



Original research article

Study of the effect of conversations in memorization activities on short-term memory, drowsiness level, and heart rate of college students

Grace Vania, Elty Sarvia , Novi Soesilo

Bachelor Program in Industrial Engineering, Universitas Kristen Maranatha, Jl. Surya Sumantri No. 65, Bandung 40164, Jawa Barat, Indonesia

ARTICLE INFO

Article history:

Received 12 October 2024

Received in revised form 9 June 2025

Accepted 22 June 2025

Published online 29 June 2025

Keywords:

Conversation

Short-term memory

Drowsiness level

Heart rate

Editor:

Bobby Kurniawan

Publisher's note:

The publisher remains neutral regarding jurisdictional claims in published maps and institutional affiliations, while the author(s) bear sole responsibility for the accuracy of content and any legal implications

ABSTRACT

Memory and concentration are essential for memorization activities. Concentration can be disrupted by conversation, as it requires managing multiple tasks simultaneously, such as focusing on memorization and engaging in conversation. Sounds may reduce or induce drowsiness, and loud noises can increase heart rate. Based on this background, this study analyzed the effects of conversation during memorization activities on short-term memory, drowsiness levels, and heart rate in college students. Short-term memory was measured using the Task Short-Term Memory test, drowsiness levels were assessed with the Stanford Sleepiness Scale, and heart rate was measured with an oximeter. The results were analyzed using the Paired Sample t-test and Pearson Correlation Test to examine relationships between variables. The findings showed that conversation affects short-term memory but has no significant impact on drowsiness levels or heart rate. The study recommends avoiding conversation during study sessions, though occasional conversation may help reduce drowsiness. Additionally, a quiet environment is recommended for memorization activities.

1. Introduction

Memory and concentration are important factors in achieving a successful learning process because these two factors are related to a person's ability to obtain and retain the information learned. Memory is especially needed in a learning process that requires the ability to memorize. Memory plays a crucial role in human learning and productivity, garnering growing interest in its functionality and application in daily life [1]. Memory can be categorized into two main types: short-term memory, which holds information temporarily for a short duration (typically around 30 seconds), and long-term memory, which can store a vast amount of information indefinitely [2]. Concentration can be influenced by environmental factors, such as sound. Conversation is thought to split learning concentration because there is more than one task being carried out at the same time, that is concentrating on learning and the

demands of answering conversations. This cognitive load can make it harder for someone to absorb and recall information effectively, as their attention is divided between learning and responding to conversations.

In higher education, memorization and repetition have been linked to better academic performance. A study conducted in Saudi Arabia showed that verbatim word and verse memory moderately predicted GPA, emphasizing the benefits of repetition for academic success [3]. Meanwhile, a study indicates that combining inquiry-based teaching and cooperative learning in physics laboratory classes enhances participation and active thinking among mechanical engineering students [4]. Yaketunis Foundation highlights that effective Qur'an memorization for visually impaired students relies on tailored communication methods and appropriate learning media [5].

*Corresponding author:

Email: elty.sarvia@eng.maranatha.edu<http://dx.doi.org/10.62870/jiss.v11i2.29125>

These studies underline that structured and repeated practice, combined with supportive learning environments, significantly boosts memory retention and academic outcomes. The study of cognitive offloading in memory tasks also supports the idea that external strategies can enhance memory performance. The strategic offloading of delayed intentions into the external environment and the impact of external aids on cognitive processes were discussed [6]. Furthermore, metacognitive beliefs play a significant role in guiding individuals' use of body and environmental cues during cognitive tasks [7].

According to Morrison and Richmond, cognitive offloading can serve as an effective compensatory strategy to improve memory-based tasks across various memory abilities [8]. Regular short-term memory training has also proven effective in increasing memory capacity and information retention, particularly in structured learning environments like language acquisition [9]. Large-scale studies have found that higher-grade students tend to employ abstract grouping strategies for word recognition more effectively [10], while teacher-led learning strategies have been shown to improve comprehension and memory retention [11].

The role of social and contextual learning in enhancing memory retention is further supported by Soviet scholars Vygotsky, Voloshinov, and Ilyenkov, who argue that memory is fundamentally social, shaped by interpretative skills and social activities, challenging the Western view of memory as solely an individual mental process [12]. This perspective aligns with the concept that conversations and social interactions during learning activities could influence not only cognitive performance but also physiological responses, such as heart rate and drowsiness.

Various external stimuli have been studied for their impact on memory and concentration during learning activities. Research has examined the influence of syntactical and numerical concepts using a between-subject design without considering environmental distractions or physiological responses [13]. Similarly, research by [14] examined the effect of color perception on short-term memory, demonstrating that color stimuli can enhance memory retention.

These studies demonstrated that external stimuli could influence memory retention, but they did not account for auditory disturbances like conversational sound or physiological responses such as heart rate and drowsiness levels during memorization activities. In addition, background noise has been shown to negatively affect cognitive performance, with fluctuating city street sounds leading to increased cognitive load and poorer performance on secondary tasks [15].

These findings suggest that many studies primarily focus on environmental noise or isolated distractions, overlooking the complexities of real-world settings where conversations are frequent in learning environments. Furthermore, poor sleep habits have been shown to negatively impact concentration,

memory performance, and overall cognitive function, leading to decreased focus and reduced memory retention in academic settings [16], [17]. Although these findings highlight how external stimuli can affect learning, many studies still focus mainly on visual cues or simple background noise. The potential impact of conversational sound, the kind of everyday chatter that happens in classrooms or study groups, remains largely unexplored.

This gap is significant because conversations are a common part of learning environments, yet we know very little about how they affect both mental focus and physical responses like heart rate and drowsiness. To bridge this gap, this study explores how conversational sound influences short-term memory, drowsiness levels, and heart rate among college students. To achieve this, the research uses the Task Short-Term Memory method for measuring memory performance, the Stanford Sleepiness Scale (SSS) to assess drowsiness, and an oximeter to monitor heart rate. These tools help capture not just the mental impact of conversational sound, but also its physical effects on the body. Noise can accelerate heart rate, increase blood pressure, cause stress disorders, affect emotional stability, disrupt communication, and reduce motivation. Therefore, monitoring heart rate during the experiment helps determine whether conversational sound is perceived as a form of noise. Based on previous research, one of the common distractions in learning environments is noise from classmates who engage in conversations [18]. However, specific studies examining the direct impact of conversational sound during memorization activities on short-term memory, drowsiness, and heart rate remain limited.

This study seeks to fill that gap by offering valuable insights into how everyday conversations influence not only cognitive performance but also physiological responses during learning activities. By understanding these interactions, the study aims to provide insights for creating learning environments that reduce distractions, improve focus, and support better memory retention.

However, it can be stated that there have been no specific studies addressing the impact of conversation during memorization activities on college students' short-term memory, drowsiness levels, and heart rate. The novelty of this research lies in its objective, which is to analyze the effect of conversation during memorization activities on college students' short-term memory, drowsiness level, and heart rate.

This study seeks to offer valuable insights into how social interactions influence cognitive functions and physiological reactions during learning activities in a college environment, presenting a distinctive viewpoint on the relationship between interpersonal communication and memory capabilities within this specific student cohort. Furthermore, this research will propose a better learning environment that college students can choose for memorization activities.

2. Material and method

This section presents the research methodology which consists of research limitations (subsection 2.1), selection of respondents (subsection 2.2), research measurement tools (subsection 2.3), research procedures (subsection 2.4), raw data (subsection 2.5) and data processing methods (subsection 2.6).

2.1. Research limitations

The respondents selected to represent the entire population studied are college students because the purpose of this research is related to the environmental conditions of college student memorization. This research is experimental in the laboratory and data collection in the Industrial Engineering study room at Maranatha Christian University. This room was chosen with the expectation that it accurately reflects the actual conditions of the study area. The data collection timeframe was between 08.00 and 17.00 WIB (GMT + 7) to capture the average lecture hours, which typically range from 08.00 to 17.00 WIB. During data collection, respondents were in a sitting position to simulate the usual learning process conditions, which are generally conducted in a seated position.

The research variables consist of an independent variable which is conversation, and the dependent variables which are short-term memory, drowsiness level, and heart rate. Each respondent will receive 2 treatments. Treatment 1 before receiving the conversation and treatment 2 after receiving the conversation. This method allows for a direct comparison of results between the two groups, making it possible to determine whether conversation has a significant effect on short-term memory. The experiment provides clear and measurable quantitative data, facilitating robust statistical analysis to obtain valid findings.

2.2. Selection of respondents

The respondents in this study are 10 college students who were previously selected using a memory test as part of the intelligence test in the psychological assessment. In the test, the respondents were asked to memorize 24 vocabulary words within a time frame of 3 minutes [19]. Next, the respondents answered 20 multiple-choice questions within a maximum time limit of 6 minutes [20]. The data obtained from the test is the number of correct answers out of a total of 20 questions given. The maximum score that can be obtained is 20 points. The sample selected for further data collection consists of respondents who scored close to the average value, as they can represent most of the entire population and accurately depict real-life conditions.

The respondents in this research must meet the requirements of being free from arrhythmia, sleep debt, and insomnia, as well as refrain from consuming caffeine before data collection. Each respondent must be free from these three conditions because individuals

with arrhythmia have an irregular heartbeat rhythm, which can be either irregular, too slow, or too fast [21]. In this study, the respondents' heart rate will be measured and serve as one of the dependent variables. Therefore, if a respondent has arrhythmia, any changes in heart rate during data collection may be influenced by their heart rhythm disorder.

Additionally, respondents must be free from sleep debt because sleep debt can cause excessive sleepiness, difficulties in concentration, and subsequently affect memory and cognitive abilities. If sleep debt persists, memory and cognitive abilities will decline [22]. In this study, memory capacity and level of drowsiness are also dependent variables to be investigated. Thus, if a respondent experiences sleep debt, any decline in short-term memory may be influenced by their sleep deprivation rather than solely by the independent variables in the study. Furthermore, if there is an increase in the level of drowsiness among respondents, it may also be influenced by their sleep debt rather than solely by the independent variables in this study.

Respondents must also be free from insomnia because individuals with insomnia remain drowsy and do not feel refreshed upon waking up. Suppose a respondent has insomnia and experiences high levels of drowsiness during data collection. In that case, it may be due to their unmet sleep needs or inadequate sleep duration compared to the normal sleep duration.

Respondents in this study are not allowed to consume caffeine before data collection because caffeine can impact a decrease in sleepiness levels, and consuming caffeine in appropriate doses can have a positive impact on improving human memory performance [23]. In this study, the short-term memory capacity and drowsiness level of the respondents will be measured and serve as dependent variables. Therefore, if respondents consume caffeine before data collection, any improvement in short-term memory capacity may be influenced by the caffeine consumed rather than solely by the independent variables in the study. Additionally, if there is a decrease in the level of drowsiness among respondents, it may also be influenced by the caffeine consumed rather than solely by the independent variables in this study.

2.3. Measurement tools

The measurement tools used in this study are Task Short-Term Memory to measure short-term memory, Stanford Sleepiness Scale to measure drowsiness, and an oximeter to measure heart rate.

2.3.1. Task Short-Term-Memory

Task Short-Term Memory is used to measure the respondent's short-term memory. During the data collection process, respondents will memorize 40 words from 5 different categories. The time given to memorize the 40 words is 5 minutes [24]. Next, the respondent will rewrite the words that have been memorized on the Task Short-Term Memory answer sheet [25].

Table 1
Stanford Sleepiness Scale questionnaire

Degree of sleepiness	Rating
Feeling active, vital, alert, or wide awake	1
High-functioning, not at peak, can concentrate.	2
Awake, but relaxed; responsive but not fully alert	3
Somewhat foggy, let down	4
Foggy; losing interest in remaining awake; slowed down	5
Nearing sleep, dream-like thoughts.	6
Asleep	7

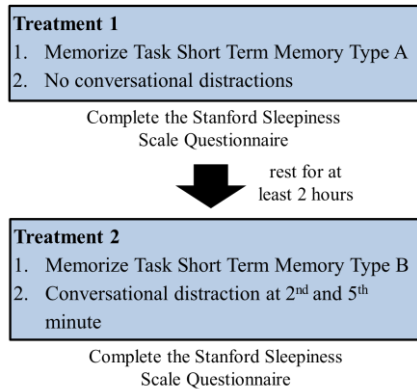


Fig. 1. Research procedure.

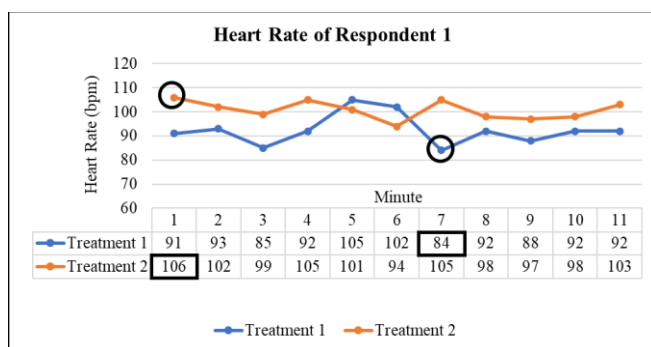


Fig. 2. The heart rate changes for respondent 1.

The time given to fill in the answer sheet is a maximum of 6 minutes, so the total data collection time for each treatment is a maximum of 11 minutes.

In this study, each respondent will receive 2 treatments, and the words memorized in each treatment will be different, so there is Task Short-Term Memory Type A for treatment 1 and Task Short-Term Memory Type B for treatment 2. The data from these measurements are the total number of correct words successfully memorized by respondents from all categories, where the maximum score is 40 points.

2.3.2. Stanford Sleepiness Scale

Stanford Sleepiness Scale is used to measure drowsiness. The indicators of drowsiness in this questionnaire are in the range of 1 to 7. A high scale means a high level of perceived sleepiness [26]. This method is appropriate because this scale is a validated tool commonly used in research related to sleepiness and alertness. This scale provides reliable and

consistently interpretable data, allowing researchers to correlate levels of sleepiness with short-term memory performance. The Stanford Sleepiness Scale questionnaire used in this study is shown in Table 1.

2.3.3. Oximeter

The oximeter is used to measure heart rate during the 11 minutes of treatment and the average heart rate data will be used for further data processing. To measure heart rate, an oximeter will be attached to the respondent's hand during data collection. Heart rate is an effective indicator for providing a direct insight into the body's response to external stimuli. Heart rate data can determine whether conversations are perceived as disturbances, offering insights into how social interactions affect students' physiological conditions.

2.4. Research procedure

The research procedure is explained in Figure 1. Each respondent will receive two treatments. Treatment 1 before receiving the conversation and treatment 2 after receiving the conversation. In treatment 2, respondents are invited to engage in simple conversations related to daily life during the 2nd and 5th minutes, with each conversation lasting for 1 minute. The conversation is introduced in the 2nd minute to provide a distraction in the middle of the memorization process. Additionally, another conversation is introduced in the 5th minute, considering that the distraction occurs when the respondent is completing the memorization process and attempting to recall the information stored in memory. During the treatment, the respondent's ability to remember will be measured using the Task Short-Term Memory, and their heart rate will also be recorded. Furthermore, the respondents will complete the Stanford Sleepiness Scale questionnaire to assess the level of sleepiness experienced during each treatment.

2.5. Raw data

2.5.1. Graph of heart rate changes

During the treatment, the respondent's heart rate was measured, and the changes were recorded every 1 minute so that the highest and lowest heart rates can be identified. Changes in heart rate for each respondent are presented in graphical form to make it easier to understand.

Respondent 1's heart rate was at its highest point in the 1st minute of treatment 2, which was 106 bpm, while the lowest point of respondent 1's heart rate was in the 7th minute of treatment 1, which was 84 bpm. The graph of respondent 1's heart rate can be seen in Fig. 2.

Respondent 2's (see Fig. 3) heart rate was at its highest point in the 5th minute of treatment 2, which was 156 bpm, while the lowest point of respondent 2's heart rate was in the 11th minute of treatment 2, which was 120 bpm.

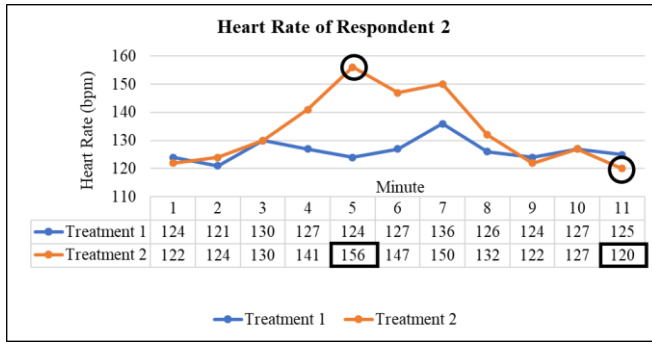


Fig. 3. The heart rate changes for respondent 2.

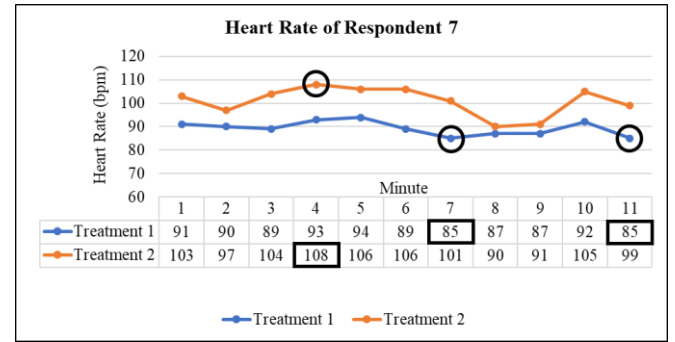


Fig. 8. The heart rate changes for respondent 7.

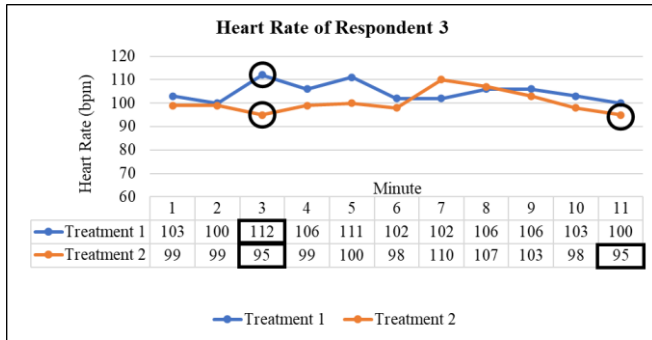


Fig. 4. The heart rate changes for respondent 3.

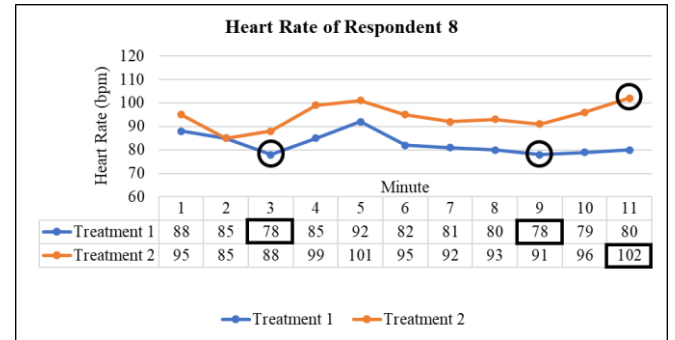


Fig. 9. The heart rate changes for respondent 8.

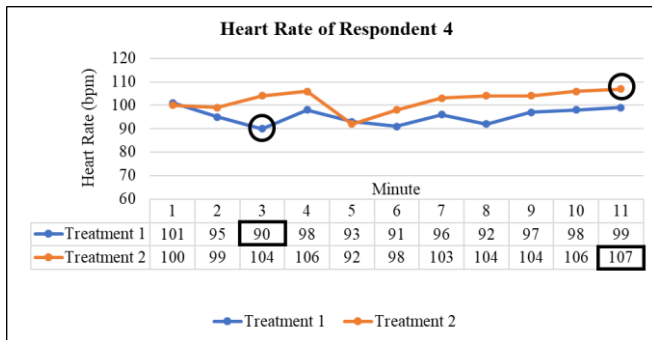


Fig. 5. The heart rate changes for respondent 4.

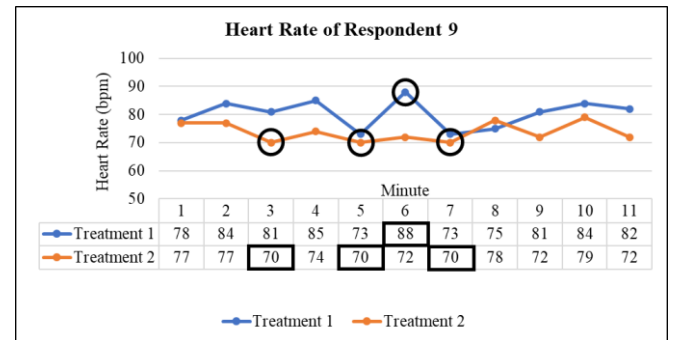


Fig. 10. The heart rate changes for respondent 9.

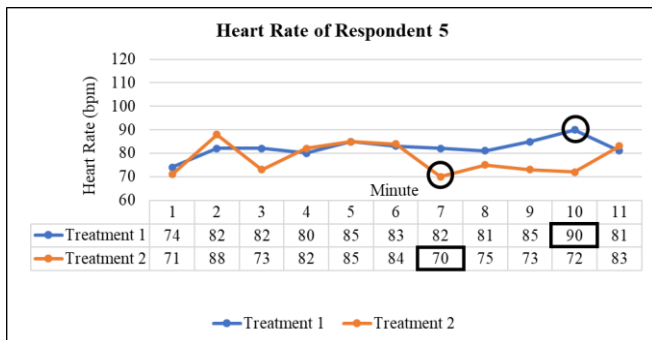


Fig. 6. The heart rate changes for respondent 5.

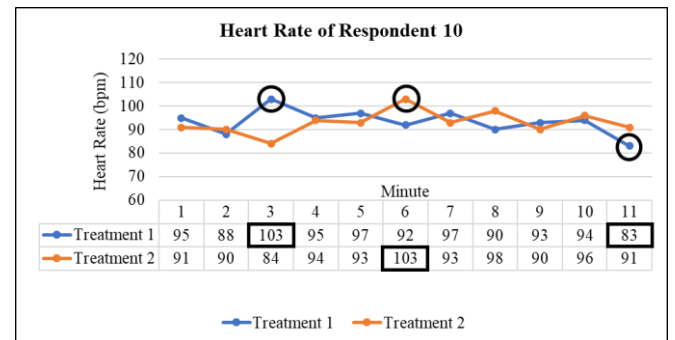


Fig. 11. The heart rate changes for respondent 10.

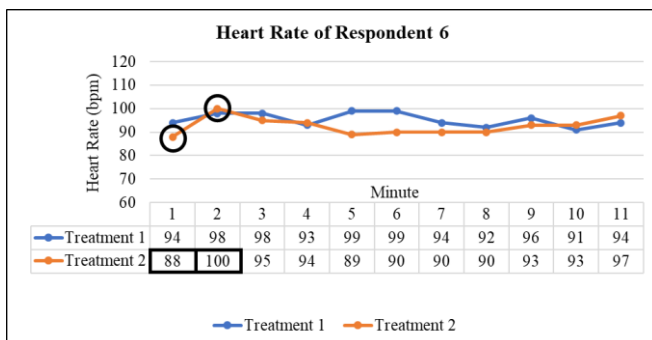


Fig. 7. The heart rate changes for respondent 6.

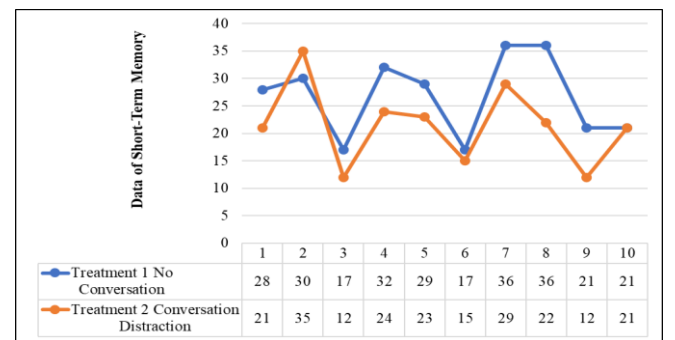


Fig. 12. Total score from Short-Term memory.

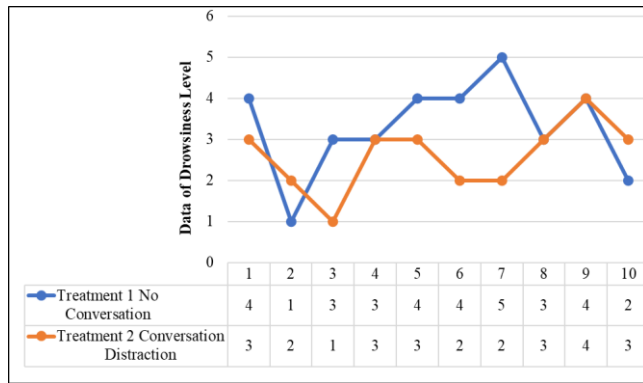


Fig. 13. Drowsiness level.

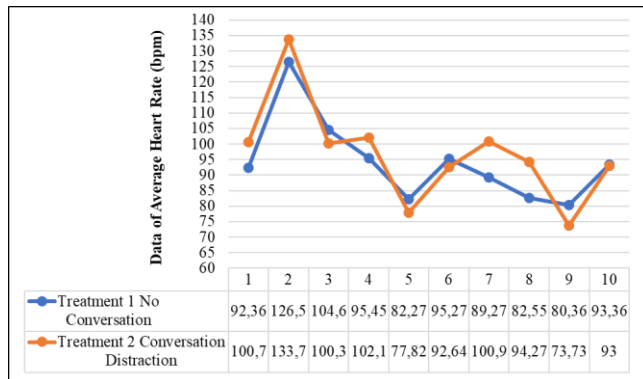


Fig. 14. Average heart rate.

For Respondent 3, the peak heart rate of 112 bpm occurred during the third minute of Treatment 1, while the lowest heart rate, 95 bpm, was recorded in both the third and eleventh minutes of Treatment 2. Refer to Fig. 4 for a graphical representation of Respondent 3's heart rate. Respondent 4 reached a maximum heart rate of 107 bpm in the eleventh minute of Treatment 2, with the lowest rate of 90 bpm observed in the third minute of Treatment 1. See Fig. 5 for Respondent 4's heart rate graph.

The highest heart rate for Respondent 5, recorded at 90 bpm, was in the tenth minute of Treatment 1, whereas the lowest, at 70 bpm, occurred in the seventh minute of Treatment 2. Fig. 6 illustrates Respondent 5's heart rate data. Respondent 6's heart rate peaked at 100 bpm during the second minute of Treatment 2 and dropped to its lowest point of 88 bpm in the first minute of the same treatment. The heart rate graph for Respondent 6 is shown in Fig. 7.

For Respondent 7, the heart rate reached a high of 108 bpm in the fourth minute of Treatment 2, while it fell to 85 bpm during both the seventh and eleventh minutes of Treatment 1. Fig. 8 displays Respondent 7's heart rate trends. Respondent 8 recorded a peak heart rate of 102 bpm in the eleventh minute of Treatment 2, with the lowest rate of 78 bpm occurring in the third and ninth minutes of Treatment 1. The heart rate graph for Respondent 8 is presented in Fig. 9.

The heart rate of Respondent 9 hit a maximum of 88 bpm in the sixth minute of Treatment 1, while it reached a low of 70 bpm during the third, fifth, and seventh minutes of Treatment 2. Fig. 10 provides a visual depiction of Respondent 9's heart rate.

Respondent 10's heart rate peaked at 103 bpm in both the third minute of Treatment 1 and the sixth minute of Treatment 2, with the lowest rate of 83 bpm recorded in the eleventh minute of Treatment 1. See Fig. 11 for Respondent 10's heart rate graph.

2.5.2. Summary of data collection

The result of the data collection on short-term memory before and after conversation is shown in Fig. 12, the result of data collection on drowsiness level before and after conversation is shown in Fig. 13, and the average heart rate before and after conversation is shown in Fig. 14.

2.6 Data processing methods

Data processing was conducted using a Paired Sample t-test to determine the effect of conversation on students' short-term memory, drowsiness level, and heart rate. Additionally, the Pearson Correlation Test was employed to assess the relationship between variables. The structure of the hypothesis for data processing with the Paired Sample t-test in this study is as:

- 1) H_{01} : there is no significant difference between short-term memory before conversation and short-term memory after conversation.
- 2) H_{02} : there is no significant difference between drowsiness level before conversation and drowsiness level after conversation.
- 3) H_{03} : there is no significant difference between heart rate before conversation and heart rate after conversation.

Data processing uses IBM SPSS Statistics 21 and hypothesis decision-making is determined based on the following conditions [27]:

- 1) Accept H_0 if the value of Sig (2-tailed) > 0,05 means that there is no significant difference between data before conversation and data after conversation.
- 2) Reject H_0 if the value of Sig (2-tailed) $\leq$ 0,05, means that there is a significant difference between data before conversation and data after conversation.

The structure of the hypothesis for data processing with the Pearson Correlation Test in this study are:

- 1) H_{01} : there is no correlation between short-term memory and drowsiness level.
- 2) H_{02} : there is no correlation between short-term memory and the average heart rate.
- 3) H_{03} : there is no correlation between the level of drowsiness and the average heart rate.

Data processing uses IBM SPSS Statistics 21. One variable with other variables correlates if the Sig (2-tailed) value < 0.05 (reject H_0) [28]. The closeness of the relationship in the Pearson Correlation Test is determined by the correlation value which can be grouped in Table 2 [29].

Table 2
Interpretation of correlational values

Correlation value	Interpretation
0.00 – 0.20	Very weak correlation
0.20 – 0.40	Weak correlation
0.40 – 0.70	Moderate correlation
0.70 – 0.90	Strong correlation
0.90 – 1.00	Very strong correlation

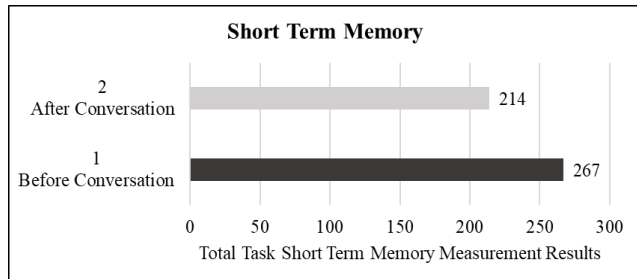


Fig. 15. Short-term Memory measurement results.

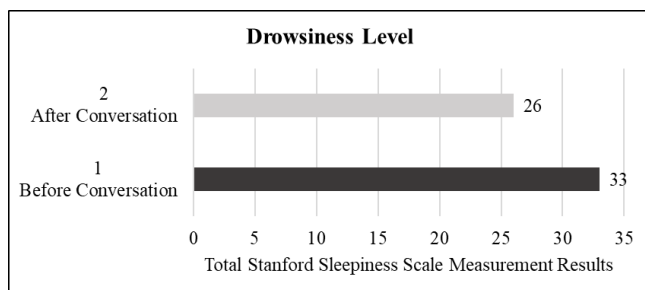


Fig. 16. Drowsiness level measurement results.

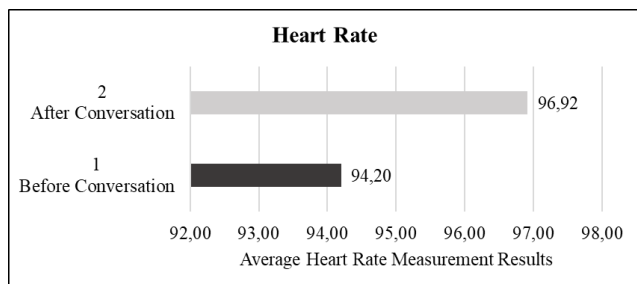


Fig. 17. Heart rate measurement results.

3. Results and discussions

3.1. Analysis of short-term memory measurement results

The Paired Sample t-test results indicate a Sig (2-tailed) value of 0.011 (≤ 0.05), leading to the rejection of H_{01} . This suggests a significant difference in short-term memory before and after conversation, confirming that conversation significantly impacts college students' short-term memory. The measurement results are shown in Fig. 15.

Short-term memory scores decreased after conversation, indicating a negative effect on memorization. In treatment 1 (before conversation), the total score for the Short-Term Memory Task was 267 points, while in treatment 2 (after conversation), it dropped to 214 points—a decline of 53 points. This

reduction likely stems from cognitive interference caused by engaging in conversation during learning, leading to divided attention. Conversations act as cognitive distractions, with their impact varying based on the conversation's complexity and the memorization task's context. More complex conversations exacerbate the negative effect on short-term memory [30].

3.2. Analysis of drowsiness level measurement results

The Paired Sample t-test yielded a Sig (2-tailed) value of 0.132 (> 0.05), leading to the acceptance of H_{02} . This indicates no significant difference in drowsiness levels before and after conversation, suggesting that conversation does not significantly affect college students' drowsiness. The results are presented in Figure 16.

Figure 16 shows that the total drowsiness score across all respondents was 33 in treatment 1 (before conversation) and 26 in treatment 2 (after conversation). Although the t-test found no significant difference, drowsiness levels were slightly lower during conversation-aided memorization. While conversations impair short-term memory, occasional dialogue may help reduce drowsiness and enhance alertness, as supported by prior studies [31]. Additionally, research indicates that 5% of respondents use conversations to combat drowsiness [32]. To maintain concentration, a 20-minute rest after learning is recommended, ideally in a quiet environment, as 63.5% of students prefer such settings for memorization [33].

3.3. Analysis of heart rate measurement results

The Paired Sample t-test yielded a Sig (2-tailed) value of 0.257 (> 0.05), leading to the acceptance of H_{03} . This indicates no significant difference in heart rate before and after conversation, suggesting that conversation does not significantly affect college students' heart rate. The results are presented in Fig. 17.

Noise can influence heart rate acceleration [34]. However, Fig. 17 shows that the average heart rate across all treatments remains within the normal range, indicating that the treatments were not perceived as noisy. The respondents, aged 19–22 years, fall within the adolescent and adult categories, with a normal resting heart rate typically ranging from 60 to 100 bpm [35].

3.3. Analysis of relations between variables

The Pearson Correlation Test yielded a Sig (2-tailed) value of 0.595 (≥ 0.05) for the correlation between short-term memory and drowsiness levels, leading to the acceptance of H_0 . This indicates no significant correlation between these variables. The Pearson Correlation coefficient of 0.126 reflects a very weak positive correlation.

Similarly, the Sig (2-tailed) value for the correlation between short-term memory and heart rate is 0.259 (≥ 0.05), resulting in the acceptance of H_0 , suggesting no

significant correlation. The Pearson Correlation coefficient of 0.265 indicates a weak positive correlation between these variables.

However, the Pearson Correlation Test for the correlation between drowsiness levels and heart rate produced a Sig (2-tailed) value of 0.005 (< 0.05), leading to the rejection of H_0 . This confirms a significant correlation between drowsiness levels and heart rate. The Pearson Correlation coefficient of -0.604 indicates a moderate negative correlation, consistent with the theory that drowsiness is associated with a slower heart rate, reducing oxygen consumption in the brain and signaling the need for rest [36].

Conversation significantly impairs short-term memory but does not significantly affect drowsiness levels or heart rate. Based on these findings, students should avoid conversations during memorization, as they disrupt concentration and act as cognitive distractions, leading to attention lapses. While conversations reduce memory performance, occasional dialogue may help alleviate drowsiness by enhancing alertness, as supported by previous studies [37]. However, this study found no statistically significant effect of conversation on drowsiness levels. To optimize concentration, a 20-minute rest after learning or memorizing is recommended [37]. Additionally, students should choose quiet learning environments, as 63.5% of students prefer such settings for memorization [38].

4. Conclusions

This study reveals that conversations during memorization tasks disrupt short-term memory, leading to a noticeable decline in performance. However, no significant impact of conversations on participants' drowsiness levels or heart rate was observed. The analysis suggests that conversations increase cognitive load, impairing concentration and information retention. The lack of changes in drowsiness and heart rate indicates that the conversations in this experiment may not have been intense enough to elicit physical responses related to fatigue or stress.

This study has several limitations. First, the sample size was limited to 10 participants, which may reduce the statistical power and generalizability of the findings. Future studies with larger, more diverse samples are recommended to validate these results. Second, the nature of the conversations may have influenced their impact. Variations in content and complexity could affect cognitive load differently. Standardizing conversation type and topic in future research could minimize variability and improve data consistency.

Future studies could explore how conversational interruptions affect learning across diverse environments and cognitive tasks to better understand their impacts. Including more participants and varying conversation complexity could provide deeper insights into cognitive load's effect on memory performance.

Additionally, investigating environmental factors such as background noise, music, or peer interactions during memorization tasks could further clarify how auditory stimuli influence learning.

While this study highlights the impact of conversations on short-term memory, further research is needed to fully understand the complexities of cognitive distraction and its effects on learning efficiency.

References

- [1] H. Feng, "Memory studies of chunking and decay of memory," *Highlights in Science, Engineering and Technology*, vol. 36, pp. 709–714, Mar. 2023, doi: [10.54097/hset.v36i.5776](https://doi.org/10.54097/hset.v36i.5776).
- [2] K. H. Jawabri and M. Cascella, "Physiology, explicit memory," *StatPearls*, 2020. [Online]. Available: <https://www.ncbi.nlm.nih.gov/books/NBK554555/>.
- [3] M. Pilotti, H. Alkuhayli, and R. Al Ghazo, "Memorization practice and academic success in Saudi undergraduate students," *Learning and Teaching in Higher Education: Gulf Perspectives*, vol. 18, no. 1, pp. 19–31, 2022, doi: [10.1108/LTHE-08-2020-0030](https://doi.org/10.1108/LTHE-08-2020-0030).
- [4] C. Andersson and G. Kroisandt, "Combining cooperative learning with inquiry-based laboratory classes in engineering education," in *Proc. 2018 IEEE World Engineering Education Conf. (EDUNINE)*, Buenos Aires, Argentina, Mar. 2018, pp. 1–5, doi: [10.1109/EDUNINE.2018.8450961](https://doi.org/10.1109/EDUNINE.2018.8450961).
- [5] S. Rosyad and G. Pratisara, "Analysis interpersonal communication between Ustadz and Santri in Yaketunis dormitory: Case study of Al-Qur'an memorization activities in Yaketunis dormitory," *Symposium of Literature, Culture, and Communication (SYLECTION)*, vol. 3, no. 1, p. 600, Nov. 2023, doi: [10.12928/sylection.v3i1.14053](https://doi.org/10.12928/sylection.v3i1.14053).
- [6] E. F. Risko and T. L. Dunn, "Storing information in-the-world: Metacognition and cognitive offloading in a short-term memory task," *Consciousness and Cognition*, vol. 36, pp. 61–74, Nov. 2015, doi: [10.1016/j.concog.2015.05.014](https://doi.org/10.1016/j.concog.2015.05.014).
- [7] T. L. Dunn and E. F. Risko, "Toward a metacognitive account of cognitive offloading," *Cognitive Science*, vol. 40, no. 5, pp. 1080–1127, Jul. 2016, doi: [10.1111/cogs.12273](https://doi.org/10.1111/cogs.12273).
- [8] A. B. Morrison and L. L. Richmond, "Offloading items from memory: Individual differences in cognitive offloading in a short-term memory task," *Cognitive Research: Principles and Implications*, vol. 5, no. 1, p. 1, Dec. 2020, doi: [10.1186/s41235-019-0201-4](https://doi.org/10.1186/s41235-019-0201-4).
- [9] O. Bratel, M. Kostiuk, S. Bratel, I. Okhrimenko, and V. Filonenko, "Short-term memory training of students during foreign language learning," *Universal Journal of Educational Research*, vol. 8, no. 4, pp. 1596–1604, Apr. 2020, doi: [10.13189/ujer.2020.080453](https://doi.org/10.13189/ujer.2020.080453).
- [10] L. Hennok, K. Mädamürk, and E. Kikas, "Memorization strategies in basic school: Grade-related differences in reported use and effectiveness," *European Journal of Psychology of Education*, vol. 38, no. 3, pp. 945–961, Sep. 2023, doi: [10.1007/s10212-022-00630-z](https://doi.org/10.1007/s10212-022-00630-z).
- [11] E. Kikas et al., "Evaluating the efficacy of a teacher-guided comprehension-oriented learning strategy intervention

- among students in Grade 4," *European Journal of Psychology of Education*, vol. 37, no. 2, pp. 509–530, Jun. 2022, doi: [10.1007/s10212-021-00538-0](https://doi.org/10.1007/s10212-021-00538-0).
- [12] D. Bakhurst, "Social memory in Soviet thought," in *The Heart of the Matter*. Leiden, The Netherlands: Brill, 2023, pp. 65–88.
- [13] M. P. Baon, D. J. L. Tenorio, A. V. L. Almano, and C. L. B. Culajara, "Measuring student's memory recall of syntactical and numerical concepts: A one-time experimental research," *International Journal of Research and Innovation in Social Science*, vol. 9, no. 1, pp. 1616–1622, Jan. 2025, doi: [10.47772/IJRISS.2025.9010133](https://doi.org/10.47772/IJRISS.2025.9010133).
- [14] N. Fakhri et al., "Pengaruh persepsi warna terhadap memori jangka pendek," *Jurnal Psikologi Integratif*, vol. 5, no. 2, pp. 1–10, 2024.
- [15] A. Bockstael, P. Corthals, and D. Botteldooren, "Communicating information in noise: Speaker's and listener's perspective," in *Proc. INTER-NOISE and NOISE-CON Congr. Conf.*, Hamburg, Germany, Aug. 2016, pp. 1502–1506.
- [16] H. J. Lawson, J. T. Wellens-Mensah, and S. Attah Nantogma, "Evaluation of sleep patterns and self-reported academic performance among medical students at the University of Ghana School of Medicine and Dentistry," *Sleep Disorders*, vol. 2019, pp. 1–8, Jun. 2019, doi: [10.1155/2019/1278579](https://doi.org/10.1155/2019/1278579).
- [17] J. M. Schmickler, S. Blaschke, R. Robbins, and F. Mess, "Determinants of sleep quality: A cross-sectional study in university students," *International Journal of Environmental Research and Public Health*, vol. 20, no. 3, p. 2019, Jan. 2023, doi: [10.3390/ijerph20032019](https://doi.org/10.3390/ijerph20032019).
- [18] S. P. Does, O. Jiran, M. C. Lisa, and O. Vorina, "Analisis konsentrasi belajar siswa pada mata pelajaran matematika di kelas V SDN No 20 SP2 SKPH Manis Raya tahun ajaran 2018/2019," *Jurnal Pendidikan Matematika (J-PiMat)*, vol. 1, no. 2, pp. 57–68, 2019.
- [19] *Psikologi, Top One Psikotest Terlengkap*. Jakarta, Indonesia: Bintang Wahyu, 2018.
- [20] Raymond, R. Suhatman, and M. Dewi, "Pembangunan game memory training terhadap peningkatan short term memory (STM) pada anak SMP menggunakan speech recognition (Studi kasus: SMP Dharma Loka Pekanbaru)," *Jurnal Nasional Teknologi dan Sistem Informasi*, vol. 4, no. 2, pp. 61–72, Aug. 2018, doi: [10.25077/TEKNOSI.v4i2.2018.061-072](https://doi.org/10.25077/TEKNOSI.v4i2.2018.061-072).
- [21] Z. F. Reza and T. Suryana, "Aplikasi monitoring kesehatan dengan memanfaatkan smartwatch berbasis Android," *Jurnal Penelitian Mahasiswa Teknik dan Ilmu Komputer (JUPITER)*, vol. 2, no. 2, pp. 85–92, 2022, doi: [10.34010/jupiter.v2i2.8873](https://doi.org/10.34010/jupiter.v2i2.8873).
- [22] A. Dwiana, T. Sari, and D. Limanan, "Introducing sleep hygiene to the Church of Sidang Jemaat Allah Bethlehem Congregation, Bogor, West Java," *MITRA: Jurnal Pemberdayaan Masyarakat*, vol. 5, no. 1, pp. 61–70, May 2021, doi: [10.25170/mitra.v5i1.1806](https://doi.org/10.25170/mitra.v5i1.1806).
- [23] L. Novita and B. Aritonang, "Penetapan kadar kafein pada minuman berenergi sediaan sachet yang beredar di sekitar Pasar Petisah Medan," *Jurnal Kimia Saintek dan Pendidikan*, vol. 1, no. 1, pp. 37–42, 2017. [Online]. Available: <http://e-journal.sari-mutiara.ac.id/index.php/KIMIA/article/view/156>.
- [24] D. P. Wulandari, G. Setiawan, N. Kristina, and S. Wijaya, *Bedah Konsep Lolos Psikotest*. Depok, Indonesia: Magenta Media, 2021.
- [25] S. Y. Putra and E. K. Purwaningtyas, "Efek kertas warna kuning terhadap memori eksplisit," *Psikoislamika: Jurnal Psikologi dan Psikologi Islam*, vol. 15, no. 1, pp. 19–25, Jun. 2018, doi: [10.18860/psi.v15i1.6658](https://doi.org/10.18860/psi.v15i1.6658).
- [26] A. Rahadhi and Sriyanto, "Pengaruh beban kerja mental, kelelahan kerja, dan tingkat kantuk terhadap penurunan tingkat kewaspadaan perawat (Studi kasus di Instalasi Gawat Darurat Rumah Sakit Umum Puri Asih, Salatiga)," *Industrial Engineering Online Journal*, vol. 5, no. 2, pp. 1–12, 2016.
- [27] W. A. Sheilliarika, S. Maryani, and H. Efendi, "Pengaruh membatasi mobilitas kereta api guna mencegah COVID-19 dengan uji-T berpasangan (Paired Sample T-Test)," *Jurnal Ilmiah Matematika dan Pendidikan Matematika*, vol. 12, no. 2, pp. 43–48, Feb. 2020, doi: [10.20884/1.jmp.2020.12.2.3741](https://doi.org/10.20884/1.jmp.2020.12.2.3741).
- [28] W. R. Safitri, "Analisis korelasi Pearson dalam menentukan hubungan antara kejadian demam berdarah dengue dengan kepadatan penduduk di Kota Surabaya pada tahun 2012–2014," *Jurnal Ilmiah Keperawatan (Scientific Journal of Nursing)*, vol. 2, no. 2, pp. 21–29, 2016.
- [29] A. Hilmiyyah, O. S. Priatna, and I. Hamdani, "Hubungan kecerdasan emosional dengan akhlak siswa," *Inspiratif Pendidikan*, vol. 10, no. 2, pp. 86–97, Dec. 2021, doi: [10.24252/ip.v10i2.26461](https://doi.org/10.24252/ip.v10i2.26461).
- [30] S. Rauf and M. Pasra, "Karakteristik penggunaan ponsel pengemudi profesional kendaraan roda empat di Kota Makassar," in *Proc. 14th FSTPT Int. Symp.*, Pekanbaru, Indonesia, 2011, pp. 1–10.
- [31] D. R. Large, G. Burnett, V. Antrobus, and L. Skrypchuk, "Driven to discussion: Engaging drivers in conversation with a digital assistant as a countermeasure to passive task-related fatigue," *IET Intelligent Transport Systems*, vol. 12, no. 6, pp. 420–426, Aug. 2018, doi: [10.1049/iet-its.2017.0201](https://doi.org/10.1049/iet-its.2017.0201).
- [32] D. Y. Irfandi, W. D. Ratminah, E. Winarno, and D. Probawati, "Analisis beban kerja dan kelelahan kerja (fatigue) dengan alat L77 Lakassidaya pada operator dump truck di PT. Semen Indonesia (Persero) Tbk Kabupaten Tuban, Jawa Timur," in *Prosiding Temu Profesi Tahunan PERHAPI*, 2022, pp. 523–534.
- [33] S. Andhika, S. Floristia, and T. Alawiyah, "Pengaruh jarak tempat tinggal dengan kampus terhadap konsentrasi belajar mahasiswa di kelas," *Natural Science: Jurnal Penelitian Bidang IPA dan Pendidikan IPA*, vol. 6, no. 1, pp. 22–28, 2020, doi: [10.15548/nsc.v6i1.1553](https://doi.org/10.15548/nsc.v6i1.1553).
- [34] D. Rimantho and B. Cahyadi, "Analisis kebisingan terhadap karyawan di lingkungan kerja pada beberapa jenis perusahaan," *Jurnal Teknologi*, vol. 7, no. 1, pp. 21–27, 2015.
- [35] Z. F. Reza and T. Suryana, "Aplikasi monitoring kesehatan dengan memanfaatkan smartwatch berbasis Android," *Jurnal Penelitian Mahasiswa Teknik dan Ilmu Komputer (JUPITER)*, vol. 2, no. 2, pp. 85–92, 2022, doi: [10.34010/jupiter.v2i2.8873](https://doi.org/10.34010/jupiter.v2i2.8873).
- [36] I. K. Afandi, R. Ferdiana, and H. A. Nugroho, "Review: Musik dan denyut jantung pada era digital," *Jurnal Sistem*

Informasi Bisnis, vol. 4, no. 3, pp. 149–155, Jan. 2016, doi: [10.21456/vol4iss3pp149-155](https://doi.org/10.21456/vol4iss3pp149-155).

- [37] S. Floristia, S. Andhika, and T. Alawiyah, "Pengaruh jarak tempat tinggal dengan kampus terhadap konsentrasi belajar mahasiswa di kelas," *Natural Science: Jurnal Penelitian Bidang IPA dan Pendidikan IPA*, vol. 6, no. 1, pp. 22–28, 2020, doi: [10.15548/nsc.v6i1.1553](https://doi.org/10.15548/nsc.v6i1.1553).
- [38] N. F. Handayani and M. Mahrita, "Faktor penyebab kesulitan belajar matematika pada siswa kelas IV di SDN Jawa 2 Martapura Kabupaten Banjar," *Jurnal PTK dan Pendidikan*, vol. 6, no. 2, pp. 61–70, 2021.

CRediT author statement

Grace Vania: Conceptualization, Methodology, Writing-Original Draft, Supervision, Analysis and Interpretation, Formal Analysis, Editing. **Elty Sarvia:** Conceptualization, Methodology, Writing - Review & Editing. **Novi:** Conceptualization, Methodology, Review.

.Acknowledgement

The author would like to thank for the support of tools and facilities that have been provided by the Work Design Analysis and Ergonomics Laboratory, Universitas Kristen Maranatha. The authors also thank the respondents for their time and willingness to participate in this research.

Disclosure statement

The authors report there are no competing interests to declare.

Funding statement

The authors received no financial support for the research, authorship, and/or publication of this article.

Data availability statement

The authors confirm that the data supporting the findings of this study are available within the article or its supplementary materials.

AI Usage Statement

AI generative tools were employed to enhance the clarity and readability of this manuscript. The authors have thoroughly reviewed and edited the AI-assisted content to ensure its accuracy and alignment with the study's findings. Responsibility for the scientific content, conclusions, and integrity of the manuscript remains entirely with the authors. This statement is provided to ensure transparency and adherence to publisher policies.

Author information



Grace Vania is a high achieving Industrial Engineering student at Universitas Kristen Maranatha who graduated with cum laude honors in 2023. She actively participates in ergonomics research focusing on work system design and human factors, while also engaging in industrial management studies related to operational efficiency.



Elty Sarvia is a lecturer in the Bachelor's Program in Industrial Engineering at Universitas Kristen Maranatha (UKM), Indonesia, where she earned her undergraduate degree. She holds a Master's degree in Industrial Engineering and Management from Institut Teknologi Bandung (ITB). As part of her academic duties, she oversees the Work Measurement & Ergonomics Laboratory, focusing on ergonomic applications in industrial settings, including workplace safety, productivity improvement, and product design. Her research examines posture analysis, system design, and user-centered product development. She participates in Perhimpunan Ergonomi Indonesia (PEI) and has completed training in Design Thinking and New Product Development Manager 2024 (CNPDM).



Novi Soesilo holds a Bachelor's degree in Industrial Engineering from Universitas Kristen Maranatha, Bandung, and a Master's degree in Industrial Engineering and Management from Institut Teknologi Bandung (ITB). She has been a full-time faculty member at Universitas Kristen Maranatha since 2003.

Her teaching portfolio includes courses such as: Work System and Ergonomics Analysis, Operations Research, Introduction to Industrial Engineering, Leadership and Teamwork.

Her primary research interests lie in the field of ergonomics, with a particular emphasis on work system design and product design.