journal (Borju)
https://jurnal.fkip-uwgm.ac.id/index.php/Borju
Volume 9, Issues 1, February,2027
EISSN : 2655-9323
Section : Research Article
Page : 1-18
DOI : 10.24903/bej.v9i1.2492

The second instrument was a reading comprehension test consisting of 25 multiple-choice items. The test was administered as a pre-test and a post-test to document students' reading comprehension before and after the instructional intervention.

Before the main data collection, both instruments underwent validity and reliability evaluation. Item validity was examined through item analysis, while internal consistency was evaluated using Cronbach's alpha. The resulting evidence was used to determine whether the instruments were sufficiently consistent for the main study.

2.4 Data Collection Procedure

The study followed four consecutive stages of data collection.

Initially, participants completed the reading interest questionnaire, and the resulting scores were used to classify students into the high-reading-interest and low-reading-interest categories.

The second stage involved administering the reading comprehension pre-test to establish students' baseline performance before the treatment. During the instructional phase, the experimental group received DLBT through inquiry-based activities, collaborative reading, authentic reading tasks, classroom discussion, and reflection. The control group received conventional teacher-centred instruction. Both groups used the same learning materials, pursued the same learning objectives, and completed the intervention across eight instructional meetings. After the intervention, all participants completed the post-test. The post-test was used as the outcome measure in the inferential comparisons reported in this article, while the pre-test served to document baseline reading comprehension before treatment.

Following the completion of the treatment, all participants completed the post-test, which provided the outcome data used for the inferential analyses of reading comprehension.

2.5 Data Analysis

Borneo Educational Journal (Borju)
https://jurnal.fkip-uwgm.ac.id/index.php/Borju
Volume 9, Issues 1, February,2027
EISSN : 2655-9323
Section : Research Article
Page : 1-18
DOI : 10.24903/bej.v9i1.2492

All quantitative data were analysed using IBM SPSS Statistics version 26. Descriptive statistics were used to summarize post-test reading comprehension scores across the four factorial cells. Before inferential testing, normality and homogeneity of variance were examined using the Shapiro–Wilk test and Levene's test, respectively. The post-test distributions did not indicate significant departures from normality. For the planned pairwise comparisons, the high-interest comparison showed unequal variances; therefore, the equal-variances-not-assumed result was reported, whereas the low-interest comparison met the homogeneity assumption. Planned independent-samples t-tests were used to compare the DLBT and conventional-instruction groups within the high- and low-reading-interest categories. A two-way ANOVA was then used to test the main effects of teaching method and reading interest and their interaction. The interaction was interpreted together with the cell means and the planned pairwise comparisons. Statistical decisions were based on $\alpha = .05$.

3. Findings and Discussion

3.1 Planned Pairwise Comparisons

To examine the first research question, post-test reading comprehension scores were compared between students receiving DLBT and those receiving conventional instruction within each reading-interest category.

Table 2 Post-test Scores of Students with High Reading Interest

Group	N	Mean	SD	*t*	*P*
Deep Learning-Based Teaching	15	82.80	3.80	10.068	< .001
Conventional Instruction	15	72.20	1.47	–	–

Among students with high reading interest, those exposed to DLBT achieved a higher mean post-test score ($M = 82.80$, $SD = 3.80$) than students receiving conventional instruction ($M = 72.20$, $SD = 1.47$). Because Levene's test indicated unequal variances for this comparison, the unequal-variance result was used: $t(18.113) = 10.068$, $p < .001$. The result indicates a statistically significant difference in post-test reading comprehension favouring DLBT among students classified as having high reading interest.

Borneo Educational Journal (Borju)
https://jurnal.fkip-uwgm.ac.id/index.php/Borju
Volume 9, Issues 1, February,2027
EISSN : 2655-9323
Section : Research Article
Page : 1-18
DOI : 10.24903/bej.v9i1.2492

The same comparison was subsequently conducted for students categorized as having low reading interest.

Table 3 Post-test Scores of Students with Low Reading Interest

Group	N	Mean	SD	*t*	*P*
Deep Learning-Based Teaching	15	73.60	3.74	3.635	.001
Conventional Instruction	15	69.07	3.06	–	–

Among students with low reading interest, those receiving DLBT obtained a mean post-test score of 73.60 (SD = 3.74), compared with 69.07 (SD = 3.06) for students receiving conventional instruction. The difference was statistically significant, t(28) = 3.635, p = .001. Although the difference was smaller than that observed among high-interest students, the direction of the result was consistent and favoured DLBT.

Across both reading-interest categories, the DLBT groups obtained higher post-test reading comprehension scores than the corresponding conventional-instruction groups. However, the size of the difference was not identical across the two categories, which provides the descriptive basis for examining the interaction effect in the two-way ANOVA.

3.2 Main Effects and Interaction Effect

The two-way ANOVA was used to answer the second and third research questions by testing the main effect of reading interest and the teaching method × reading interest interaction.

Table 4 Two-Way ANOVA Results

Source	Df	*F*	*P*
Teaching Method	1	85.984	< .001
Reading Interest	1	57.110	< .001
Teaching Method × Reading Interest	1	13.818	< .001

The two-way ANOVA showed a significant main effect of teaching method, F(1, 56) = 85.984, p < .001, and a significant main effect of reading interest, F(1, 56) = 57.110, p < .001. More importantly, the teaching method × reading interest interaction was statistically significant, F(1, 56) = 13.818, p < .001. The significant interaction indicates

Borneo Educational Journal (Borju)
https://jurnal.fkip-uwgm.ac.id/index.php/Borju
Volume 9, Issues 1, February,2027
EISSN : 2655-9323
Section : Research Article
Page : 1-18
DOI : 10.24903/bej.v9i1.2492

that the difference between DLBT and conventional instruction varied across reading-interest levels. The cell means show a larger instructional difference among high-interest students (82.80 versus 72.20; mean difference = 10.60) than among low-interest students (73.60 versus 69.07; mean difference = 4.53). Thus, the interaction provides evidence that the instructional advantage associated with DLBT was stronger among students with high reading interest in this sample.

Taken together, the analyses show that post-test reading comprehension differed by teaching method and reading-interest category, and that the size of the teaching-method difference varied significantly across reading-interest levels.

3.3 Discussion

The higher post-test reading comprehension scores obtained by students in the DLBT condition can be interpreted in relation to the cognitive and social processes embedded in the intervention. Students engaged in inquiry, collaboration, authentic reading tasks, discussion, and reflection rather than relying primarily on teacher explanation. These activities required learners to interpret information, connect ideas, justify responses with textual evidence, and reflect on their understanding. Such processes are consistent with the current Indonesian Deep Learning approach, which emphasizes mindful, meaningful, and joyful learning, and with broader deep-learning perspectives that emphasize active participation and authentic application of knowledge (Andayanie et al., 2025; Setyoningsih et al., 2025). Comparable advantages over instructor-centred teaching have been reported for collaborative, scaffolded reading instruction among EFL learners (Abdel-Al Ibrahim et al., 2023) and for critical reading strategy instruction among ninth-grade students (Gebremariam & Weldeyohannes, 2025).

From a reading-comprehension perspective, the instructional activities also required students to move beyond surface-level retrieval. Grabe and Stoller (2020) emphasize that effective reading involves strategic construction of meaning, including interpretation, evaluation, and integration of information. Explicit instruction in reading strategies has

Borneo Educational Journal (Borju)
https://jurnal.fkip-uwgm.ac.id/index.php/Borju
Volume 9, Issues 1, February,2027
EISSN : 2655-9323
Section : Research Article
Page : 1-18
DOI : 10.24903/bej.v9i1.2492

likewise been found to improve L2 reading comprehension (H. Li et al., 2022; Yapp et al., 2023). The higher achievement of the DLBT group is therefore theoretically consistent with an instructional environment that repeatedly required students to process textual information actively rather than merely reproduce information supplied by the teacher.

Viewed from this perspective, the findings illustrate how instructional experiences influence reading achievement by shaping the way learners interact with written texts. When students participate actively in constructing understanding, reading becomes a process of inquiry rather than a task of retrieving isolated information. This learning condition is particularly important in EFL classrooms, where successful comprehension depends on students' ability to interpret meaning, connect ideas across texts, and integrate linguistic knowledge with prior experience. The present findings are consistent with the view that learning environments encouraging these forms of engagement may provide more favourable conditions for reading comprehension than instruction dominated by teacher explanation.

The present findings should nevertheless be interpreted as evidence from a specific instructional context rather than proof that every element of DLBT independently caused the observed differences. The intervention combined inquiry, collaboration, authentic tasks, discussion, and reflection as an integrated teaching condition. This caution is consistent with evidence that the benefits of inquiry-oriented instruction depend on how well it is structured and guided by the teacher (Wang et al., 2022). The results therefore support the effectiveness of the DLBT condition as implemented in this study.

The main effect associated with reading interest is also consistent with established reading-motivation research. Students with stronger reading interest may be more willing to devote attention and effort to reading, persist when comprehension becomes difficult, and engage more deeply with texts. Research on reading motivation has linked intrinsic motivational characteristics with reading behaviour and reading competence (Y. Li et al.,

Borneo Educational Journal (Borju)
https://jurnal.fkip-uwgm.ac.id/index.php/Borju
Volume 9, Issues 1, February,2027
EISSN : 2655-9323
Section : Research Article
Page : 1-18
DOI : 10.24903/bej.v9i1.2492

2024; Ma & Zhao, 2025; Schiefele et al., 2012; Wigfield et al., 2016). The present findings extend this relationship to the eighth-grade EFL context examined in this study.

The relationship between reading interest and comprehension can also be understood theoretically in terms of students' willingness to sustain attention and effort during reading. Students with stronger reading interest may be more inclined to explore ideas presented in texts, connect information with prior knowledge, and persist when comprehension difficulties emerge. Such engagement may provide more opportunities to apply vocabulary knowledge, reading strategies, and meaning-making processes that support successful reading performance.

These findings should be distinguished from a simple claim that reading interest directly causes higher achievement. Reading interest was measured and classified rather than experimentally manipulated. Related EFL research has also shown that motivational variables do not always translate directly into comprehension gains (Anggia & Habók, 2025). Accordingly, the statistically significant main effect is best interpreted as a difference in reading comprehension achievement associated with the two reading-interest categories.

The significant interaction provides the most distinctive contribution of the study. In a factorial design, an interaction means that the effect of one factor depends on the level of the other factor (Andrade, 2024). In the present study, the larger DLBT–conventional difference among high-interest students than among low-interest students is consistent with the proposition that students' motivational readiness can shape how fully they engage with an instructional approach that demands active reading and reflection.

At the same time, the low-interest DLBT group also outperformed the low-interest conventional group. This pattern is important because it indicates that DLBT was not beneficial only for students who already had strong reading interest. Rather, the instructional condition was associated with higher post-test performance in both

Borneo Educational Journal (Borju)
https://jurnal.fkip-uwgm.ac.id/index.php/Borju
Volume 9, Issues 1, February,2027
EISSN : 2655-9323
Section : Research Article
Page : 1-18
DOI : 10.24903/bej.v9i1.2492

categories, although the magnitude of the difference was greater among high-interest students.

The interaction therefore suggests a complementary relationship between instructional design and learner characteristics. DLBT can provide opportunities for active meaning construction, while reading interest may affect students' willingness to sustain engagement with those opportunities. This interpretation is consistent with research emphasizing that reading motivation and instructional conditions can jointly support comprehension rather than functioning as isolated influences (Guthrie & Wigfield, 2000; Wigfield et al., 2016).

For classroom practice, the findings imply that implementing meaningful reading instruction should be accompanied by deliberate efforts to cultivate students' interest in reading. Meta-analytic evidence indicates that school-based interventions designed to trigger interest can improve both reading motivation and reading comprehension (van der Sande et al., 2023). Teachers can provide purposeful texts, opportunities for choice and discussion, authentic reading tasks, and reflective activities so that students with different levels of initial interest have opportunities to participate. However, these implications should be viewed as pedagogical recommendations rather than direct causal conclusions beyond the evidence of the present experiment.

The interaction observed in this study provides additional empirical evidence for understanding reading instruction in Indonesian EFL classrooms, particularly within the implementation of the Merdeka Curriculum. While earlier studies have frequently examined instructional innovation and reading interest as separate variables, the present research demonstrates that a more comprehensive explanation of reading comprehension achievement can be obtained by considering how these variables influence one another. The application of a 2 × 2 factorial experimental design therefore contributes not only methodological value but also a broader understanding of how learner centred pedagogy and learner characteristics jointly shape reading outcomes.

Borneo Educational Journal (Borju)
https://jurnal.fkip-uwgm.ac.id/index.php/Borju
Volume 9, Issues 1, February,2027
EISSN : 2655-9323
Section : Research Article
Page : 1-18
DOI : 10.24903/bej.v9i1.2492

The evidence generated through this investigation supports a more integrated view of reading instruction by showing that teaching method and reading-interest category were both related to post-test reading comprehension and that their combination produced a statistically significant interaction.

Beyond their statistical significance, the results provide practical guidance for English teachers implementing learner-centred instruction. At the same time, fostering students' interest in reading remains equally important because sustained engagement encourages learners to participate more fully in those learning experiences. Rather than treating instructional innovation and reading motivation as separate educational priorities, English teachers may achieve better learning outcomes by integrating both into a coherent instructional framework. Such integration is particularly relevant to the implementation of the Merdeka Curriculum, which places meaningful learning and active student participation at the centre of classroom practice.

The findings should be interpreted within several limitations. The sample was drawn from one junior secondary school and comprised 60 students, so the results may not generalize to other schools, grade levels, or educational settings. The intervention lasted eight instructional meetings, which limits conclusions about longer-term effects. Reading interest was measured as a learner characteristic rather than manipulated experimentally. Although pre-test scores were collected to document baseline reading comprehension, the inferential comparisons reported in this article were based on post-test scores. Future research should involve larger and more diverse samples, longer interventions, and baseline-adjusted analyses when appropriate.

Despite these limitations, the balanced 2 × 2 factorial design provides a useful basis for examining how instructional approach and learner characteristics operate together. The results show that the DLBT condition was associated with higher reading comprehension than conventional instruction, that high-reading-interest students achieved higher scores

Borneo Educational Journal (Borju)
https://jurnal.fkip-uwgm.ac.id/index.php/Borju
Volume 9, Issues 1, February,2027
EISSN : 2655-9323
Section : Research Article
Page : 1-18
DOI : 10.24903/bej.v9i1.2492

than low-reading-interest students, and that the magnitude of the instructional difference varied significantly by reading-interest level.

4. Conclusion

This study found a significant main effect of teaching method on post-test reading comprehension, with students in the DLBT condition achieving higher scores than those in the conventional-instruction condition. Reading interest also showed a significant main effect, with high-interest students achieving higher post-test scores than low-interest students. Most importantly, the teaching method × reading interest interaction was significant, indicating that the size of the instructional difference varied across reading-interest levels. The cell means showed a larger DLBT advantage among high-interest students than among low-interest students.

The findings provide empirical support for considering meaningful, learner-centred reading instruction together with students' engagement with reading. Within the Indonesian Deep Learning context, the results indicate that the DLBT condition used in this study was associated with higher reading comprehension in both reading-interest categories, although the difference was larger among high-interest students. Because reading interest was measured rather than manipulated and the study was conducted in one school with a relatively small sample, the findings should be interpreted within these boundaries.

Future studies should replicate the investigation with larger and more diverse samples, longer instructional periods, and baseline-adjusted analyses when appropriate to determine whether the observed main effects and interaction are sustained across contexts.

Statements and Declarations

Author Contributions: Novi Supriyati: conceptualization, methodology, investigation, data curation, formal analysis, writing original draft; **Masagus Firdaus**: conceptualization, supervision, validation, writing review & editing; **Hanni Yukamana**: methodology, supervision, validation, writing review & editing. All authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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Borneo Educational Journal (Borju)
https://jurnal.fkip-uwgm.ac.id/index.php/Borju
Volume 9, Issues 1, February,2027
EISSN : 2655-9323
Section : Research Article
Page : 1-18
DOI : 10.24903/bej.v9i1.2492

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Conflict of Interest: The authors declare that there are no conflicts of interest regarding the research, authorship, or publication of this article.

Ethical Approval and Informed Consent: This study were conducted in accordance with established ethical principles for educational research. Permission to conduct the research was obtained from the principal of SMP Negeri 2 Banyuasin I. All participating students were informed about the purpose and procedures of the study, and informed consent was obtained from the students and their parents or guardians prior to participation. Participation was voluntary, and all data were anonymised and used solely for research purposes.

Data Availability: The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Declaration of Generative AI: During the preparation of this manuscript, the authors used ChatGPT as an AI-assisted tool to support language editing, structural revision, and formatting checks. The authors carefully reviewed and edited the AI-assisted output and take full responsibility for the content of the manuscript.

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Section : Research Article
Page : 1-18
DOI : 10.24903/bej.v9i1.2492

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