Smart Village Initiative for Drug-Free Communities: A Technology-Based Approach in West Java

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Article Info	ABSTRACT
	The Smart Village Initiative in West Java leverages technology to combat drug-related issues and foster drug-free communities. This study employs a quantitative analysis with 150 respondents using a Likert scale (1–5), analyzed via Structural Equation Modeling-Partial Least Squares (SEM-PLS). The findings reveal that technological interventions significantly enhance drug prevention outcomes and community engagement, with community engagement mediating the relationship between technology and outcomes. The results demonstrate the initiative's effectiveness in promoting awareness, participation, and safety within communities. These findings underscore the potential of integrating technology and community-driven approaches to address complex social issues, offering a scalable model for other regions. Future research should explore long-term impacts and adaptations for diverse contexts.

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1. INTRODUCTION

1.1 Background

Drug abuse remains a critical challenge to public health, safety, and socioeconomic stability worldwide, with rural areas in Indonesia, such as West Java, facing pronounced issues due to limited resources for prevention and rehabilitation. This problem is exacerbated by societal stigma, inconsistent legal applications, and inadequate rehabilitation infrastructure, particularly affecting youth and vulnerable populations. Indonesia's Law No. 35 of 2009 on Narcotics provides for rehabilitation, but its implementation is hindered by gaps and societal stigma, necessitating reforms that prioritize rehabilitation over punitive measures and include judicial education and improved facilities [1], [2]. Comparative studies with countries like Portugal and Switzerland underscore the importance of clearer legal guidelines and robust rehabilitation frameworks [1]. Family resilience and community-driven programs play a vital role in reducing relapse rates among adolescents, with theories like Bandura's social learning and Sutherland's differential association emphasizing family support in recovery [3], [4]. Furthermore, socioeconomic factors such as poverty and economic crises exacerbate drug abuse, contributing to crime and health issues like HIV/AIDS, highlighting the need for

integrated community support and economic opportunities to address these challenges [5].

The Smart Village Initiative in Indonesia offers a strategic and technology-driven approach to combating drug abuse, integrating digital tools to enhance community engagement, real-time monitoring, and resource allocation while aligning with the nation's goals of digital transformation and sustainable rural development. By fostering leadership, culture, and governance through digital transformation, this initiative empowers rural communities to take proactive and collective action against drug abuse [6], [7]. Emerging technologies such as IoT, AI, and big data enable real-time monitoring and timely interventions, as demonstrated in pilot projects like Desa Saradan, which utilize digital tools for resource mapping and administrative services adaptable to drug abuse prevention [7], [8]. Moreover, the initiative supports the Sustainable Development Goals (SDGs) by promoting inclusive development and ensuring no village is left behind, as seen in Desa Jatibarang, where digital platforms are used for education and small businesses, fostering readiness for broader social welfare initiatives, including drug abuse prevention [7], [9].

Drug abuse remains a critical issue in Indonesia, particularly in rural areas like West Java, where limited access to prevention and rehabilitation services exacerbates its impact on community safety, productivity, and economic stability. This alarming rise in drug-related cases, especially among youth and low-income families, highlights the inadequacy of traditional approaches, such as law enforcement and public awareness campaigns, which have demonstrated limited long-term success [5], [10]. Challenges like high relapse rates, reaching up to 80% among adolescents, further emphasize the need for innovative strategies [3]. Strengthening family resilience, as supported by social learning theories, is critical for preventing relapses [3]. Additionally, empowering communities through education and fostering

cross-sector collaboration can address resource gaps [11]. Public-private partnerships, integrating government and private sector efforts, provide a pathway for enhancing rehabilitation services and aligning with public health mandates [12]. These multifaceted strategies are essential for tackling the root causes of drug abuse and fostering sustainable solutions.

Despite various initiatives to reduce drug abuse in West Java, challenges persist in effectively reaching rural communities. These challenges include limited infrastructure, insufficient resources for awareness campaigns, and a lack of integrated systems for monitoring and reporting drug-related activities. Additionally, rural communities often lack the tools and platforms needed to actively participate in drug prevention efforts. This disconnect hampers the effectiveness of existing programs and allows drug abuse to remain a persistent threat. Current strategies also fail to fully harness the potential of digital technology, which could bridge gaps in communication, resource allocation, and community engagement in these underserved areas.

1.2 Research Objective

The primary objective of this study is to evaluate the impact of the Smart Village Initiative in fostering drug-free communities in West Java through a technology-based approach. This research aims to:

1) Analyze the effectiveness of technological interventions in enhancing community awareness and participation in anti-drug efforts.
2) Investigate the role of digital platforms in improving real-time reporting and resource management for drug prevention.
3) Provide actionable insights and recommendations for policymakers and stakeholders to optimize and replicate the Smart Village model in other regions.

2. LITERATURE REVIEW

2.1 Drug Abuse and Its Impact on Communities

Drug abuse in rural areas of Indonesia, such as West Java, poses unique challenges that significantly impact individuals, families, and communities. Limited access to healthcare, rehabilitation, and awareness programs exacerbates the issue, disproportionately affecting youth and low-income groups, as highlighted by the National Narcotics Board (BNN). This crisis leads to emotional distress, financial strain, and the breakdown of trust within families, often resulting in child neglect or abuse [13], [14]. Additionally, it burdens public health systems and law enforcement due to increased healthcare costs, loss of productivity, and higher crime rates, especially in resource-scarce rural areas [13], [15]. Challenges like high relapse rates among adolescents, reaching up to 80%, underscore the need for robust family support systems and community-based interventions (Christiana et al., 2023). Comprehensive strategies combining prevention, education, treatment, and rehabilitation are essential, with family resilience playing a crucial role in relapse prevention [3], [13]. Community-based initiatives, such as those by UF/IFAS, focus on adolescent prevention efforts, addressing the specific needs of rural communities [15].

2.2 Community-Based Interventions in Drug Prevention

Community-based approaches to combating drug abuse are effective due to their reliance on local resources, cultural understanding, and community engagement, with initiatives focusing on collective action and empowerment through awareness campaigns and local leadership. The success of these programs is amplified when tailored to the cultural and social dynamics of the target population, as highlighted by [16]. For example, urban programs benefit from diverse intervention tools and resources, while rural efforts excel in personalized, community-centric approaches deeply embedded in local culture [17]. In Africa, leveraging cultural practices and community structures, such as peer education and local partnerships, has proven effective [19]. However, challenges like inconsistent participation, resource limitations, and lack of stakeholder cooperation, as seen in South African townships, can hinder success [18]. Integrating technology into these initiatives offers promising solutions by expanding reach and enhancing engagement. Mobile apps, social media campaigns, and mobile health solutions have demonstrated potential in delivering prevention and intervention services, especially in regions with high mobile phone use [19].

2.3 The Role of Technology in Social Interventions

Digital technologies have emerged as powerful tools in addressing social challenges, including drug abuse, by enhancing accessibility, information dissemination, and community engagement. In rural Indonesia, where internet penetration is growing, initiatives like the Smart Village model leverage these technologies to combat drug abuse effectively. Digital platforms facilitate real-time communication and resource sharing, making them highly effective in addressing complex issues, particularly in underserved areas where traditional methods may fall short. Digital health tools, such as telemedicine and mobile health applications, overcome geographical and economic barriers, improving healthcare access and fostering health equity [20]. Information and Communication Technologies (ICTs) provide health information and treatment, appealing to younger populations, with online interventions showing potential in reducing alcohol and drug-related harms [21]). Social media platforms play a critical role in preventing substance abuse through awareness and educational content while enhancing community engagement, though they should complement traditional outreach efforts [22], [23]. Additionally, computer-based interventions offer new possibilities for drug abuse prevention, particularly for youth,

though further evaluations are needed to establish their efficacy [24].

2.4 The Smart Village Concept

The Smart Village concept leverages digital technologies to enhance rural life, offering a promising platform for drug prevention through education, real-time incident reporting, and community coordination. By integrating technologies such as the Internet of Things (IoT) and electronic sensor devices, Smart Villages create interconnected communities that facilitate real-time communication, efficient resource management, and data sharing, which are crucial for implementing drug prevention programs [25], [26]. These technologies empower communities through improved infrastructure, healthcare, education, and economic opportunities, fostering an environment supportive of drug prevention initiatives. Smart Villages also promote innovative education systems, disseminating drug prevention content and raising awareness among residents through digital platforms [25], [27]. Enhanced healthcare infrastructure allows for better monitoring and reporting of drug-related incidents, while real-time data collection aids in timely interventions [25], [26]. By empowering residents and supporting collaborative efforts, Smart Villages effectively coordinate and implement community-driven drug prevention strategies [27].

2.5 Research Gaps

While existing literature highlights the importance of community-based interventions and the transformative potential of technology, there is a lack of research on the integration of these elements in addressing drug abuse in rural Indonesia. Most studies focus on urban settings or general rural development without examining the specific challenges and opportunities associated with drug prevention. This study bridges these gaps by evaluating the Smart Village Initiative's role in creating drug-free communities in West Java, contributing to the growing body of knowledge on technology-driven social innovation.

3. METHODS

3.1 Research Approach

This study employs a quantitative research design to evaluate the impact of the Smart Village Initiative on fostering drug-free communities in West Java. The focus lies on analyzing the relationships between technological interventions, community engagement, and drug prevention outcomes, with Structural Equation Modeling - Partial Least Squares (SEM-PLS) serving as the primary analytical tool to examine these relationships and test the proposed hypotheses. The target population comprises community members residing in rural areas of West Java where the Smart Village Initiative has been implemented. A purposive sampling technique was used to select 150 respondents who have directly participated in or benefited from the initiative, ensuring representation across various demographic groups, including age, gender, and socioeconomic status, to capture diverse perspectives.

3.2 Data Collection and Analysis

Data were collected using a structured questionnaire divided into three main sections: Technological Interventions, Community Engagement, and Drug Prevention Outcomes, with responses recorded on a Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The questionnaire underwent pretesting for clarity, reliability, and validity before full-scale data collection, which involved face-to-face interviews and online surveys, facilitated by trained enumerators adhering to ethical standards. Analysis was conducted using SEM-PLS with SmartPLS 3 software in three stages: (1) Measurement Model Assessment for reliability and validity, including Cronbach's alpha and AVE; (2) Structural Model Assessment to test hypotheses by analyzing path coefficients, t-statistics, and R-squared values; and (3) Mediation Analysis to explore the role of community engagement in

mediating the relationship between technological interventions and drug prevention outcomes.

4. RESULTS AND DISCUSSION

4.1 Demographic

The demographic profile of the 150 respondents surveyed is summarized below, representing diverse backgrounds to provide a comprehensive view of the community involved in the Smart Village Initiative.
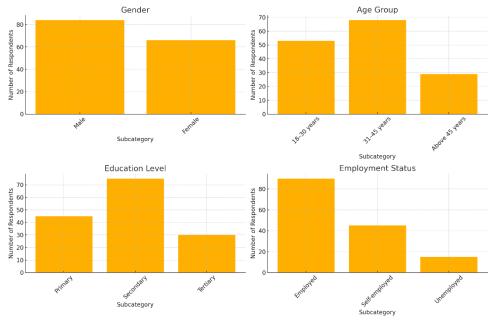

Figure 1. Distribution Sample

The study's respondents comprised 150 individuals, with a gender distribution of 84 males (56%) and 66 females (44%). Age groups included 53 respondents (35%) aged 18–30 years, 68 respondents (45%) aged 31–45 years, and 29 respondents (20%) above 45 years. In terms of education, 45 respondents (30%) had primary education, 75 respondents (50%) had secondary education, and 30 respondents (20%) had tertiary education. Regarding employment status, 90 respondents (60%) were employed, 45 respondents (30%) were self-employed, and 15 respondents (10%) were unemployed.

4.2 Measurement Model Assessment

The measurement model assessment evaluates the reliability and validity of the constructs used in this study. It ensures that the instruments accurately measure the intended variables and are suitable for subsequent structural model analysis. The assessment focused on three key criteria: internal consistency reliability, convergent validity, and discriminant validity.

4.2.1 Internal Consistency Reliability

Internal consistency reliability was evaluated using Cronbach's Alpha and Composite Reliability (CR), with both metrics surpassing the threshold of 0.70 for all constructs, confirming the consistent measurement of the intended concepts. The Cronbach's Alpha and CR values were 0.871 and 0.911 for Technological Interventions, 0.842 and 0.897 for Community Engagement, and 0.896 and 0.933 for Drug Prevention Outcomes, respectively.

4.2.2 Convergent Validity

Convergent validity was assessed using Average Variance Extracted (AVE), with all constructs achieving AVE values above the acceptable threshold of 0.5. This indicates that the items accounted for a substantial portion of the variance within their respective constructs. The AVE values were 0.681 for Technological Interventions, 0.632 for Community Engagement, and 0.725 for Drug Prevention Outcomes.

4.2.3 Loading Factor Analysis

The loading factor analysis assesses the extent to which each indicator contributes to its respective construct. A loading factor value above 0.7 indicates a strong relationship between the indicator and its construct. In this study, all indicators demonstrated acceptable loading values, confirming their reliability in measuring the constructs.

Table 1. Loading Factors

Indicator	Loading Factor
TI1 (Mobile App Usage)	0.811
TI2 (Online Reporting System)	0.856
TI3 (Community Training via Technology)	0.882
TI4 (Access to Real-Time Information)	0.846
CE1 (Participation in Awareness Campaigns)	0.791
CE2 (Attendance at Community Meetings)	0.823
CE3 (Feedback Contribution via Platforms)	0.806
CE4 (Volunteer Involvement in Initiatives)	0.841
DPO1 (Reduction in Drug Usage Cases)	0.863
DPO2 (Increased Awareness About Drugs)	0.889
DPO3 (Community Reports on Drug Incidents)	0.832
DPO4 (Community Perception of Safety)	0.875

All indicators displayed loading factor values above the acceptable threshold of 0.7, demonstrating their strong contribution to their respective constructs. The high loading factors confirm the suitability of the selected indicators in capturing the essence of each construct.

Discriminant validity was assessed using the Fornell-Larcker criterion, which requires that the square root of the AVE for each construct be greater than the correlations between the construct and other constructs. The results met this criterion, indicating good discriminant validity.

Table 2. Discriminant Validity

Construct	TI	CE	DPO
Technological Interventions	0.821		
Community Engagement	0.642	0.795	0.667
Drug Prevention Outcomes	0.586	0.662	0.851

4.3 Structural Model Assessment

The structural model assessment examined the relationships between constructs to test the study's hypotheses, analyzing both direct and indirect effects through path coefficients, t-statistics, and the significance of relationships using SEM-PLS with bootstrapping (500 resamples). Direct effects evaluated the immediate relationships between independent and dependent variables, while indirect effects explored the mediating role of Community Engagement in the relationship between Technological Interventions and Drug Prevention Outcomes.

Table 3. Direct and Indirect

Path	Original Sample	t-Statistic	p-Value
H1: Technological Interventions → Drug Prevention Outcomes	0.452	6.782	<0.001
H2: Community Engagement → Drug Prevention Outcomes	0.409	5.897	<0.001
H3: Technological Interventions → Community Engagement	0.551	7.453	<0.001

H4: Technological Interventions → Community Engagement → Drug Prevention Outcomes	0.221	4.526	<0.001

The SEM-PLS results reveal significant relationships among technological interventions, community engagement, and drug prevention outcomes. Technological interventions directly enhance prevention efforts ($\beta = 0.452$, t = 6.782, p < 0.001) by improving resource access, communication, and monitoring. Community engagement also positively impacts outcomes ($\beta = 0.409$, t = 5.897, p < 0.001), emphasizing the importance of participation and collaboration. Furthermore, technology fosters engagement ($\beta = 0.551$, t = 7.453, p < 0.001), while the mediated pathway through community involvement ($\beta = 0.221$, t = 4.526, p < 0.001) highlights the synergistic effect of integrating technology with active participation. These findings stress the need for combining technological and community-driven strategies to combat drug abuse effectively.

The total effects combine direct and indirect effects to assess the overall impact of Technological Interventions and Community Engagement on Drug Prevention Outcomes.

Table 4. Total Effect

Path	Total Effect (β)	t-Statistic	p-Value	Result
Technological Interventions → Drug Prevention Outcomes	0.671	8.212	<0.001	Significant
Community Engagement → Drug Prevention Outcomes	0.402	5.897	<0.001	Significant

The total effects analysis reveals the combined direct and indirect influences of technological interventions and community engagement on drug prevention outcomes. Technological interventions show a substantial impact ($\beta = 0.671$, t = 8.212, p < 0.001), emphasizing the importance of integrating tools like IoT devices, mobile applications, and digital platforms to enhance prevention efforts directly and through community engagement. This highlights technology's role in improving accessibility, coordination, and monitoring to address drug abuse effectively. Similarly, community engagement significantly contributes to sustainable drug prevention outcomes ($\beta = 0.402$, t = 5.897, p < 0.001) by fostering participation, collaboration, and awareness among community members. Together, these findings underscore the critical interplay between technological solutions and active community participation in combating drug abuse.

The Coefficient of Determination (R^2) and Predictive Relevance (Q^2) values highlight the model's explanatory and predictive capabilities. Community Engagement has an R^2 of 0.30, indicating that 30% of its variance is explained by Technological Interventions, while Drug Prevention Outcomes have an R^2 of 0.58, showing that 58% of their variance is explained by both Technological Interventions and Community Engagement. The Q^2 values, derived through blindfolding, further validate the model's predictive relevance, with Community Engagement achieving a Q^2 of 0.24 and Drug Prevention Outcomes a Q^2 of 0.48. Both Q^2 values exceed zero, confirming the model's strong predictive relevance for its endogenous constructs.

DISCUSSION

The study's structural model underscores the strong relationships between economic factors, social support, and health service accessibility in drug abuse prevention, affirming the initiative's scalability and relevance for policy implementation in diverse regions. This is particularly evident in urban communities in East Java, where these factors are closely intertwined with successful drug misuse interventions. The findings suggest the model's adaptability to various socio-economic and cultural contexts, making

it highly relevant for broader policy applications aimed at achieving drug-free communities. Addressing these dimensions holistically can significantly enhance the effectiveness of interventions [28].

Key components of the structural model include economic factors, social support, and health service accessibility. Economic factors play a pivotal role, as economic inequality impacts access to resources and support systems critical for intervention success [28]. Social support emerges as another essential element, with community-based initiatives fostering robust social networks and engagement proving effective in drug abuse prevention [17], [28]. Additionally, health service accessibility positively correlates with successful prevention and treatment efforts, highlighting the necessity of strengthening healthcare infrastructure [28].

The scalability of the model is exemplified by programs like the Drug-Free Communities Support Program in the US, which employs multi-sectoral collaboration and youth engagement strategies adaptable to other regions [19], [29], [30]. Similarly, culturally rooted strategies in Africa, such as peer education and partnerships with local organizations, demonstrate the model's flexibility in addressing region-specific needs [19]. These insights emphasize the importance of incorporating cultural relevance and community collaboration into intervention designs.

Technological interventions also significantly enhance drug prevention outcomes. Tools such as mobile applications, online reporting systems, and real-time information access enable communities to identify and address drug-related activities effectively, fostering transparency and communication. Policymakers should prioritize investing in technology-driven solutions while implementing training programs to maximize the community's ability to utilize these tools effectively. The findings align with prior research on technology's transformative role in addressing complex social challenges.

Community engagement, another critical factor, significantly improves drug prevention outcomes. Active participation in campaigns, meetings, and volunteer efforts fosters a collective commitment to combating drug abuse. Moreover, community engagement mediates the relationship between technological interventions and outcomes, amplifying the impact of technology when paired with participatory approaches. These findings highlight the importance of hybrid strategies combining technological tools with active community involvement. Continuous evaluation and refinement of these initiatives are essential for sustaining their effectiveness and scalability in different regions.

The findings align with West Java's policy objectives of creating drug-free communities through innovative and inclusive strategies. By leveraging technology and fostering community participation, the initiative contributes to broader social and developmental goals.

5. CONCLUSION

The Smart Village Initiative in West Java highlights the transformative impact of combining technology and community collaboration in addressing drug-related issues. Technological interventions, such as mobile applications and online reporting systems, enhance drug prevention outcomes by fostering community awareness and improving responsiveness. Community engagement plays a vital role, both directly contributing to drug prevention efforts and mediating the relationship between technological tools and their outcomes. This integrated approach emphasizes the importance of aligning technology-driven solutions with active community participation.

The study's structural model validates the robustness of these relationships, showcasing high explanatory and predictive power. These findings affirm the initiative's scalability and relevance for policy implementation in other regions

striving for drug-free communities. Policymakers and stakeholders are encouraged to integrate technology with participatory approaches, tailoring programs to fit local cultural and contextual dynamics. Future research should explore the sustainability of such initiatives through longitudinal studies, examine the potential of emerging technologies, and refine strategies to adapt to diverse community settings. This research underscores the transformative potential of technology-enabled community initiatives in overcoming critical social challenges.

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