

Smartphone Regulation and Qur'anic Memorization Quality: An Indicator-Based Comparative Study and Its Implications for Pesantren Management

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Abstract:

This study aims to analyze the relationship between smartphone use and the quality of Quran memorization among tahfidz students and to develop regulatory implications for using digital technology as a strategic instrument in Islamic boarding school management. This study uses a comparative quantitative approach involving 30 tahfidz students at Islamic boarding schools. The study collected data on the quality of Quran memorization by measuring five indicators: memorization fluency, tajwid accuracy, muroja'ah strength, memorization stability, and verse continuation speed. Data analysis used the Shapiro-Wilk normality test, Levene's homogeneity test, and the Independent-Samples t-test. The results showed a significant difference in total memorization quality between students who used smartphones and those who did not ($t(28) = -2.711$; $p = 0.011$), with the non-smartphone group achieving higher memorization scores. Significant differences also emerged in fluency, recitation strength, and memorization stability, while tajweed accuracy and verse recall speed did not differ significantly. These findings reinforce the relevance of Operant Conditioning Theory in explaining how environmental stimulus control influences learning behavior, as well as Social Identity Theory in understanding the role of collective Islamic boarding school identity. The implications of this research emphasize the importance of data-driven digital regulation to manage technology adaptively without diminishing the core value of Quran memorization education.

Keywords: *Smartphone, Memorization Quality, Islamic Boarding School Management, Digital Regulation*

Abstrak:

Penelitian ini bertujuan untuk menganalisis hubungan penggunaan smartphone dengan kualitas hafalan Al-Qur'an pada santri tahfidz serta merumuskan implikasi regulasi penggunaan teknologi digital sebagai instrumen strategis dalam manajemen pesantren. Penelitian ini menggunakan pendekatan kuantitatif komparatif dengan melibatkan 30 santri tahfidz di pondok pesantren. Data kualitas hafalan Al-Qur'an dikumpulkan melalui pengukuran lima indikator, yaitu kelancaran hafalan, ketepatan tajwid, kekuatan muroja'ah, stabilitas hafalan, dan kecepatan melanjutkan ayat. Analisis data dilakukan melalui uji normalitas Shapiro-Wilk, uji homogenitas Levene, dan uji perbedaan Independent Samples t-test. Hasil penelitian menunjukkan adanya perbedaan signifikan pada kualitas hafalan total antara kelompok santri yang menggunakan smartphone dan kelompok yang tidak menggunakan smartphone ($t(28) = -2,711$; $p = 0,011$), dengan kelompok non-smartphone memperoleh skor hafalan lebih tinggi. Perbedaan signifikan

juga ditemukan pada aspek kelancaran, kekuatan muroja'ah, dan stabilitas hafalan, sedangkan aspek ketepatan tajwid dan kecepatan recall ayat tidak menunjukkan perbedaan yang signifikan. Temuan ini memperkuat relevansi Teori Operant Conditioning dalam menjelaskan pengaruh kontrol stimulus lingkungan terhadap perilaku belajar serta Social Identity Theory dalam memahami peran identitas kolektif pesantren. Implikasi penelitian ini menegaskan pentingnya regulasi digital berbasis data untuk mengelola teknologi secara adaptif tanpa mengurangi nilai utama pendidikan tahfidz Al-Qur'an.

Kata Kunci: *Smartphone, Kualitas Hafalan, Manajemen Pesantren, Regulasi Digital*

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INTRODUCTION

Islamic boarding schools are unique Islamic educational institutions in Indonesia that combine Islamic scientific development, spiritual discipline, and moral internalization through students' collective life (Zainuri et al., 2025; Muslichuddin et al., 2025; Sartika et al., 2025). Although they developed as traditional institutions based on face-to-face religious studies, Islamic boarding schools now face modern currents and the rise of digital technology (Mustofa et al., 2023; Halimah et al., 2024; Sailin et al., 2024; Hidayatullah et al., 2025; Ihsan et al., 2025). However, these dynamics cannot be generalized; they present specific digital dilemmas in smartphone use.

Conceptually, a gap remains in how we think about the role of digital technology in modern Islamic education. On the one hand, the digital pedagogy perspective highlights smartphones' potential to accelerate learning through digital Quran recitations, murottal applications, and visual platforms (Khikmah et al., 2025; Hussain, 2025). In contrast, information processing theories emphasize that smartphones are not simply neutral media but devices with a high capacity for cognitive distraction (Figl & Remus, 2023; Imamiyah et al., 2026). This theoretical gap is crucial in the context of Islamic boarding school-based Quran memorization education. Memorizing the Quran is not simply a process of verbal repetition, but rather a complex cognitive activity that requires high levels of attention, stable muroja'ah (recitation), and long-term memory retention (Agustono & Firdaus, 2025). Smartphones create a fundamental dilemma: are they a supportive tool, or do they disrupt concentration and weaken students' memorization?

Islamic boarding schools respond to this dilemma in different ways, depending on the type and character of the institution. In modern or vocational/integrated Islamic boarding schools, smartphone access is generally more open to support academic activities and communication. Conversely, in traditional Islamic boarding schools (pesantren) or those specialising in Quran memorization programs, rules tend to be very strict, even prohibiting smartphone use altogether (Atsari, 2026). This variation in policies shows that Islamic boarding schools respond differently to the penetration of digital technology (Murdiyanto et al., 2025; Suradji & Faridi, 2025).

Several previous studies have attempted to map technology's impact in Islamic boarding schools. Research by Hikmah & Riyadi (2025) found that free

access to smartphones can increase cognitive distraction and reduce discipline during muroja'ah time. Meanwhile, a study by Birgün (2026) showed that religious applications do not automatically improve memorization quality without adequate pedagogical guidance. Although these studies provide a general overview, most of the literature remains stuck in the general dichotomy of positive and negative impacts or is limited to examining media ownership.

Other research emphasizes the urgency of this issue. Recent studies by (Salim et al. 2024) regarding digital media interaction in religious education show that smartphone penetration triggers attention fragmentation and weakens students' working memory capacity. In the context of verbal and auditory memory processing, research by Hinds et al. (2023), which was supported by the findings of Umar et al. (2024) in Islamic educational institutions, revealed that the physical presence of smartphones near learners (even when inactive) creates a cognitive brain drain that reduces long-term memory retention capacity.

Meanwhile, studies by Jaya and Sucipto (2023) and Ulmadevi et al. (2023) found that smartphone addiction or dependence is significantly related to decreased self-regulated learning (SRL) and academic performance in students. Although these reputable Scopus studies consistently highlight the impact of smartphones on cognitive function and learning behaviour, research specifically examining their impact on quantitative indicators of complex memory formation, such as the quality, stability, and fluency of Quran memorization in the communal ecosystem of tahfiz Islamic boarding schools, is still very limited (Jaya & Sucipto, 2023; Ulmadevi et al., 2023).

This study not only discusses digital technology in a generic manner like previous studies, but also specifically tests the existence of smartphones and empirically re-evaluates the general assumptions that have developed: does the existence of smartphones always have an absolute negative impact, or is the policy of strict restrictions or prohibitions empirically proven to support the quality of students' memorization? This study offers novelty through a quantitative comparative approach based on precise memorization quality indicators (fluency, accuracy of tajweed, strength of muroja'ah, stability of memorization, and speed of remembering verses) between groups of students who use and do not use smartphones in tahfiz Islamic boarding schools.

To explain this phenomenon, this study uses B.F. Skinner's Behaviourist Learning Theory as the main theoretical foundation (Sajari et al., 2025). The author is aware of other cognitive theories, such as Cognitive Load Theory (Sweller), which focuses on the load on working memory capacity, and Self-Regulated Learning Theory (Zimmerman), which highlights students' self-regulation abilities. However, this study selects Skinner's Behaviourism Theory because the Islamic boarding school tahfiz ecosystem depends on the effectiveness of the boarding school's educational management. Islamic boarding school-based tahfiz education operates by creating a structured environment (environmental shaping) where strict regulations, such as prohibiting or restricting smartphones, function as external stimulus control (stimulus control) to eliminate distractions. (Leeder, 2022). The memorization behavior and muroja'ah discipline of adolescent students are heavily influenced by operant conditioning (systemic reinforcement, rules, and

sanctions) before the students can achieve the ideal level of cognitive self-regulation. Therefore, Skinner's Behaviourist framework provides the most relevant basis for analyzing how environmental manipulation and control (in the form of smartphone restrictions) directly shape habituation and the outcomes of students' memorization quality.

Based on the conceptual and theoretical background, this study aims to examine and analyze comparatively the differences in the quality of Al-Qur'an memorization between students who use and do not use smartphones based on indicators of fluency, accuracy of tajweed, strength of muroja'ah, stability of memorization, and speed of memorizing verses at the Al-Ikhlash Bahrul Ulum Islamic Boarding School, while also formulating policy recommendations for Islamic boarding school management regarding the regulation of smartphone use based on empirical findings so that the policies implemented are not merely based on normative assumptions, but are based on data (data-driven policy) that is in line with the objectives of tahfiz education. This study argues that technology policies in Islamic educational institutions must be grounded in empirical evidence about students' cognitive dynamics and learning behaviour. By understanding the real impact of smartphone use on memorization indicators, Islamic boarding school managers can design appropriate pedagogical strategies and regulations to address the dilemma of digitalization in the Islamic boarding school environment.

RESEARCH METHODS

This study uses a quantitative, comparative design to examine differences in the quality of Al-Qur'an memorization between smartphone users and non-smartphone users at the Al-Ikhlash Bahrul Ulum Islamic Boarding School. The research subjects were 30 students in the tahfidz program, divided into two independent groups: 15 students who use smartphones and 15 who do not. The subjects were purposively selected, taking into account equal study periods and the intensity of the tahfidz program undertaken. The research instrument was a memorization quality assessment sheet based on five indicators, namely memorization fluency, tajwid accuracy, muroja'ah strength, memorization stability, and speed of continuing verses. Each indicator was assessed using a 1–5 Likert scale, so the total score was the sum of all indicators, with a range of 5–25, as shown in Table 1.

Table 1. Indicators and Criteria for Assessing the Quality of Qur'an Memorization by Students

Indicators	1 (Very Low)	2 (Low)	3 (Enough)	4 (Good)	5 (Very Good)
Fluency in Memorization	Memorization is often interrupted, requires a lot of repetition, and needs intensive help.	Memorization has stalled several times and still requires a lot of repetition.	Relatively smooth memorization, but there are still small pauses and repetitions.	Smooth memorization with minimal pauses and repetition	Recitation is very smooth, without interruption or repetition.
Accuracy of Pronunciation and Tajwid	Many mistakes in pronunciation, recitation, and length	Errors in tajwid and pronunciation still occur quite frequently.	The errors are relatively few and still tolerable.	Errors are minimal and rare.	The recitation is very accurate and follows the rules of tajwid and makhraj.
The Power of Muroja'ah	Old memorization is often forgotten	Old memorization is	The old memorization is	Long-term memory is	Old memorization is

	and requires a lot of correction.	still often incorrect and unstable.	fairly well preserved with a few corrections.	preserved with minimal correction	very strong and almost without correction
Memory Stability	The quality of memorization is inconsistent and subject to change.	Low memorization consistency in repeated deposits	Consistency is fairly stable but not yet optimal	Consistency in memorization is good in repeated deposits	The consistency of memorization is very stable and well maintained.
Speed of Verse Recall	Very slow in continuing the verse and often hesitant	Slow and takes quite a long time	Fast enough, but there is still a delay	Quick to respond with minimal delay	Very fast and spontaneous without pause

Data analysis was performed using SPSS 21 software through several stages. First, descriptive analysis was performed to obtain the mean ($\bar{X} = \sum X / N$) and standard deviation ($SD = \sqrt{[\sum (X - \bar{X})^2 / (N - 1)]}$). Second, normality was tested using the Shapiro-Wilk test ($W = (\sum a_i X_{(i)})^2 / \sum (X_i - \bar{X})^2$), as the sample size in each group was less than 50. Third, Levene's test assessed homogeneity of variance between groups before comparative testing.

Hypothesis testing was performed using an independent-samples t-test for two independent groups with the formula: $t = (\bar{X}_1 - \bar{X}_2) / \sqrt{[S_p^2 (1/n_1 + 1/n_2)]}$, with pooled variance calculated using: $S_p^2 = [(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2] / (n_1 + n_2 - 2)$. Where $\bar{X}_1$ and $\bar{X}_2$ are the means of each group, S_1^2 and S_2^2 are the group variances, and n_1 and n_2 are the sample sizes of each group. The significance level used is 0.05 with a 95% confidence interval. The analysis covered both total scores and each indicator to identify specific differences in memorization quality. The results of this test were then used to formulate policy implications for Islamic boarding school management regarding the regulation of smartphone use, based on empirical findings.

RESULTS AND DISCUSSION

Results

Descriptive statistics provided an initial comparison of Al-Qur'an memorization quality between smartphone and non-smartphone users (Table 2). Beyond establishing data distribution and normality for subsequent inferential testing, this exploratory analysis revealed early patterns of differences in central tendencies and score dispersion between the two groups, offering insight into how smartphone usage may relate to memorization performance.

Table 2. Descriptive Statistics of Memorization Quality Scores

Group	n	Mean	SD	95% CI	Min	Max	Skewness	Kurtosis
Smartphone	15	19.60	2.586	[18.17, 21.03]	16	25	0.912	0.243
Non-Smartphone	15	22.13	2.532	[20.73, 23.54]	17	25	-0.538	-0.707

A descriptive analysis described the distribution of memorization quality scores among students who use smartphones and those who do not. The results show that the non-smartphone group had a higher average score ($M = 22.13$; $SD = 2.532$) than the smartphone group ($M = 19.60$; $SD = 2.586$). The 95% confidence interval for the smartphone group was 18.17 to 21.03, while the non-smartphone group was 20.73 to 23.54. Although the ranges show limited overlap, these findings remain strictly descriptive, and confirmation of statistical significance awaits subsequent inferential testing.

In terms of data distribution, both groups showed relatively comparable variability, with variance values of 6.686 (smartphone) and 6.410 (non-smartphone). The score ranges were also similar, at 9 for the smartphone group and 8 for the non-smartphone group. The median of the smartphone group (Md = 19.00) is lower than the median of the non-smartphone group (Md = 22.00), further supporting a difference in the distribution's central tendency between the two groups.

We analyzed the data distribution using skewness and kurtosis values. The smartphone group showed positive skewness (0.912), indicating a slightly right-skewed distribution, while the non-smartphone group showed negative skewness (-0.538), indicating a slightly left-skewed distribution. The kurtosis values for both groups (0.243 and -0.707) were within the acceptable range for a near-normal distribution.

Table 3. Normality Test Results

Group	n	Kolmogorov-Smirnov (p)	Shapiro-Wilk (W)	Shapiro-Wilk (p)
Smartphone	15	0.022	0.900	0.096
Non-Smartphone	15	0.024	0.895	0.081

We used the Shapiro-Wilk test for normality because each group had fewer than 50 participants. The results showed a significance value of 0.096 for the smartphone group and 0.081 for the non-smartphone group ($p > 0.05$). Thus, both groups meet the normality assumption. Although the Kolmogorov-Smirnov test showed a significance value below 0.05, Shapiro-Wilk is more recommended for small samples, so the normality results refer to that test.

The Shapiro-Wilk test results show $W = 0.900$ for the smartphone group and $W = 0.895$ for the non-smartphone group, with degrees of freedom (df) of 15 each. Significance values of 0.096 and 0.081, above the 0.05 threshold, indicate insufficient evidence to reject the null hypothesis that the data come from a normally distributed population. In other words, the distribution of memory quality scores in both groups does not differ significantly from a normal distribution. The W statistic value, which is close to 1, also indicates that the data distribution pattern conforms to the normal curve. Therefore, the normality assumption for parametric analysis is met, making the independent-samples t-test methodologically and statistically valid for the next stage of analysis.

Table 4. Group Statistics of Memorization Quality

Group	n	Mean	SD	SE
Smartphone	15	19.60	2.586	0.668
Non-Smartphone	15	22.13	2.532	0.654

The independent-samples t-test results show a significant difference in memorisation quality between students who use smartphones and those who do not. Table 4 shows descriptive statistics on the quality of Al-Qur'an memorization in the two groups. The smartphone group ($n = 15$) had an average score of 19.60 with a standard deviation of 2.586 and a standard error of 0.668. Meanwhile, the non-smartphone group ($n = 15$) showed a higher average of 22.13 with a standard deviation of 2.532 and a standard error of 0.654. This descriptive difference of 2.53 points suggests that students who do not use smartphones have better memorization quality than students who do.

In terms of data distribution, both groups showed comparable variation, as indicated by nearly identical standard deviation values (2.586 and 2.532). This suggests scores within each group were fairly homogeneous and that there were no extreme differences in memorization performance. The relatively small standard error values in both groups also indicate that the average estimates are fairly stable and representative of the population studied. Overall, these descriptive results provide an initial indication of differences in memorization quality between the two groups before further inferential testing.

Table 5. Independent Samples t-Test

Comparison	t(df)	p	Mean Difference	95% CI
Smartphone vs. Non-Smartphone	-2.711 (28)	0.011*	-2.533	[-4.447, -0.619]

The independent-samples t-test shows a significant difference in the quality of Al-Qur'an memorization between students who use smartphones and those who do not, with $t(28) = -2.711$ and $p = 0.011$ ($p < 0.05$). The non-smartphone group had a higher average score than the smartphone group, with a mean difference of 2.533 points. The negative t-value and mean difference indicate that the smartphone group scored lower than the non-smartphone group. Thus, smartphone use is associated with a significant difference in memorization quality. The 95% confidence interval for the mean difference is between -4.447 and -0.619, and does not cross zero, further confirming that the difference is statistically significant. This range shows that, in the population, the non-smartphone group consistently has a higher memorization quality score by 0.619 to 4.447 points than the smartphone group. These findings suggest that restricting smartphone use in Islamic boarding schools may improve students' memorization quality, especially in tahfidz learning, which requires high concentration and cognitive stability.

Table 6. Indicator-Based Differences in Memorization Quality

Indicator	t(df)	p	Mean Difference	95% CI
Fluency in recitation	-3.347 (28)	0.002**	-0.533	[-0.860, -0.207]
Strength of long-term revision	-2.530 (28)	0.017*	-0.533	[-0.965, -0.101]
Accuracy of tajwid	-1.420 (28)	0.167	-0.400	[-0.977, 0.177]
Stability in repeated recitation	-2.269 (28)	0.031*	-0.667	[-1.269, -0.065]
Speed in recalling verses	-1.420 (28)	0.167	-0.400	[-0.977, 0.177]

Table 6 presents results from an analysis of differences in Quran memorization quality across five indicators between students who use smartphones and those who do not. Overall, the independent-samples t-test results show that not all indicators differ significantly. Of the five indicators analyzed, three differ significantly, while the other two do not. This pattern indicates that smartphone use is associated with variations in certain aspects of memorization quality, but not across all measured dimensions.

On the fluency in recitation indicator, a t-value of $t(28) = -3.347$ was obtained with $p = 0.002$ ($p < 0.01$). The mean difference of -0.533, with a 95% confidence interval between -0.860 and -0.207, indicates a significant and consistent difference, as the interval does not cross zero. This means that the non-smartphone group has a significantly higher level of fluency in recitation than the smartphone group.

These findings suggest that memory fluency, which requires concentration and continuous practice, tends to be more optimal in environments with minimal digital distractions.

For the long-term revision indicator, $t(28) = -2.530$ was obtained with $p = 0.017$ ($p < 0.05$), with an average difference of -0.533 . The 95% confidence interval ranges from -0.965 to -0.101 and does not cross zero, confirming a significant difference between the two groups. This means the non-smartphone group performs better at maintaining and strengthening long-term memory. These results indicate that reducing distracting stimuli can support consistent muroja'ah and long-term memorization.

Conversely, for the tajwid accuracy indicator, $t(28) = -1.420$, $p = 0.167$, indicating that the difference is not statistically significant. The 95% confidence interval (-0.977 to 0.177) crosses zero. This lack of significant variation is notable and suggests that tajwid mastery is less sensitive to smartphone usage. A plausible explanation is that tajwid proficiency relies heavily on direct, face-to-face instruction with a qualified teacher (*talaqqi*), where articulation (*makhraj*) and recitation rules are corrected in real time rather than the presence or absence of digital devices.

The stability indicator in repeated recitation showed significant results with a $t(28)$ value of -2.269 and $p = 0.031$ ($p < 0.05$). The average difference of -0.667 was the largest among indicators, with a 95% confidence interval between -1.269 and -0.065 that did not cross zero. This indicates that memorization stability in repeated recitation was better in the non-smartphone group. Higher memory performance stability indicates that a more controlled learning environment can help maintain consistent memory quality. While this suggests that a less digitally distracted environment may help maintain memory stability, these results should be interpreted moderately. Because other dimensions, such as recall speed, showed no significant differences, technology's impact on memorization appears nuanced and multidimensional rather than uniformly detrimental across all cognitive domains.

On the speed of recall indicator, $t(28) = -1.420$, $p = 0.167$, shows no significant difference between the two groups. The confidence interval crosses zero (-0.977 to 0.177), reinforcing this conclusion. Although the non-smartphone group had a higher average, the difference was not statistically significant. Overall, these findings indicate that smartphone use has a greater effect on performative aspects such as fluency and stability of memorization than on recall speed or the technical accuracy of reading.

Discussion

The findings show that students without smartphones demonstrated stronger memorization quality in fluency, muroja'ah strength, and memorization stability. This pattern aligns with Operant Conditioning Theory, which emphasizes stimulus control and environmental consequences in shaping behaviour (Johansson, 2024; Rios et al., 2025). A structured environment can increase desired learning behaviours such as focus, discipline, and repetition (Heald et al., 2023). It also aligns with Guo et al. (2025), Li et al. (2023), and Meerits et al. (2025), who emphasize environmental control in sustaining behavior.

However, findings should not be interpreted as proving direct causation, because motivation, methods, and teacher quality may also contribute.

Interpreting smartphone restriction as negative reinforcement aligns with the literature but requires conceptual precision. Negative reinforcement refers to removing an unwanted stimulus to strengthen behaviour, rather than imposing punishment (Arechavala-Lopez et al., 2022). In this study, reducing notifications, entertainment, and external communication may create conditions that support repeated recitation and focused learning. This interpretation complements the observed differences in fluency and stability while extending the discussion by connecting environmental regulation with tahfizh routines. Nevertheless, the comparative design cannot establish that distraction removal alone produced the differences. The finding supports an association between regulated environments and memorization indicators in this setting.

The study extends Skinnerian analysis of punishment, positive reinforcement, and shaping. Sanctions for smartphone violations may reduce undesirable behaviour, consistent with Kärner et al. (2026), whereas limited smartphone permissions for senior students can operate as rewards for responsibility. The gradual expansion of access reflects differential reinforcement and shaping, as Leeder (2022) describes. These practices suggest that pesantren regulation can move beyond prohibition toward graduated management. At the same time, the findings differ from a restrictive interpretation because they do not reject technology entirely. Rather, access is differentiated by maturity and responsibility, suggesting that regulation may involve structured progression rather than uniform control.

The absence of significant differences in tajwid accuracy and verse recall speed provides an important qualification to the behavioural explanation. Although environmental regulation was associated with fluency and stability, technical accuracy and recall speed may depend on pedagogical guidance, memory capacity, and personal practice (Alifah & Pasaribu, 2026; Oakley et al., 2026). This finding supports the argument that stimulus control does not affect every dimension of memorization equally. It also strengthens the relevance of direct teacher instruction and talaqqi for qualitative aspects of Quranic reading. This distinction refines behaviourist interpretation by showing that environmental management may support learning conditions without replacing instructional expertise or cognitive factors in this educational context.

Social Identity Theory provides a complementary explanation for why smartphone regulation may become meaningful. Tajfel and Turner's perspective emphasizes group membership in constructing self-concept (Khadka, 2024; Pellet et al., 2026), while santri identity incorporates discipline, simplicity, obedience, and spiritual commitment (Mubarak et al., 2026). Constructing a "pure santri" identity may strengthen adherence because compliance becomes socially connected to belonging and status, consistent with (Kanzola et al. 2025). Conversely, students with controlled access may develop more adaptive identities linking their pesantren responsibilities with wider external roles, reflecting role differentiation (Hasan, 2025; Setiawan et al., 2026).

The study integrates environmental stimulus control and collective identity into a theoretical account of digital regulation in tahfizh education. It moves beyond the binary opposition between smartphone prohibition and unrestricted use, showing how regulation can shape learning conditions, behavioural habits, and institutional identity. Practically, administrators can develop tiered, evidence-informed policies, while teachers prioritize talaqqi for tajwid and use technology for monitoring, communication, and recognition. Public tahfizh examinations through social media illustrate this institutional use, consistent with the finding that technology can support reinforcement without becoming an individual distraction. These implications should remain contextual rather than universally causal or prescriptive.

CONCLUSION

This study shows that smartphone regulation is associated with differences in specific dimensions of Al-Qur'an memorization quality, particularly fluency, muroja'ah strength, and memorization stability. At the same time, tajwid accuracy and verse recall speed show no significant differences. The key lesson is that effective tahfizh learning depends not simply on whether smartphones are permitted or prohibited, but on how the learning environment is structured, behavioural expectations are reinforced, and digital access is managed in line with students' responsibilities. Theoretically, integrating Operant Conditioning Theory and Social Identity Theory contributes a more nuanced understanding of digital regulation in pesantren by connecting environmental stimulus control, behavioural reinforcement, and collective santri identity within contemporary tahfizh education. Practically, the findings provide a basis for measured and gradual smartphone policies rather than absolute prohibition, while emphasizing that digital regulation should complement, not replace, teacher-led instruction and talaqqi. However, this study is limited by its comparative design and its focus on a single Islamic boarding school, which restricts causal interpretation and generalizability. Future research should employ longitudinal or experimental designs, involve multiple pesantren, and examine additional factors such as motivation, memorization methods, teacher quality, duration of smartphone exposure, and students' digital self-regulation to clarify how these factors interact with different dimensions of memorization quality.

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