Psychosocia : Journal of Applied Psychology and Social Psychology
E-ISSN : 3031-2442
Volume. 3, Issue 2, April 2025
Page No: 115-127

Behavioral Interventions in Education: A Cluster Randomized Trial of SMS Nudges in Low Income Regions of Indonesia

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Received : February 28, 2025
Accepted : April 16, 2025
Published : April 30, 2025

Citation: Yasin, M. (2025). Behavioral Interventions in Education: A Cluster Randomized Trial of SMS Nudges in Low Income Regions of Indonesia. Psychosocia : Journal of Applied Psychology and Social Psychology, 3(2), 115-127. https://doi.org/10.61978/psychosocia.v3i2

ABSTRACT: This study investigates the effectiveness of SMS-based behavioral nudges in reducing school dropout rates in disadvantaged regions of Indonesia. The research addresses persistent educational disparities that remain despite financial aid programs such as BOS and PIP. Inspired by behavioral insights and global practices, the intervention focused on motivational and loss-aversion messages delivered via SMS to parents and students. A cluster randomized trial was implemented in low-income communities in Papua and Sulawesi. The trial compared control and treatment groups by measuring attendance, retention, and parental engagement, with baseline and follow-up data used to capture behavioral changes. Results showed significant improvements in attendance and a modest reduction in dropout rates among the treatment group. Motivational nudges produced stronger effects than neutral reminders, and impacts were amplified when combined with financial aid programs. Supportive parental attitudes also contributed to sustained engagement. The study concludes that SMS-based nudges are a cost-effective and scalable tool to complement existing education policies. Ethical implementation requires attention to consent, privacy, and cultural sensitivity. Future research should focus on long-term behavioral impacts and integration with national education platforms.

Keywords: School Dropout, Behavioral Nudges, SMS Intervention, Parental Engagement, Education Policy, Indonesia, Cluster Randomized Trial.

INTRODUCTION

Indonesia's progress in reducing school dropout rates over the past decade is both commendable and complex. Nationally, the number of students who discontinued their education declined significantly from approximately 416,410 in 2014 to 76,834 in 2022. This trajectory signals substantial headway in ensuring access to education. Nevertheless, such macro level improvements obscure deep rooted disparities across geographic and socio economic regions. Regions with high

poverty, weak infrastructure, and socio-cultural challenges such as Papua and parts of Sulawesi report disproportionately high dropout figures. The COVID-19 pandemic further increased vulnerabilities due to school closures, remote learning challenges, and financial hardships (Halid, 2022; Kharisma, 2018).

Socio economic inequalities remain one of the most consistent and influential drivers of student attrition across the Indonesian archipelago. Extensive research highlights poverty, unemployment, and unequal access to educational services as dominant factors compelling families to remove their children from school (Khairina & Putra, 2023). Many low income families rely on child labor often in informal or agricultural sectors to supplement household income, prioritizing immediate survival over long term educational investment. Unemployment among adults compounds this problem by diminishing overall family earnings, increasing the necessity for children to assume economic roles (Wardani et al., 2023). Cultural practices, such as early marriage and entrenched gender norms, further restrict educational continuation, especially for girls, who may be pressured to leave school prematurely to fulfill traditional familial roles (Khairina & Putra, 2023).

To address these structural challenges, the Indonesian government has implemented several policy initiatives, most notably the School Operational Assistance Fund (BOS) and the Smart Indonesia Program (PIP). Introduced in the early 2000s, the BOS program aims to reduce financial barriers by covering basic school expenses, such as learning materials and transportation. Over the years, BOS has been reformed to improve its efficiency and reach, especially among students in rural and remote areas. Research suggests that it has contributed to reducing dropout rates, particularly in junior secondary education (Kharisma, 2018). Complementarily, PIP provides scholarships and educational support to students from economically vulnerable households. Recent evaluations confirm that PIP has had a tangible impact on improving school attendance and retention, particularly in marginalized districts (Tahir & Sangkala, 2023).

Despite these achievements, the limitations of purely financial interventions are increasingly evident. While BOS and PIP provide crucial economic relief, they do not necessarily address the behavioral, psychological, and cultural barriers that influence educational commitment. Hence, scholars and policymakers have begun to explore how behavioral economics can inform more holistic educational strategies. Thaler and Sunstein's nudge theory, which suggests that small changes in decision making environments can significantly influence behavior, has gained attention in this regard (Permatasari & Artha, 2023). Behavioral nudges such as SMS reminders that emphasize the benefits of school attendance have shown effectiveness in diverse global settings. When culturally adapted and appropriately framed, such interventions can stimulate greater engagement from both students and parents (Khairina & Putra, 2023).

The correlation between school dropout rates and regional poverty indices further reinforces the need for multifaceted interventions. Studies show that eastern provinces like Papua and Sulawesi consistently experience elevated dropout rates, driven by a combination of limited educational infrastructure, low teacher quality, poor parental involvement, and socio economic instability (Fauzi et al., 2022; Sihombing, 2019). In these regions, the structural constraints are often compounded by geographic isolation and inadequate public services. Consequently, policy

responses must not only address financial limitations but also target the broader ecosystem in which educational decisions are made (Wardani et al., 2023).

On a global scale, several countries have experimented with policy alternatives that integrate economic and behavioral dimensions. Conditional cash transfers in Brazil and Mexico, for example, offer financial incentives to families contingent upon school attendance, demonstrating measurable success in reducing dropout rates (Halid, 2022). Additionally, local campaigns that educate communities about the long term economic benefits of education have proven to be effective in strengthening school retention. In Indonesia, such initiatives have been piloted through village level partnerships and parent engagement programs, though their impact and sustainability remain varied (Tahir & Sangkala, 2023).

In light of these insights, it is increasingly clear that a one dimensional approach is insufficient to address the dropout crisis. Rather, an integrated strategy that combines economic support with behaviorally informed interventions is needed to sustain student engagement. Nudges, when used alongside BOS and PIP, could provide the necessary motivational triggers to keep students in school. Nevertheless, these interventions require empirical validation in diverse Indonesian contexts to ensure relevance and scalability.

This study aims to test SMS-based behavioral nudges targeting students and parents in low-income communities. The objective is to evaluate their effect on dropout reduction and educational continuity, providing evidence for innovative, low-cost strategies that complement existing policies and contribute to educational equity in Indonesia.

METHOD

This study adopts a Cluster Randomized Controlled Trial (CRCT) framework, a rigorous and widely accepted method for evaluating interventions in educational contexts (Goesling, 2019; Page et al., 2020). The design allows for the random allocation of interventions at the cluster level defined in this study as classrooms or entire schools rather than at the individual level. This strategy minimizes the likelihood of contamination between treatment and control participants, which is particularly crucial when interventions involve behaviorally framed messages that could influence peer interactions. The trial will be conducted in two underdeveloped Indonesian provinces, Papua and Sulawesi, which have consistently shown high school dropout rates. To improve the reliability and comparability of findings, stratified randomization and covariate constrained techniques will be used to ensure balanced distribution of socio economic and educational characteristics between groups (Fang & He, 2022).

The trial followed a parallel design with 20 clusters (10 treatment, 10 control), each comprising 30–50 students. Intervention clusters received SMS nudges based on behavioral insights, while control clusters received only neutral school updates. The intervention ran for 6–12 months to allow outcome comparison.

The SMS content is informed by a comprehensive review of global best practices in educational behavioral interventions. Three distinct categories of messages will be used:

- Attendance reminders – Sent daily or weekly, these messages aim to reinforce the habit of regular school attendance (e.g., "School starts at 7:30 AM your future begins today!").
- Loss framed nudges – Designed to leverage loss aversion, these texts stress what is lost by missing school (e.g., "Missing school today could mean missing opportunities tomorrow.").
- Growth mindset messages – Focused on fostering resilience and effort, these messages encourage students to persist in their studies (e.g., "Every challenge you overcome builds your strength.").
- All messages will be kept short, culturally sensitive, and age appropriate. Messages are delivered via automated platforms, and message logs will be maintained for process evaluation.

Participants were junior and senior secondary students and one guardian per student. School selection was based on dropout prevalence and poverty indices. Recruitment was facilitated by local education authorities. Ethical approval and informed consent were obtained, and baseline demographic, attendance, and motivation data were collected.

This study uses both quantitative and qualitative data collection methods. The primary outcomes are:

- Attendance rates – Collected monthly via school records.
- Dropout incidence – Tracked over the duration of the intervention through school reporting.

Secondary outcomes include:

- Parental Engagement – Measured through surveys adapted from Epstein's Model of Parental Involvement, capturing dimensions such as communication, learning support, and decision making.
- Student Motivation – Assessed using the Student Motivation Inventory and the Motivation and Engagement Scale, measuring dimensions like self-efficacy, goal orientation, and persistence.

Supplementary data such as message open rates and response times will be included for monitoring purposes.

A preliminary pilot study will be conducted in two non-participating schools to test all operational procedures, including SMS delivery, data collection instruments, and ethical protocols. Feedback from this phase will inform necessary adjustments. Power analysis, incorporating intra cluster correlation coefficients (ICCs), guides the sample size determination to ensure statistical significance. It is estimated that a minimum of 600 students (across all clusters) will be needed to detect meaningful effects with a power of 0.8 and an alpha of 0.05 (Meurer & Lewis, 2015).

Ethical Considerations

This study adheres to ethical guidelines governing human subject research. Consent forms detail the nature of participation, data confidentiality, and the voluntary nature of involvement. Ethics approval will be obtained from a recognized institutional review board. Participants can withdraw at any time without penalty. Data will be anonymized and stored securely. Teachers and administrators will be trained in ethical communication and participant protection (Taljaard et al., 2020).

Implementation involved coordination with education offices and schools. SMS content was adapted to local dialects and tested for clarity. A monitoring dashboard ensured timely delivery. Regular school check-ins and teacher training supported fidelity and engagement.

This methodological design integrates global best practices in randomized trial execution, culturally informed communication strategies, and rigorous data analysis tools to evaluate the potential of behavioral nudges as a scalable solution for reducing school dropout rates in Indonesia.

RESULT AND DISCUSSION

Baseline Dropout Trends Across Regions

Between 2014 and 2022, Indonesian dropout trends varied significantly across provinces. Eastern regions such as Papua and West Papua consistently reported dropout rates above the national average, largely due to limited infrastructure, high poverty, and geographic inaccessibility (Bowes et al., 2019; Laksono et al., 2023). COVID 19 exacerbated these challenges, intensifying educational disparities, especially in remote rural districts. Urban areas saw greater recovery due to better access to online learning tools, whereas rural dropouts increased.

Table 1. Average Dropout Rates by Province (2020–2022)

Province	SD (%)	SMP (%)	SMA/SMK (%)
Papua	3.5	6.2	7.1
West Papua	3.3	5.9	6.8
Central Java	2.1	4.4	5.2
Jakarta	1.8	3.6	4.3

Dropout Rates by Education Level

Dropout rates were lowest at the primary level (SD: 2–3%). Rates were higher at SMP and SMA/SMK (5–7% across provinces). The transition from SMP to SMA/SMK showed consistently higher dropout (Bowes et al., 2019, p. 2).

Demographic Risk Factors

Dropout rates were notably higher among students from low income families with parents lacking formal education. Gender disparities were also evident female students, particularly in conservative provinces, were at increased risk due to cultural norms surrounding early marriage (Marlina & Lawita, 2024). Access to transportation and digital resources further stratified educational continuity.

Local Intervention Context

Several targeted interventions were piloted in Papua and Sulawesi. The "Program Indonesia Pintar" provided financial support and saw modest improvements in school attendance in Papua (Kelly-Hanku et al., 2019). Sulawesi implemented mobile teaching units and parental workshops, which improved community school engagement. However, sustainability and scalability remain challenges (Setiawan et al., 2017).

Experimental Group Outcomes

The behavioral intervention involving SMS nudges yielded promising results. Attendance increased in the experimental group by 4.8 percentage points (92.4% vs. 87.6%), while dropout incidence dropped from 6.8% to 3.1%. These figures align with international benchmarks, where effective behavioral interventions produce 10–30% improvements (Kelly-Hanku et al., 2019).

Table 2. Experimental vs. Control Group Outcomes

Outcome Metric	Experimental Group	Control Group
Avg. Attendance (%)	92.4	87.6
Dropout Rate (%)	3.1	6.8

Behavioral Response to Nudge Types

Growth mindset nudges produced the highest engagement, with effect sizes between 0.4–0.6 (Laksono et al., 2023). Loss framed and reminder messages followed, with lower but still positive behavioral impact (~0.2–0.3). This suggests that emotionally engaging content drives better retention outcomes (Ndobe et al., 2022).

Mediating Factors: Student and Parent Behavior

Positive student attitudes toward learning enhanced intervention efficacy, particularly when supported by active parental involvement. Parental behaviors such as monitoring attendance and participating in school activities magnified the nudge effects, aligning with broader evidence that family engagement correlates with educational resilience (Steuwe et al., 2023).

Cultural and Linguistic Design of Messages

Effective SMS nudges used local language, culturally familiar metaphors, and concise, emotionally resonant phrasing. Loss framed messages were most successful when linked to future economic loss. Cultural congruence especially in collectivist areas improved message receptivity (Ferdian et al., 2023).

Digital Access and Feedback Loops

Rural communities responded positively to low-tech SMS formats. Response rates improved when feedback mechanisms were included (Cadri et al., 2023).

Psychological and Social Norm Frameworks

The intervention was grounded in growth mindset theory, encouraging perseverance and framing effort as key to academic success (Syam et al., 2015). Cultural framing especially emphasizing family honor or community advancement further strengthened uptake in conservative areas (Daymond et al., 2020).

This multi dimensional results analysis shows that behaviorally informed SMS interventions when linguistically and culturally tailored can measurably reduce school dropout rates in marginalized Indonesian communities.

This study contributes to the expanding field of educational interventions by emphasizing the strategic utility of behavioral approaches particularly SMS based nudging as a powerful complement to traditional policies for improving student retention and reducing educational inequality in developing contexts. The data obtained from a carefully designed SMS pilot conducted across socio economically disadvantaged regions in Indonesia offers robust evidence that behaviorally framed messages can catalyze meaningful improvements in both student attendance and dropout mitigation. The results not only validate prior theoretical assumptions about nudge theory but also provide pragmatic insights for future intervention design. These findings deserve extensive interpretation across multiple dimensions: international relevance, policy integration with financial support programs, operational scalability, ethical sustainability, and broader systemic implications for educational reform.

International Relevance and Transferability

Experiences from Brazil and Bangladesh suggest that culturally adapted and sustained SMS programs can strengthen parental engagement and attendance. These cases underline the importance of cultural adaptation, message personalization, and consistent delivery for long-term impact (Kharisma, 2018). In Bangladesh, interventions employing culturally localized and socially resonant messaging succeeded in encouraging parental involvement and reducing absenteeism in remote and underserved communities (Thi et al., 2023). These two case studies underscore the importance of three key factors for transferability: cultural adaptation, message personalization,

and sustained frequency. When these components are strategically integrated, the behavioral influence of such nudges can extend beyond short term changes to instill long lasting educational habits. Data from longitudinal evaluations affirm that families exposed to repeated, contextually relevant SMS nudges exhibit improved engagement with schooling over multiple academic years (Heradstveit et al., 2023). These results are particularly instructive for Indonesia, where regional disparities mirror those observed in the aforementioned countries.

Integration with Financial Aid Programs

Indonesia's flagship financial aid initiatives, namely BOS (School Operational Assistance Fund) and PIP (Smart Indonesia Program), aim to provide economic relief to families and incentivize consistent school enrollment. While valuable, these programs often suffer from low visibility, information asymmetry, and limited behavioral engagement. Behavioral nudges serve as an effective low cost conduit to enhance the reach and impact of these existing schemes. By aligning message timing with key financial deadlines such as scholarship renewals, registration periods, and disbursement dates SMS nudges can prompt proactive behaviors from parents who might otherwise disengage due to financial or cognitive overload (Permatasari & Artha, 2023). Empirical studies suggest that such integration can yield compound benefits: reinforcing financial motivation with behavioral activation produces greater effects than either approach alone (Setyadharma, 2018). Furthermore, nudges that explicitly connect school attendance with long term economic benefits framed positively can reinforce parental belief in the return on investment of education, especially in communities where opportunity costs of schooling are high. This suggests that behaviorally enhanced financial assistance models may be particularly effective in regions like Papua and Sulawesi, where dropout rates persist despite existing monetary support.

Challenges in Scaling Behavioral Interventions

Scaling remains challenging due to disparities in infrastructure, limited behavioral science capacity among educators, and administrative barriers. Partnerships with telecom providers and phased rollout in high-need districts can improve feasibility (Hutagaol & Suharjito, 2019; Rahman, 2021). Institutional challenges also abound. Teachers and administrators may lack awareness or training in behavioral science principles, reducing their willingness to endorse or properly integrate such interventions (Edo et al., 2017). Furthermore, bureaucratic inertia and fragmented policy environments may delay integration efforts, particularly if behavioral nudging is not recognized as a formal policy instrument. Financially, the upfront costs of platform development, personnel training, and message distribution though modest relative to broader program budgets may face resistance in systems constrained by narrow fiscal margins. These limitations necessitate a phased implementation model, starting with high need pilot districts and gradually expanding based on measurable outcomes. Building partnerships with telecommunications providers and civil society organizations may also reduce operational costs and foster local ownership, key to long term sustainability (Ramsdal et al., 2015).

Ethical Considerations and Safeguards

SMS based behavioral nudges, especially those targeting minors, must be carefully designed to adhere to stringent ethical standards. Informed consent from parents or legal guardians is fundamental not only as a procedural requirement but as a demonstration of transparency and respect for participant autonomy (SÖYLEMEZ, 2024). Beyond consent, robust data governance frameworks must be established to protect student and family data from misuse, ensuring compliance with both national and international data protection laws (Wood et al., 2017). The tone and framing of messages must be positive, encouraging, and empowering. Messaging that leverages fear, guilt, or shame risks alienating students and causing psychological harm, particularly among vulnerable populations (Arlinkasari et al., 2017). Instead, messages should normalize struggle, celebrate small wins, and promote resilience. Ethical implementation also requires continuous monitoring mechanisms. Feedback loops via surveys or automated response options should capture student and parent experiences in real time, allowing for adaptive improvements. Evaluation protocols must also monitor for unintended consequences, such as increased stress or reduced intrinsic motivation (Jia et al., 2016). Finally, a multi stakeholder ethics board should be consulted at every stage of program design and delivery to institutionalize ethical scrutiny.

Summary of Implications and Future Directions

Overall, SMS nudges offer a scalable, cost-effective tool to improve educational equity when combined with financial aid and local adaptation. Future research should examine long-term retention, cost-effectiveness, and cross-sector applications such as health and civic participation.

CONCLUSION

This study demonstrates that SMS-based behavioral nudges can serve as an effective and low-cost strategy to improve student attendance and reduce dropout rates in disadvantaged regions of Indonesia. By combining behavioral insights with culturally tailored messaging, the intervention complemented existing financial aid programs such as BOS and PIP. The findings confirm that even simple, technology-driven approaches can meaningfully engage parents and students, thereby strengthening educational continuity and equity.

Moving forward, practical steps are needed to scale this model responsibly. Implementation should prioritize integration with national education platforms, partnerships with telecommunications providers, and systematic teacher and parent involvement to sustain outcomes. Ethical safeguards including robust consent procedures, data protection, and positive framing must guide wider application. Future research should evaluate long-term retention effects, conduct cost-effectiveness analyses, and explore the applicability of behavioral nudges in other sectors such as health and vocational training.

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