

Effectiveness of visual, auditory, and kinesthetic reading techniques on students' reading comprehension: A sensory comparative study in the context of higher education

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ABSTRACT

Reading interest in Indonesia remains low, negatively affecting students' reading comprehension and productive skills such as writing and speaking. Although various reading techniques have been introduced, their relative effectiveness remains uncertain. This study compares the effectiveness of four reading techniques—read-aloud, read-type, read-memorize, and read-write—on students' comprehension levels. Employing a quasi-experimental design with a posttest-only control group, this research involved 80 fifth-semester students of the Indonesian Language and Literature Education Study Program at FKIP Pasundan University in the 2023/2024 academic year. The participants were randomly assigned to four treatment groups, each receiving one of the reading techniques. Comprehension was assessed using a standardized test consisting of 30 multiple-choice and short-answer questions based on Bloom's taxonomy, supplemented by observation of student behavior during reading. Data were analyzed using ANOVA and followed by Tukey HSD post-hoc testing. The findings revealed that the read-write group achieved the highest comprehension scores, followed by read-type, while read-aloud and read-memorize showed lower and statistically insignificant differences. Techniques involving kinesthetic activities—writing and typing—were more effective, likely due to deeper cognitive engagement from motor activity. This supports the levels of processing theory, which suggests that deeper encoding occurs through active manipulation of information. These results imply that incorporating kinesthetic reading strategies into learning activities can enhance reading comprehension. Practically, educators in higher education can integrate read-write and read-type strategies into coursework to improve critical reading skills and knowledge retention.

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Introduction

Interest and reading habits in Indonesia are still relatively low (Amelia et al., 2024; Karim & Hartati, 2022; Putri, 2023; Rahayu, 2021; Sari & Wijaya, 2022; Setiawan, 2024). In fact, reading is a basic skill in language that can support other abilities, such as writing and speaking. Reading is a receptive activity in which the reader seeks to understand the writing, both the explicit information and the implied meaning conveyed by the author. Thus, it is not surprising that if someone likes to read, it will be directly proportional to other productive skills, such as writing and speaking (Afriansyah & Yanti, 2020). Reading skills also play

a crucial role in life, as knowledge can be acquired through reading activities. A comprehensive understanding of the text will make it easier for individuals to absorb information to the fullest (Wiana & Nuraeni, 2024). With critical thinking skills, readers can assess and analyze a text or their understanding of a material to determine its truth (Prayogi et al., 2023).

But unfortunately, the importance of reading is not fully realized by most people in Indonesia. UNESCO notes that Indonesia's reading interest index is only 0.001%, which means that only 1 in 1,000 people have the habit of reading. In addition, the Ministry of Communication and Information of the Republic of Indonesia (Kemenkominfo) once cited the results of the World's Most Literate Nations Ranked research conducted by Central Connecticut State University in March 2016. The research ranked Indonesia 60th out of 61 countries in terms of reading interest, just below Thailand (59th) and slightly better than Botswana (61st). Interestingly, in terms of literacy support infrastructure, Indonesia is actually above several European countries. Meanwhile, the Program for International Student Assessment (PISA) report shows that Indonesia's reading literacy ranking has increased by five positions compared to 2018. However, despite the increase in ranking, the literacy score obtained actually decreased, so that Indonesia is still in the bottom 11 of the 81 countries surveyed (Indrasari, 2024; Yusran, 2024). This is certainly very concerning, especially for the world of education which is the main milestone for the progress of a nation.

This condition also occurs among students. Based on observations made during 1 semester of the 2023/2024 academic year on students of the Indonesian Language and Literature Education Study Program at FKIP Pasundan University, it was found that 90% of students preferred to listen rather than read. Most of them also admitted that they understood better listening to the lecturer's explanation than reading themselves so that when the lecturer asked them to read and asked them to present, they tended to only read the material contained in the slides, not presenting it in their own language. Of course, this is not effective because students only read the material without understanding its contents, as evidenced when asked, they cannot explain anything other than reading back the contents in the slides. This is reinforced by several studies that show that students are still less capable in reading activities, which indicates that they can read texts without deep understanding. Students frequently read without engaging in post-reading activities, leading to insufficient comprehension of the material read (Irwansyah et al., 2024; Pujiastuti et al., 2022; Zahroh & Kirani, 2024).

For many years, different reading methods have been utilized to enhance reading comprehension, such as skimming methods (Sweller, 1988), scanning methods (Atkinson & Shiffrin, 1968), intensive reading methods (Piaget & Vygotsky, 1978), SQ3R methods (Piaget, 1952; Vygotsky, 1978), annotating and highlighting methods (Paivio, 1986); and DRTA (Stauffer, 1969).

Skimming is a rapid reading method used to grasp the general concept or main point of a text without going into specifics. The goal is to obtain information concisely but thoroughly (Sweller, 1988; University of Idaho Writing Center Resources, 2022). Meanwhile, scanning is a reading technique that aims to find specific information in the text, such as dates, names, or certain data, without reading the entire content. Readers immediately look for keywords that are relevant to the information needed (Atkinson & Shiffrin, 1968; University of Idaho Writing Center Resources, 2022). Intensive reading is a reading technique that is done carefully and carefully to understand the content of the reading in depth. It is commonly employed to grasp intricate content or demands thorough comprehension (Artrisdyanti, 2023; Piaget & Vygotsky, 1978). SQ3R represents survey, question, read, recite, and review. It is a method for reading that enhances retention and understanding, by progressing from minor details to larger concepts. This method can be beneficial for individuals who rely on textual information and seek to improve their comprehension (Piaget, 1952; University of Idaho Writing Center Resources, 2022; Vygotsky, 1978). Annotating and highlighting are reading strategies that consist of marking or taking notes on significant sections of the text to enhance understanding and facilitate information review (Paivio, 1986; Wolfe & Neuwirth, 2001). DRTA means directed reading thinking activity. This method aims to engage readers in critical and active thinking while reading by encouraging them to make predictions, read, and then assess or verify these predictions according to the text's content. DRTA is frequently utilized in education to enhance students' understanding of reading (Bariska & Hariani, 2017; Stauffer, 1969).

These techniques are still used today. However, based on observations that have been made, the various techniques have not shown significant results, especially to increase awareness of the importance of reading. In addition, most of these reading techniques only emphasise the visual aspect. This is a limitation that needs to be criticised, given that the reading experience can be enriched through the involvement of other senses such as hearing (auditory) and movement (kinesthetic). Previous research tends to isolate one technique in one study without conducting a thorough comparison between various sensory-based techniques, so it has not been able to provide a comprehensive picture of their effectiveness in improving reading comprehension.

There have been many studies related to reading skills and techniques (Ginting et al., 2024; Marwani et al., 2022; Masada & Evitarini, 2022; Saragih et al., 2024; Windasari & Gushendra, 2023). These studies show that the strategies or techniques used are successful in increasing students' motivation and comprehension in reading and also that various reading techniques have different effects on students' comprehension, depending on the method used and other supporting factors. However, most of the previous studies only discussed one of the reading techniques (skimming, SQ3R, DRTA), without comparing various reading techniques comprehensively in one study. In addition, previous studies also emphasized visual ability, without comparing with other sensory abilities, such as auditory and kinesthetic. Thus, the sensory approach to reading, which involves visual, auditory and kinesthetic in an integrated way, has not been widely raised as the main focus of research. In fact, this approach has a strong theoretical basis, one of which refers to the levels of processing theory (Craik & Lockhart, 1972) which states that the deeper the information is processed, the stronger its retention in memory. Activities such as writing, typing or reading aloud can theoretically trigger higher cognitive engagement than passive reading.

Based on these explanations, this study tries to describe and compare other variations of techniques where the techniques applied are associated with the sensory aspects used, namely read-aloud techniques involving auditory aspects, read-type techniques involving motoric (kinesthetic) aspects, read-memorize techniques involving visual aspects, and read-write techniques involving motoric (kinesthetic) aspects. Furthermore, the implications for students' reading comprehension level are also studied. Thus, this research is not only applicable, but also offers theoretical contributions to the development of reading comprehension techniques through a multisensory approach.

Method

This study used a quasi-experimental design with a posttest-only control group design to test the effect of various reading techniques on students' reading comprehension level. In this design, four treatment groups were formed without conducting a pretest, so measurements were only taken after the treatment was given. This aims to avoid the training effect or bias that might arise if students already know the type of questions that will be given. The four treatment groups were formed based on the reading techniques used, namely read-aloud, read-type, read-memorize, and read-write. Each group was given the same reading material and tested for understanding through evaluation questions.

The population in this study were students of the Indonesian Language and Literature Education Study Program of FKIP Pasundan University in the 5th semester of the 2023/2024 academic year in the Psycholinguistics course. The sample was chosen through purposive sampling method, ensuring that students possess different levels of reading abilities. The sample selection criteria included students who were actively attending lectures, had academic backgrounds that reflected a range of reading abilities, and were willing to participate in the entire series of treatments. The sample included four groups, each made up of 20 students, totaling 80 students. The randomisation process was conducted after screening based on these criteria, using a spreadsheet program-assisted randomisation technique to ensure fair and random group assignment. All groups were given the same reading text to ensure equality in the material read.

The research instruments used were reading comprehension test and observation. The reading comprehension test was used to measure the extent to which students understood the content of the reading text after using certain reading techniques. Meanwhile, observations were made to record the level of student engagement and response during reading activities. The data obtained were analyzed using inferential statistical methods, with one-way ANOVA test to compare the reading comprehension results of the four treatment groups and Post-hoc test (Tukey HSD) to see which pair of groups had significant differences.

The reading comprehension test instrument was developed based on Bloom's taxonomy indicators at the low to middle level cognitive domain, with the composition of multiple choice and short fill-in questions. Before being used in the research, the instrument was validated by two experts (one Lecturer of Linguistics course and one Lecturer of Reading Skills course) and tested on a small group of students outside the main sample. The results of the validity test using item-total correlation showed valid values (>0.3), and the reliability of the test was calculated using Cronbach's Alpha with a result of 0.82, which indicates high internal consistency. Content validity was also reviewed in terms of the items' conformity to the reading skill indicators relevant to the academic context, while reliability was retested using the split-half test which yielded comparable results.

To control for confounding variables such as differences in initial reading ability between individuals, equalisation was carried out based on academic grades and previous mastery of reading theory obtained from previous courses (Reading Skills). In addition, the reading texts used were adjusted for difficulty based on lexical analysis, so that they were equal for all groups. The type of text used was lecture material for the

Psycholinguistics course for 1 semester, with an average number of 13 pages for 11 chapters with a medium level of complexity based on lexical analysis using the Ure formula and the level of sentence rigidity based on Flesch Reading Ease which has been modified for the Indonesian context.

Ethical considerations in this study include providing informed consent to all respondents, which explains the objectives, procedures, and the right of respondents to withdraw at any time. The researcher guarantees the confidentiality of the respondent's identity, and the test and observation data are only used for academic purposes. This research has also obtained permission from the study programme and the lecturer in charge of the course concerned.

The research procedure began with the division of students into four groups randomly. Next, each group was given treatment according to the specified reading technique: (1) read-aloud group: read orally without writing or typing anything down, (2) read-type group: retyping the reading content, (3) read-write group: rewriting the reading content, and (4) read-memorize group: memorizing the reading content without writing or typing. After completing the reading activity, students immediately took the posttest to measure their understanding of the text that had been read. The results of the four groups were then compared to determine which technique was most effective in improving reading comprehension.

Results and Discussion

Results

This study examines the effectiveness of several reading techniques and their implications for comprehension levels. The reading techniques studied are read-aloud, read-type, read-memorize, and read-write techniques. Based on data that has been collected for 1 semester on students of the Indonesian Language and Literature Education Study Program, FKIP Pasundan University in semester 5 of the 2023/2024 academic year in the Psycholinguistics course, posttest scores were obtained czn be seen in Table 1.

Table 1. Recapitulation of posttest scores based on reading technique

Respondent to-	Reading Technique			
	Read-Aloud	Read-Type	Read-Memorize	Read-Write
1	67	73	50	87
2	68	67	70	67
3	70	93	70	73
4	70	87	50	87
5	60	73	46	73
6	67	60	50	80
7	73	80	72	67
8	60	60	86	73
9	60	87	66	87
10	73	87	66	67
11	60	87	40	73
12	53	87	67	67
13	73	80	66	70
14	68	80	85	93
15	73	80	80	73
16	73	73	72	80
17	67	80	66	93
18	73	87	87	93
19	68	80	86	93
20	73	73	72	87
Average Score	67,45	78,7	67,35	79,15

To clarify the difference in average scores between the reading techniques, a graph of the average posttest scores based on the reading techniques used can be seen in Fig. 1.

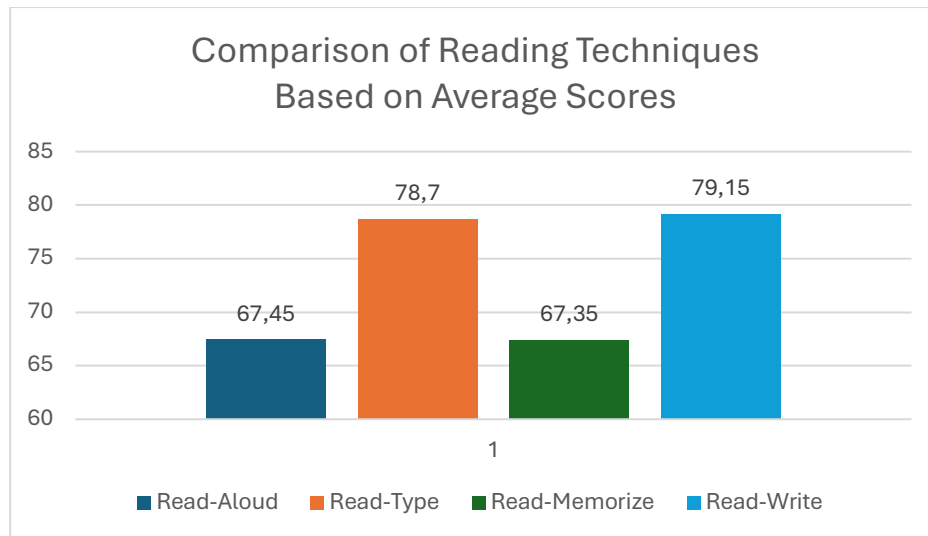


Fig 1. Graph of average posttest scores based on reading technique

Based on the data in table 1 and figure 1, it is clear that the read-write technique has the highest average (79.15), followed by read-type (78.7), while read-aloud (67.45) and read-memorize (67.35) have lower values and are almost the same. Furthermore, to find significant differences between these reading techniques, calculations were made using statistical tests, namely ANOVA and Post-hoc (Tukey HSD) tests. The following is the calculation using one-way ANOVA test and Post-hoc test (Tukey HSD).

The ANOVA test results show that the F value = 8.55 and p-value = 0.000058 ($p < 0.05$). Since the p-value is smaller than 0.05, there is a significant difference between the reading techniques. Therefore, we continue with the Post-hoc Test (Tukey HSD) to find out which group is significantly different. The results of the Tukey HSD test, showing the comparison between each pair of reading techniques and their significance can be seen in Table 2.

Table 2. Post-hoc test results (Tukey HSD)

Grup 1	Grup 2	Mean Diff	p-Value	Lower Bound	Upper Bound	Significance ($p < 0.05$)
Read-Aloud	Read-Type	11.25	0.003	4.12	18.38	Significance
Read-Aloud	Read-Memorize	0.10	1.000	-6.98	7.18	Not Significant
Read-Aloud	Read-Write	11.70	0.002	4.57	18.83	Significance
Read-Type	Read-Memorize	-11.15	0.003	-18.28	-4.02	Significance
Read-Type	Read-Write	0.45	0.997	-6.68	7.58	Not Significant
Read-Memorize	Read-Write	11.60	0.002	4.47	18.73	Significance

Table 2 indicates that the read-type and read-write techniques produced significantly better outcomes than read-aloud and read-memorize ($p < 0.05$). This suggests that reading techniques that incorporate motor (kinesthetic) elements, like typing or writing, are more successful in enhancing reading comprehension. There is no notable distinction between the read-type and read-write techniques ($p = 0.997$), indicating that both techniques are nearly equally effective in enhancing reading comprehension. The read-aloud techniques has the lowest average score and differs significantly from the other techniques, particularly when compared to read-type and read-write. This shows that reading by only remembering without any additional activity is less effective in improving comprehension. The read-aloud technique has no significant difference with read-memorize ($p = 1.000$), which indicates that only reading by voice without the addition of other techniques also has less effect in improving reading comprehension.

This analysis suggests that kinesthetic reading techniques, such as read-write and read-type, are more effective for enhancing students' comprehension compared to other methods like read-aloud and read-memorize.

Discussion

The writing style and tone should prioritize clarity, avoiding overly technical language that might confuse readers. Explanations should be straightforward, concise, and free from unnecessary repetition. Consistency ensures alignment between the objectives, results, and discussions. All claims and interpretations should be supported by evidence from the study and relevant references.

Students' ability to decode words and comprehend texts significantly impacts reading success. Effective decoding abilities enhance understanding (National Reading Panel, 2000). Understanding written material is a complicated task that depends on a variety of cognitive and language-related processes. Simply put, this complexity can be understood as the result of two sets of skills: decoding and linguistic comprehension (Nation, 2019).

Read-aloud techniques are in the third position after read-write techniques and read-type techniques. This technique involves the auditory aspect which can help in information processing. However, without reinforcement from writing or hand gestures, the information absorbed may be less than other techniques. Based on the dual coding theory (Paivio, 1986), oral reading involves the verbal modality but does not utilize the visual aspect enough, so information retention may be lower than other methods that involve more sensory modalities. Mayer (2020) emphasises the importance of combining sensory channels in the learning process, where information processing that involves more than one modality is proven to be more effective than using only one modality. In the context of reading, techniques that only involve auditory aspects such as read-aloud tend to be less optimal when compared to multimodal techniques.

The read-write technique and read-type technique showed the highest results. This indicates that rewriting information both manually and digitally can help in understanding and remembering the material and is quite effective in improving retention. Based on Mueller & Oppenheimer (2014) research, retyping information can improve understanding because it requires individuals to reprocess information before recording it. Levels of processing theory (Craik & Lockhart, 1972) also supports this finding, where deeper processing (through typing) helps in long-term retention. However, based on Mueller & Oppenheimer (2014) research, handwriting is better than typing in understanding complex concepts because it engages the brain more in information processing. This is also in line with the theory of embodied cognition, which states that physical activity (handwriting) can strengthen understanding through sensorimotor engagement (Barsalou, 2008; James & Engelhardt, n.d.; Kontra et al., 2015; Mangen & Velay, 2010). In addition, handwriting can activate almost the entire brain, whereas typing only activates a small part of it. This finding suggests that writing by hand can increase brain connectivity compared to typing on a keyboard (Van Der Weel & Van Der Meer, 2024). Kinesthetic integration in reading learning improves not only long-term memory but also students' inferential ability in understanding academic texts. Techniques that combine visual and kinesthetic elements become a form of sensory approach that is very effective for conceptual understanding (Ghaleb & Majeed, 2023; Parra, 2021).

Another thing, read-type techniques involve eye contact with blue light from the device used, which can certainly result in disruption of eye health. According to Amalia (2019) blue light with a wavelength of 415-455 nm can penetrate the cornea and be absorbed by the iris or pupil, which has the potential to harm eye health. Ayaki et al. (2017) and Makarim (2023) corroborates that blue light emitted from digital device screens can cause damage to the eyes, including eyestrain and visual impairment. Thus, read-write techniques remain superior to other techniques. However, if reading and typing must be done, it is best to use glasses that can counteract the radiation from the device being used. As Amalia (2019) found that exposure to blue light from electronic media can affect eye health, and the use of blue light filters or anti-blue light glasses is recommended to prevent damage.

This finding is also in line with the results of recent neuroscience research showing that motor activities such as handwriting can activate motor cortex areas and prefrontal cortex areas related to working memory, attention and decision-making (James, 2017). Kinesthetic activities during active reading or copying of text create stronger memory traces due to the integrated multisensory (visual, tactile, and motor) involvement in the learning process. In addition, brain scans through fMRI show that reading while performing movements (writing/typing) stimulates more brain areas than passive reading (James & Engelhardt, 2012).

Several international studies also link sensory-based reading techniques with multimodal learning principles applied in higher education, such as in the studies of Fleming (2011) and Kalantzis & Cope (2020), which suggest the integration of visual, kinesthetic and auditory modalities to maximise students' cognitive achievement. In the context of higher education, this approach is particularly relevant given that the complexity of the material students learn demands varied information processing strategies.

The effectiveness of read-write and read-type techniques can also be attributed to the increased concentration required when students have to actively reproduce the content. This process is not just copying, but involves mental rearrangement of information, which strengthens the connection of concepts.

Therefore, the active involvement of the body and mind together makes this technique superior in promoting deep understanding compared to passive techniques such as read-memorize.

Next, the read-memorize technique. This technique had the lowest result, which indicates that simply reading without any other form of note-taking or repetition is not effective for improving comprehension. This is in line with the forgetting curve theory (Boutis et al., 2019; Ebbinghaus et al., 1913) which states that without reinforcement through active repetition, information tends to be quickly forgotten. This is also supported by active recall theory, which states that actively recalling information is more effective than just passive reading (Roediger & Butler, 2011).

The findings suggest that reading techniques that involve additional physical activity (such as typing and writing) are more effective in improving comprehension and retention. Read-memorize techniques that rely solely on passive memory skills are less effective and support the forgetting curve theory. Thus, practically speaking, learning should involve typing or writing to improve comprehension.

However, in addition to these techniques, there are other factors in successful reading comprehension. Students who use cognitive and metacognitive strategies in reading have better comprehension (Pressley & Afflerbach, 1995). Intrinsic motivation also plays a major role in student engagement with reading activities. Highly motivated students also tend to be more actively involved in the reading process and achieve better results (Schunk & Zimmerman, 2008). In addition, the social environment, including support from parents and teachers, greatly influences reading interest and success. Collaboration between habituation at home (parents) and learning on campus can increase students' engagement in reading (Boerma et al., 2018; Wang et al., 2022; Yeo et al., 2014). Interactive learning methods, including the use of technology and collaborative activities can also increase student engagement and success in reading (Kucan & Beck, 1997). This concept is further reinforced by the multimodal learning approach in the context of higher education, which emphasises the importance of providing students with opportunities to access information through various sensory channels in order to form a fuller and deeper understanding (Moreno & Mayer, 2007).

Other factors that influenced the inter-group results in this study included participants' dominant learning styles, previous learning experiences, and concentration levels at the time of treatment. For example, participants who are more accustomed to visual or auditory methods may show different responses despite uniform treatment. In addition, the atmosphere of the study room, the emotional readiness of the students, and the time of implementation may also be indirectly influencing factors.

Practically, these findings provide important implications for the world of higher education, especially in designing reading learning strategies. Lecturers and educators can integrate kinesthetic techniques such as read-write or read-type into exploratory lecture assignments. For example, reading assignments are accompanied by the activity of taking notes, summarising with handwriting, or retyping the contents of the reading in their own language. This strategy not only improves comprehension, but also trains critical thinking skills, organises information, and prepares students for more complex academic tasks.

Although the results of this study show the effectiveness of kinesthetic techniques, this study has some limitations that need to be considered. One of them is the potential variation in participants' initial reading ability that cannot be fully controlled despite the purposive sampling method. Although the texts used were standardised, differences in academic background, personal interest in reading, as well as learning strategies commonly used by students may affect the results. In addition, the complexity of the reading texts used may also affect the effectiveness of certain techniques. Texts with a high level of abstraction may be more suitable for read-write techniques, while descriptive texts may be quite effective with read-aloud techniques. This suggests that the effectiveness of reading techniques is not only influenced by the type of technique, but also by the characteristics of the text and the readers. Therefore, further research is recommended to control these variables more strictly and use a more heterogeneous population.

Conclusion

Based on the analysis that has been carried out, it can be concluded that reading techniques that involve motor aspects (kinesthetic), namely read-write and read-type techniques provide better understanding compared to other reading techniques (read-aloud and read-memorize). Therefore, reading techniques have different influences on comprehension and retention of information. In other words, read-write techniques and read-type techniques have proven to be more effective than other methods in improving comprehension. In contrast, the read-memorize technique has the lowest effectiveness due to the lack of information reinforcement. Although the read-type technique has shortcomings in terms of eye health, based on the data obtained, the technique is still effective when compared to read-aloud and read-memorize techniques.

The implication of the results of this analysis is that students are advised not only to read passively, but also to record or retype the information learned. Students can also combine techniques, namely combining read-aloud or read-memorize with writing or typing so that it is expected to improve comprehension better than just reading and remembering. Additionally, teachers can apply active learning techniques, such as taking notes or typing summaries after reading to improve student comprehension. For further research, experiments can be carried out by considering additional factors, such as the type of reading material, reading duration, and individual learning style preferences.

Declarations

- Author contribution** : Marlia responsible for the entire research project, including conceptualization, data collection, analysis, and manuscript writing. She also led the writing of the manuscript and the collaboration with the second author. Tran Quoc Si participated in checking the grammar of the English used. He also revised the manuscript. Both authors approved the final manuscript.
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- Conflict of interest** : Both authors declare that they have no competing interests.
- Ethics Approval** : Information on Ethics Approval and informed consent statements are required for all articles published in BAHASTRA since 2025.
- Additional information** : No additional information is available for this paper

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