

Comparative effectiveness of Quizlet-based SDCL and Duolingo-based direct instruction on vocabulary mastery

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ABSTRACT

This quasi-experimental study aimed to examine the effectiveness of technology-integrated instructional methods—Quizlet-based Self-Directed Collaborative Learning (SDCL) and Duolingo-based Direct Instruction (DI)—in enhancing vocabulary mastery among senior high school students in Indonesia. Twenty-seven students from SMA Muhammadiyah 6 Makassar were divided into two groups: an experimental group ($n = 14$) taught using SDCL and a control group ($n = 13$) taught using DI. Both groups completed vocabulary pre- and post-tests. Statistical analyses included normality testing, descriptive statistics, N-Gain Score analysis, and an independent samples t-test. The results showed that both instructional approaches improved vocabulary mastery, with mean post-test scores rising from 42.4 to 71.2 in the experimental group and from 32.1 to 65.4 in the control group. N-Gain analysis revealed slightly higher gains in the control group ($M = 0.4839$) compared to the experimental group ($M = 0.4481$). However, the independent samples t-test ($p = 0.645$) indicated no statistically significant difference in vocabulary improvement between the two groups. These findings suggest that both methods are effective and may be employed complementarily to support vocabulary learning in secondary education.

Keywords: Direct Instruction, Duolingo, English Language Learning, N-Gain Score, Quizlet, Self-Directed Collaborative Learning

INTRODUCTION

Vocabulary is recognized as a core component in language acquisition and proficiency. It underpins the development of the four main language skills: listening, speaking, reading, and writing (Vedadi et al., 2018). Mastery of vocabulary is essential not only for basic comprehension but also for expressing complex ideas

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and engaging in meaningful communication (Schmitt et al., 2021). Students with limited vocabulary often struggle to understand content, articulate opinions, and participate effectively in academic discussions. Moreover, vocabulary knowledge is intricately linked to critical and creative thinking abilities, both of which are crucial for academic and life success (Labonté & Smith, 2022; Cosgun & Atay, 2021; Song et al., 2024; Kusuma et al., 2025).

Traditional vocabulary instruction methods, such as rote memorization, are increasingly seen as insufficient. Effective vocabulary acquisition requires intentional strategies that engage learners in meaningful use of words within context (McKeown, 2019). Comprehensive approaches that incorporate varied learning methods—such as interactive discussions, contextual usage, and self-assessment—are considered more effective. These strategies must be sustainable and adaptive to learner needs, promoting long-term vocabulary retention and application (Duan, 2017; Salehpour & Behnam, 2022; Wang, 2014).

Self-Directed Collaborative Learning (SDCL) is a pedagogical approach that empowers students to take control of their own learning while collaborating with peers. It merges autonomy with group dynamics to promote deeper engagement and reflection. According to Prayitno et al. (2022), SDCL fosters learners' ability to plan, implement, and evaluate their learning experiences. The collaborative aspect further enhances communication, teamwork, and leadership skills, while also supporting vocabulary development through peer interactions and feedback (Coll & Treagust, 2021; Sippel, 2019).

The integration of SDCL into language instruction not only improves students' lexical competence but also supports metacognitive growth. In group settings, learners exchange vocabulary knowledge and correct each other's errors, which accelerates language acquisition (Sun et al., 2022; Werdiningsih, 2022). Moreover, SDCL aligns well with 21st-century educational goals, emphasizing learner independence, adaptability, and social competence. In the digital age, the use of technology in education has become increasingly prevalent. Language learning applications such as Duolingo and Quizlet offer innovative and interactive platforms for vocabulary acquisition. These tools allow students to access personalized learning content, practice vocabulary in gamified environments, and receive instant feedback. The visual, auditory, and repetitive features of these applications enhance memory retention and learner motivation (Nguyen & Lê, 2023; Fu et al., 2021).

Technology also supports SDCL by enabling learners to study at their own pace, outside the constraints of the classroom (Karatas & Arpaci, 2021; Morris & Rohs, 2021). Platforms that facilitate communication and collaboration—such as forums, shared documents, and chat applications—allow learners to work together on vocabulary tasks regardless of physical location (Kim & Choi, 2023; Sukdee B, 2024). When integrated effectively, technology becomes a powerful enabler for both independent and collaborative learning (Al-Samarraie & Saeed, 2018; Bilová, 2018).

Previous studies have examined the role of technology and collaborative learning in vocabulary development with varying emphases. For instance, Zhoc et al. (2018)

highlighted how emotional intelligence and self-directed learning contribute to improved academic outcomes, while Aurellia et al. (2023) emphasized the effectiveness of blended learning in fostering learner autonomy. Similarly, Prayitno et al. (2022) demonstrated that collaborative constructivist strategies enhance students' understanding and peer interaction, and Karatas and Arpaci (2021) showed that self-directed learning supported by digital tools improves readiness for online learning. In contrast, Hamid and Sangkala (2023) reported that Duolingo-based direct instruction significantly improved vocabulary among junior high school students, underscoring the value of structured, gamified practice. Although these studies collectively affirm the importance of both collaborative and direct technology-enhanced approaches, few have directly compared their relative effectiveness within the same context. This gap is particularly evident in Indonesian secondary schools, where empirical evidence on the comparative impact of Quizlet-based SDCL and Duolingo-based direct instruction remains scarce. Vocabulary mastery is a fundamental component of language proficiency, as it supports learners' ability to comprehend, communicate, and engage in academic tasks. In recent years, self-directed collaborative learning (SDCL) supported by digital tools has been promoted as an effective approach to vocabulary acquisition. However, despite its advantages, many educational institutions in developing countries such as Indonesia still face challenges in adopting these methods. Limited access to resources, insufficient teacher training, and low levels of digital literacy among students remain significant barriers. Furthermore, the persistence of teacher-centered classroom practices often constrains the implementation of student-centered approaches like SDCL.

In the specific context of Senior High School Muhammadiyah 6 Makassar, these challenges are evident, as traditional learning structures dominate classroom practices and hinder active learner participation. Previous studies have highlighted the benefits of student-centered and technology-enhanced learning for promoting vocabulary growth and learner autonomy (Aurellia et al., 2023; Zhoc et al., 2018). Yet, there remains a lack of empirical evidence comparing different technology-integrated instructional models in Indonesian secondary education, particularly those that contrast collaborative and independent learning dynamics. This gap underscores the need to examine how SDCL integrated with tools such as Quizlet compares with direct instruction supported by applications like Duolingo in enhancing vocabulary mastery.

Therefore, the present study aims to investigate the comparative effectiveness of Quizlet-based SDCL and Duolingo-based Direct Instruction in improving students' vocabulary mastery. By addressing this gap, the study seeks to contribute both theoretically and practically. Theoretically, it extends the growing body of research on technology-supported vocabulary instruction by providing evidence from an underexplored educational setting. Practically, the findings will benefit teachers, students, and policymakers by offering insights into how collaborative and independent technology-enhanced approaches can be implemented to overcome persistent barriers in EFL classrooms. Ultimately, this research aspires to inform more effective pedagogical strategies that promote both linguistic competence and 21st-century learning skills among Indonesian learners.

METHODS

Research design

This study employed a quasi-experimental design using a nonequivalent control group (Creswell & Creswell, 2018). The participants consisted of 27 eleventh-grade students from Senior High School Muhammadiyah 6 Makassar, who were divided into two groups: an experimental group ($n = 14$) and a control group ($n = 13$). The experimental group was taught using Quizlet-assisted Self-Directed Collaborative Learning (SDCL), while the control group was taught through Duolingo-assisted Direct Instruction (DI). Both groups completed pre-tests and post-tests to measure changes in vocabulary mastery.

Instruments

The main research instrument was a vocabulary test designed to assess mastery of four-word classes: nouns, adjectives, verbs, and adverbs. The test was developed based on the school's English curriculum and validated through expert judgment to ensure content validity. The instrument was administered as both a pre-test and post-test to evaluate students' vocabulary gains. The reliability of the test was calculated using Cronbach's alpha, which indicated acceptable internal consistency (Field, 2013).

Data collection

The treatment was conducted over eight sessions, each lasting 60 minutes. In the experimental group, students engaged in SDCL activities, including independent exploration of new vocabulary, small group discussions, collaborative vocabulary tasks, and reinforcement using the Quizlet platform. This design aimed to combine learner autonomy with peer collaboration (Prayitno et al., 2022). In contrast, the control group followed a more structured, teacher-centered approach using Duolingo. Students practiced individually on the application under teacher guidance, focusing on repetitive exercises and immediate feedback features typical of Direct Instruction (Duan, 2017). All sessions were supervised to ensure consistency in implementation across groups.

Data analysis

Data analysis followed several steps. First, descriptive statistics were calculated to summarize pre-test and post-test scores. Second, the normalized gain (N-Gain) score was computed to measure the relative improvement in vocabulary mastery, following the formula introduced by Hake (1999). Third, normality testing was conducted using the Shapiro–Wilk test, which is suitable for small sample sizes (Razali & Wah, 2011). Finally, an Independent Samples t-test was applied to examine whether there were statistically significant differences in vocabulary gains between the experimental and control groups. Statistical analyses were performed using SPSS software version 25 (Kusumadewi, 2018).

RESULTS

To provide a clearer picture of students' vocabulary mastery before and after the implementation of the Quizlet-assisted Self-Directed Collaborative Learning (SDCL), the students' scores in the experimental class were categorized based on predetermined classification criteria. The classification helps to identify shifts in performance levels and the effectiveness of the treatment. The detailed classification of students' scores in the experimental class is presented in the following table:

Table 1. Classification score of students' Pre-test and Post-test Experiment Class

No	Classification	Score	Pre-Test	Post-Test
1	Very Good	85-100	0	3
2	Good	65-84	2	5
3	Fair	55-64	3	4
4	Poor	35-54	2	1
5	Very Poor	10-34	6	0
Average Score			42.4	71.2

Note: Data analysis results, 2025

The results presented in Table 1 show a substantial improvement in students' vocabulary mastery in the experimental class after the implementation of Quizlet-assisted Self-Directed Collaborative Learning (SDCL). Prior to the treatment, a significant number of students (6 out of 13) were categorized as Very Poor (scores between 10–34), and no students achieved a Very Good score (85–100). The average score before the intervention was 42.4, indicating generally low performance. Following the intervention, the number of students in the Very Poor category decreased to zero, and there was a marked increase in the number of students achieving higher classifications: 3 students reached the Very Good category and 5 students reached Good. The average score increased notably to 71.2, placing it in the "Good" classification range. These results suggest that the integration of Quizlet into SDCL was effective in enhancing students' vocabulary knowledge, shifting most students from low to moderate and high-performance levels. This outcome supports the hypothesis that technology-integrated collaborative learning fosters better vocabulary acquisition (Deng & Trainin, 2023).

Furthermore, to compare the effectiveness of the Direct Instruction (DI) method supported by Duolingo, the vocabulary scores of students in the control class were also classified based on the same criteria used in the experimental class. This classification aims to highlight changes in student performance before and after the intervention in the control group. The distribution of scores in the control class is presented in the following table.

Table 2. Classification score of students' Pre-test and Post-test Control Class

No	Classification	Score	Pre-test	Post-test
1	Very Good	85-100	0	1
2	Good	65-84	0	6
3	Fair	55-64	0	6

No	Classification	Score	Pre-test	Post-test
4	Poor	35-54	7	1
5	Very Poor	10-34	7	0
Average Score			32.1	65.4

The data in Table 2 indicate a significant improvement in students' vocabulary mastery in the control class following the implementation of Duolingo-assisted Direct Instruction (DI). In the pre-test, the majority of students were concentrated in the lower classifications: 7 students were in the Poor category (scores 35–54) and 7 students were in the Very Poor category (scores 10–34). Notably, no students reached the "Fair, Good, or Very Good" levels, and the average score was 32.1, which falls into the Very Poor classification.

After the intervention, there was a substantial upward shift. The Very Poor category was eliminated entirely, and only 1 student remained in the Poor category. A total of 12 students moved into the Fair (6 students), Good (6 students), and Very Good (1 student) categories. The average post-test score increased dramatically to 65.4, moving into the "Good" classification. These findings suggest that the Duolingo-assisted Direct Instruction method was effective in enhancing students' vocabulary skills. The transition from lower to higher classifications illustrates notable progress in student performance, reinforcing the value of structured, technology-supported vocabulary instruction (Hamid & Sangkala, 2023).

Before conducting an Independent Samples t-test to answer the research question regarding differences in vocabulary mastery between students taught using Quizlet-Based Self-Directed Collaborative Learning (SDCL) and Duolingo-Based Direct Instruction, a normality test was first conducted on the pre-test and post-test data of both groups. A normality test is necessary to ensure that the data meets the requirements for using parametric tests. At this stage, the Shapiro-Wilk test was used, as it is more suitable for small sample sizes ($n < 50$). The results of the normality test are presented in the following table:

Table 3. Normality Test Results of Pre-test and Post-test Data in Experimental Classes and Control Classes Using the Shapiro-Wilk Test

Group		Tests of Normality					
		Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Pre-test	Experiment Class	.163	13	.200*	.920	13	.253
	Control Class	.173	14	.200*	.925	14	.261
Post-test	Experiment Class	.160	13	.200*	.957	13	.714
	Control Class	.169	14	.200*	.879	14	.056

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

The results of the normality test using the Shapiro-Wilk Test show that all data on the pre-test and post-test for the experimental and control classes have significance values above 0.05 (Experiment Pre-test = 0.253; Experiment Post-test = 0.714; Control Pre-test = 0.261; Control Post-test = 0.056), which means that all data are

statistically normally distributed. Although the post-test value in the control class is close to the significance limit, the value remains within the acceptable threshold, so there is no violation of the normality assumption. Based on these results, it can be concluded that the data qualify for parametric analysis using Independent Samples t-Test, specifically to answer the third problem formulation regarding the difference in vocabulary acquisition between students taught using Quizlet-Based SDCL and Duolingo-Based Direct Instruction. The two independent samples t-test is appropriate because each group consists of different subjects and has met the basic assumption of normal distribution (Manik et al., 2023).

To find out whether there is a significant difference in vocabulary mastery between students taught using the Quizlet-based Self-Directed Collaborative Learning (SDCL) approach and students taught using the Duolingo-based Direct Instruction approach, the learning outcomes improvement value was calculated using the N-Gain Score formula (Ariffin, 2021). The N-Gain Score value is calculated based on the difference in pre-test and post-test scores obtained by each student from both groups, then followed by Independent Samples T-Test analysis using SPSS software (Wang, 2003). The data obtained is presented in the form of three statistical tables, namely: (1) Descriptive Statistics to see the average and distribution of the improvement scores of all participants, (2) Group Statistics to compare the average scores between the experimental and control classes, and (3) Independent Samples Test to test the significance of differences between the two groups. These three tables form the basis for assessing the relative effectiveness of the two learning approaches in improving students' vocabulary acquisition.

Descriptive statistics

To obtain a general overview of the students' vocabulary improvement across both groups, a descriptive analysis of the N-Gain Score was conducted. The N-Gain Score measures the relative effectiveness of the treatment in enhancing vocabulary mastery. The following table presents the minimum, maximum, mean, and standard deviation of N-Gain Scores from all participants in both the experimental and control classes.

Table 4. Table Descriptive Statistics N-Gain-Score

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
NGain_Score	27	.16	.93	.4667	.19104
Valid N (listwise)	27				

The Descriptive Statistics table shows that the mean value of the N-Gain Score of all study participants is 0.4667, with a minimum score of 0.16 and a maximum of 0.93. This indicates that in general there was an increase in student learning outcomes in vocabulary acquisition, both in the experimental and control classes. The standard deviation value of 0.19104 indicates the level of dispersion or diversity of improvement scores among students. The smaller the standard deviation value, the more homogeneous the improvement achieved by students (Field, 2013). This result shows that most students experienced an increase in learning outcomes that were in a fairly uniform range.

Group statistics

To further examine the effectiveness of the two instructional methods—Quizlet-assisted Self-Directed Collaborative Learning (SDCL) in the experimental class and Duolingo-assisted Direct Instruction (DI) in the control class—an N-Gain Score analysis was conducted. The N-Gain Score reflects the normalized gain in students' vocabulary mastery after treatment. The group statistics presented in the following table summarize the mean, standard deviation, and standard error of N-Gain Scores for both groups.

Table 5. Table Group Statistics

Group Statistics					
	Group	N	Mean	Std. Deviation	Std. Error Mean
NGain_Score	Experiment Class	13	.4481	.24670	.06842
	Control Class	14	.4839	.12709	.03397

The Group Statistics table shows that the average N-Gain Score for the experimental class is 0.4481, while the control class reaches 0.4839. This means that students in both groups experienced a fairly good increase in learning outcomes, but descriptively the control class was slightly higher than the experimental class. The standard deviation value for the experimental class is 0.24670, greater than the control class (0.12709), which means that the variation in learning outcomes in the experimental class is greater. Meanwhile, the standard error of mean value is higher in the experimental class (0.06842) than the control class (0.03397), indicating that the mean estimation of the experimental class against the population varies more. This finding suggests that although Quizlet-based learning in SDCL provides improvement, the results have not exceeded the achievement of the control class consistently (Creswell & Creswell, 2018).

Independent samples test

To determine whether there is a statistically significant difference in vocabulary improvement between the experimental group (Quizlet-assisted SDCL) and the control group (Duolingo-assisted DI), an Independent Samples t-Test was conducted. This test compared the mean N-Gain Scores of both groups. The results, including Levene's Test for equality of variances and the t-test for equality of means, are summarized in the following table.

Table 6. Independent Samples Test Analysis
Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	5.704	.025	-.479	25	.636	-.03576	.07470	-.18961	.11808
Equal variances not assumed			-.468	17.654	.645	-.03576	.07639	-.19648	.12495

The Independent Samples Test table shows that the Leven's Test value has a significance of 0.025, which is smaller than 0.05. This means that the variance of the two groups is not homogeneous, so the interpretation continues with the "Equal variances not assumed" line. The t-test results yielded a Sig. (2-tailed) of 0.645, which is greater than 0.05, so it can be concluded that there is no statistically significant difference between the N-Gain Score of the experimental and control classes. The mean difference value is -0.03576, with a 95% confidence interval (-0.19648 to 0.12495) that includes a value of zero, indicating that this difference could have occurred by chance. Thus, although both learning approaches (Quizlet-SDCL and Duolingo-Direct Instruction) improved vocabulary acquisition, the difference between them was not statistically significant (Gay et al., 2012).

A comparison between the two methods showed that both were effective in improving students' vocabulary acquisition. However, there was no statistically significant difference between the Quizlet-SDCL and Duolingo-Direct Instruction approaches. This shows that the success of learning is not solely determined by the method, but also by the context of implementation, student characteristics, and the integration between teaching strategies and media used (Velayati & Djalal, 2022). Quizlet-SDCL develops students' cognitive and affective aspects more independently and collaboratively, while Duolingo-Direct Instruction emphasizes system-based structure and repetition.

The differences reflect two complementary approaches in the context of language education. This is in line with Krashen's (1983) view, which emphasizes that optimal second language learning requires comprehensible input as well as an environment that supports both active engagement and independent exploration. Thus, the selection of learning methods should be tailored to the needs and characteristics of students. Teacher flexibility in combining collaborative and direct learning strategies is key to accommodating students' diverse learning styles (Creswell & Creswell, 2018).

DISCUSSION

The findings of this study demonstrate that both Quizlet-based Self-Directed Collaborative Learning (SDCL) and Duolingo-based Direct Instruction (DI) can significantly improve vocabulary mastery among EFL learners. Although the experimental group (SDCL) showed strong progress, the control group (DI) achieved a slightly higher mean N-Gain score. However, the difference was not statistically significant, suggesting that both instructional models are comparably effective.

This result aligns with previous research by [Labonté and Smith \(2022\)](#), which emphasized that technological integration into learning environments—regardless of instructional approach—can enhance learner motivation and vocabulary acquisition when properly scaffolded. Similarly, [Karatas and Arpaci \(2021\)](#) confirmed that self-directed learners, when supported with digital platforms, tend to show improved readiness and retention in online or blended language learning environments.

The effectiveness of the SDCL model in this study supports findings by [Zhoc et al. \(2018\)](#), who highlighted the role of emotional intelligence and collaborative engagement in promoting learner autonomy and academic performance. Quizlet, as used in this model, enabled students to co-construct meaning, reflect, and provide peer feedback—an instructional dynamic that fosters deeper vocabulary retention ([Prayitno et al., 2022](#)).

Meanwhile, the control group taught through Duolingo-based DI also demonstrated significant vocabulary gains. This supports [Duan's \(2017\)](#) argument that structured, repetitive exposure to vocabulary through gamified applications like Duolingo enhances memory encoding. Moreover, the structured nature of Direct Instruction aligns with the needs of learners who prefer clearly defined tasks and immediate feedback, as noted by [Schmitt et al. \(2021\)](#).

While both approaches yielded positive results, the greater variation in the SDCL group's N-Gain scores suggests differing levels of student engagement and collaboration quality ([Gaad, 2022](#)). This variation mirrors the findings of [Coll and Treagust \(2001\)](#), who noted that group-based models are highly dependent on group dynamics and individual initiative. In contrast, DI's lower standard deviation reflects more consistent performance gains, likely due to the uniformity of instruction and technology pacing.

Notably, the absence of a significant difference also echoes the work of [Laborda and Litzler \(2015\)](#), who found that method effectiveness in language learning is often context-dependent rather than method-dependent. Factors such as learners' familiarity with technology, prior exposure to collaboration, and classroom culture all mediate instructional impact. From a pedagogical perspective, these findings affirm the importance of instructional flexibility. While SDCL offers the advantage of peer interaction and learner autonomy, DI with Duolingo provides structured, individualized practice ([Permatasari & Aryani, 2023](#)). Rather than favoring one over the other, educators may consider integrating both—leveraging the strengths of collaborative and direct approaches to accommodate diverse learner needs

(Khonamri et al., 2020). To improve overall educational outcomes. This blended approach not only promotes engagement but also fosters a more inclusive learning environment that addresses students' diverse preferences and abilities (Kutubkhanah Alsaied, 2022).

CONCLUSION

This study aimed to compare the effectiveness of Quizlet-assisted Self-Directed Collaborative Learning (SDCL) and Duolingo-assisted Direct Instruction (DI) in enhancing vocabulary mastery among eleventh-grade students at Senior High School Muhammadiyah 6 Makassar. The findings revealed that both instructional methods led to substantial improvements in vocabulary acquisition. The average post-test scores increased significantly in both the experimental class (from 42.4 to 71.2) and the control class (from 32.1 to 65.4). In terms of normalized learning gains, the control group achieved a slightly higher mean N-Gain score of 0.4839 compared to 0.4481 in the experimental group. Nevertheless, the results of the Independent Samples t-Test indicated that the difference between the two groups was not statistically significant ($p = 0.645$). These results suggest that both methods were equally effective in improving vocabulary mastery. The implications of these findings highlight that technology-supported instruction—whether collaborative through Quizlet or structured through Duolingo—can serve as a valuable tool in promoting vocabulary learning in EFL classrooms. Educators may therefore select instructional strategies according to classroom needs, student preferences, and available resources, while also considering the potential benefits of integrating collaborative and direct approaches. However, this study is not without limitations. The relatively small sample size and short treatment duration limit the generalizability of the findings. Moreover, the study focused solely on vocabulary mastery and did not account for other language skills such as reading comprehension, speaking, or writing. Future research should therefore involve larger and more diverse samples, longer intervention periods, and the integration of additional language skills to provide a more comprehensive understanding of the impact of technology-assisted SDCL and DI. Comparative studies that explore other digital platforms or hybrid models may also yield further insights into how best to optimize vocabulary learning in various educational contexts.

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CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this paper. All authors have approved the final version of the manuscript and agree with its submission to English Learning Innovation (ENGLIE).

AUTHOR(S) CONTRIBUTION

Sutraeni, S.: Research design (lead), data collection (lead), data analysis (lead), writing–original draft (lead). **Asriati, S.:** Supervision (lead), methodological framework (lead), statistical interpretation (lead), review (lead). **Qalby, N.:** Literature review (lead), editing (supporting), discussion and conclusion refinement (lead), review (supporting).

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