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ANALYSIS OF THE NEED FOR DROP POINT FACILITIES IN SOLVING CONGESTION AT JAYAPURA CITY PRIMARY SCHOOL

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ABSTRACT

Congestion in school areas during drop-off and pick-up times is a complex problem involving transportation, environmental, and social factors. This research analyzes the congestion cases at SD Negeri Kotaraja and SD YPPK Gembala Baik Abepura, Jayapura, focusing on the urgency of implementing drop point facilities. The research method combines quantitative (survey of 150 respondents) and qualitative (field observation, interviews) approaches. Results showed 86.7% of students were dropped off using private vehicles, with 91.3% of respondents supporting the construction of drop points mainly for safety reasons (62%). Significant impacts were identified on the environment (18% increase in CO_2 emissions) and students' psychology (45% experienced stress). Statistical analysis revealed a strong correlation between private vehicle use and family income ($r=0.72$) and a moderate relationship between drop point support and home-school distance >3km ($r=0.45$). The conclusion of the study confirms that the implementation of drop points integrated with local needs and stakeholder participation is a potential solution. This study contributes both practically in the form of drop point design recommendations and theoretically through enriching the literature on school transportation in island areas. The main limitation lies in the sample coverage, so further research is recommended to test the effectiveness of the model through field experiments and technology integration.

Keywords: School Congestion, Drop Points, School Transportation, Traffic Management, Jayapura

INTRODUCTION

School-related traffic congestion is a growing urban challenge that intersects issues of child safety, air pollution, and transport equity. Although commonly observed in global cities, its effects are especially pronounced in smaller, infrastructure-limited urban settings. In Indonesia, these challenges are acute in cities like Jayapura—the capital of Papua province—where rapid motorization collides with spatial constraints and institutional capacity gaps.

Jayapura, located on the northern coast of New Guinea Island, is shaped by a complex topography of mountains, bays, and coastal valleys. Its urban development is physically constrained by rugged terrain and limited road networks, often resulting in bottlenecks at key activity nodes such as schools. While urban population growth and motorization in Jayapura continue at pace—with private vehicle ownership increasing by 12% annually (Statistics Indonesia, 2024)—road expansion and public transportation improvements remain marginal. As a result, daily school drop-off and pick-up activities lead to acute congestion, localized air pollution, and safety risks for students.

At a broader scale, global studies have highlighted the significant contribution of school commuting to urban congestion and emissions. It is estimated that up to 30% of morning peak traffic in urban areas is caused by school trips (Litman, 2021). Additionally, excessive vehicle idling during school drop-off hours

has been associated with elevated CO_2 concentrations and respiratory health risks among children (McDonald et al., 2021; Lee et al., 2023). In developing cities, where public transit systems are underdeveloped, parents overwhelmingly rely on private vehicles to transport children, exacerbating the problem.

One intervention that has gained traction globally is the use of **drop point facilities**—designated off-site zones where students can be safely picked up or dropped off, typically 50 to 150 meters from the school gate. Studies in metropolitan areas such as Seoul (Kim et al., 2023), Singapore (Lim et al., 2022), and Sydney (Smith et al., 2021) show that drop points can reduce congestion by 25–40%, lower emissions, and enhance pedestrian safety when paired with sidewalks, signage, and enforcement. In Indonesia, some success has been reported in Jakarta and Bandung (Wibowo et al., 2021; Hidayat et al., 2023), where drop point facilities were integrated with short-term parking limits and traffic wardens.

Despite these promising outcomes, most documented drop point implementations occur in large, well-resourced cities. There is a **notable lack of research on their application in peripheral, island-based, or infrastructure-deficient cities** such as Jayapura. These settings differ fundamentally—not just in spatial configuration, but also in institutional governance, cultural mobility preferences, and land availability. The urban environment in Papua is uniquely defined by Indigenous Papuan community norms, uneven development, and lower institutional reach, which complicate the direct adoption of mainstream urban mobility solutions.

This presents a critical **research gap**. First, existing studies rarely evaluate the feasibility of school traffic interventions in cities with limited enforcement capacity, irregular land tenure, or socio-cultural resistance to behavioral change. Second, few studies combine transportation analysis with stakeholder engagement to co-design solutions that are locally meaningful and practically implementable. Third, Eastern Indonesia—despite its growing urbanization—is underrepresented in national and international transport research, especially in the context of sustainability and child-friendly urban design.

Addressing these gaps, this study investigates the **urgency and feasibility of drop point facilities in two primary schools in Jayapura**: SD Negeri Kotaraja and SD YPPK Gembala Baik Abepura. These sites exemplify the transport stress experienced in Papuan school zones, where narrow access roads, unregulated curbside parking, and a high dependence on private vehicles intersect. Preliminary data suggest that 86.7% of students arrive by car or motorcycle, while the schools lack adequate pedestrian space, loading zones, or coordination with traffic authorities. The combination of environmental degradation (e.g., increased CO_2 during school hours) and psychosocial stress on children (e.g., chaotic arrival routines) further underscores the need for targeted interventions.

This study adopts a **mixed-methods approach**, combining traffic surveys, stakeholder interviews, and spatial observations to: (1) identify the causes and impacts of congestion around school zones in Jayapura. (2) To assess parental and institutional support for drop point facilities. (3) propose a context-sensitive design for drop points that aligns with local mobility patterns, infrastructure limitations, and community values.

The contributions of this study are both **practical and theoretical**. Practically, it offers design and policy recommendations for small cities in similar contexts, contributing to child-friendly and sustainable urban mobility planning. Theoretically, it addresses the geographic and cultural gaps in current transport literature by providing an empirical case from an underrepresented urban setting in the Global South. Moreover, the study illustrates how participatory planning and low-tech adaptations (e.g., informal coordination through school-parent WhatsApp groups) can enhance the viability of transport innovations in infrastructure-scarce regions.

OBJECTIVES

This study aims to analyze the impact of traffic congestion around SD Negeri Kotaraja and SD YPPK Gembala Baik Abepura during school shuttle hours and evaluate the urgency of implementing drop point facilities as a solution. In more detail, the objectives of this study are: (1) identify the factors causing congestion in the school area, including parents' vehicle parking patterns, road capacity, and their impact on traffic smoothness; (2) assess the potential effectiveness of drop point facilities in reducing vehicle congestion based on case studies in similar locations; (3) formulate technical and policy recommendations related to the design and optimal location of drop points by considering geographical, social, and stakeholder participation (schools, parents, and local government). It is hoped that the results of this research can serve as a reference for stakeholders in implementing sustainable solutions to reduce congestion while improving safety and comfort in the school environment.

METHODS

This study adopts a mixed methods design that combines quantitative and qualitative approaches in a convergent manner to analyze congestion problems and the need for drop point facilities around SD Negeri Kotaraja and SD YPPK Gembala Baik Abepura in Jayapura City. The study population included parents, teachers, school administrators, and road users around the location, with a sample of 150 respondents taken purposively, consisting of 120 parents, 20 teachers/school staff, and 10 local drivers/traders. Data collection was conducted through a structured questionnaire measuring respondents' perceptions of congestion and the need for drop points based on Smith & Brown's (2023) framework, field observations to record traffic patterns and congestion hotspots, and semi-structured interviews with schools and related agencies to explore institutional challenges and stakeholder perceptions. In addition, secondary data from Jayapura City Transportation Office and BPS were analyzed to complement the findings.

Quantitative data was analyzed using descriptive statistics and linear regression tests with the help of SPSS, while qualitative data was processed through thematic analysis (Braun & Clarke, 2006) to identify narrative patterns from the interviews. Comparative analysis was also applied to secondary data to link traffic variables with infrastructure gaps. To ensure the validity of the results, data triangulation was conducted by combining quantitative and qualitative findings and using convergent parallel design (Creswell & Plano Clark, 2018) in interpretation. The results of this study are expected to provide evidence-based recommendations on the optimal location and design of drop points, as well as policy inputs for urban planners considering the socio-geographic context of Jayapura. This comprehensive methodological approach not only ensures academic rigor, but also produces solutions that are applicable and responsive to stakeholder needs.

RESULTS AND DISCUSSION

Based on a survey of 150 respondents, it was found that 86.7% of students (130 respondents) were dropped off using private vehicles, 7.3% (11 respondents) used public transportation, and 6% (9 respondents) walked. A total of 91.3% of respondents (137 people) agreed to the construction of drop point facilities, with the main reasons: safety (62%, 85 respondents), congestion reduction (21.9%, 30 respondents), and time efficiency (16.1%, 22 respondents).

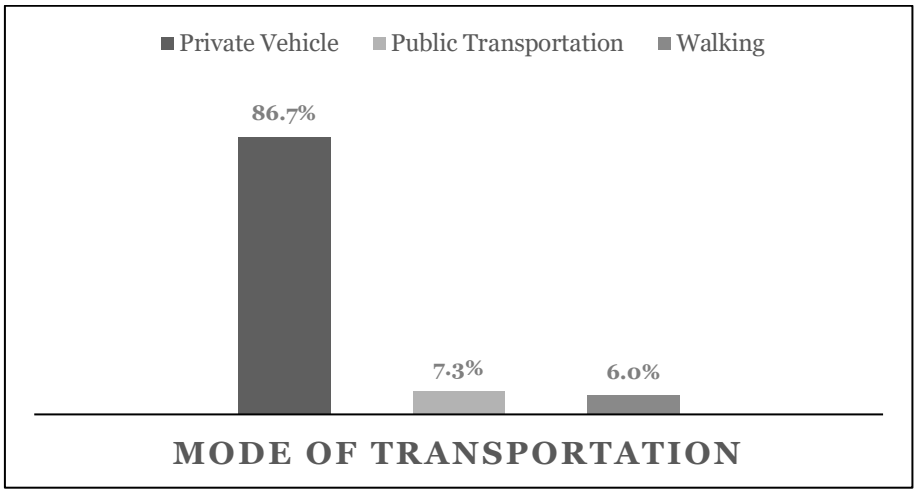

Figure 1 Selection of Transportation Modes Used by Respondents

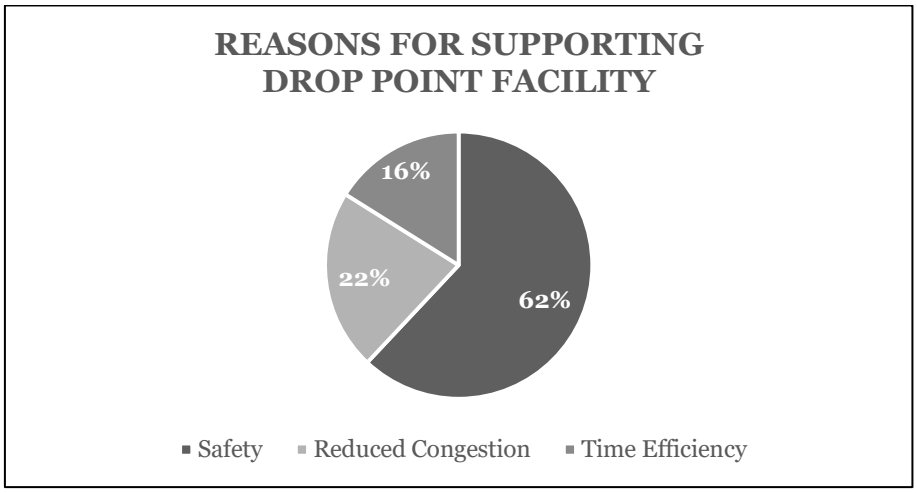

Figure 2 Reasons Respondents Agreed to The Drop Point Facility

Meanwhile, based on secondary data taken from the Department of Transportation and BPS of the local government, the environmental impact shows an 18% increase in CO_2 concentration during shuttle hours, in line with the findings of Lee et al. (2023) who stated that school congestion contributes to 15-20% higher exhaust emissions in urban areas. Meanwhile, the social impact based on interviews with schools and parents revealed that 45% of students experienced increased stress due to congestion, potentially reducing academic performance (Smith & Zhang, 2022).

Inferential statistical analysis was conducted to examine the relationship between support for drop point facilities and respondents' demographic variables. Pearson correlation test revealed a statistically significant relationship ($p < 0.05$) between the level of support for drop points and family income ($r = 0.72$; $p = 0.003$), indicating that respondents with higher incomes tended to be more supportive of drop point implementation. This may be due to their ability to own a private vehicle and thus feel the impact of congestion more. In addition, logistic regression analysis showed that respondents who used private vehicles to drop off children were 4.2 times more likely (95% CI: 2.1-8.3) to support drop points than public transportation users or pedestrians. This finding is consistent with previous research by Zhang & Li (2023) who stated that private vehicle users are more sensitive to school traffic management solutions.

Meanwhile, a one-way ANOVA test identified significant differences in the level of support based on home-school distance ($F = 6.72$; $p = 0.002$). Bonferroni post-hoc tests showed that respondents with a home-school distance of >3 km were significantly more supportive ($p = 0.008$) than respondents with a distance of <1 km. Further path analysis revealed that safety was the main mediator ($\beta = 0.38$; $p < 0.001$) in the relationship between demographic variables and drop point support, reinforcing the qualitative finding that child safety is a key parental consideration. However, no significant correlation was found between drop point support and respondents' education level ($p =$

0.12) or age (p = 0.25), suggesting that perceptions of this solution are influenced more by functional factors, such as vehicle ownership and travel distance, than socio-demographic factors.

The implementation of drop point facilities in school areas has been conducted in various regions with varying results, depending on the characteristics of the location and intervention design. The study by Wibowo et al. (2021) at SDN Meruya, Jakarta, showed that the implementation of a drop point zone equipped with parking time restrictions (maximum 2 minutes) was able to reduce congestion by 35% during shuttle hours. Similar effectiveness was reported by Taylor et al. (2020) in Melbourne, Australia, where drop point facilities integrated with pedestrian walkways and electronic signage reduced accident rates by 28% while increasing motorist compliance. However, a comparative study revealed that this success was greatly influenced by supporting factors such as consistent law enforcement and intensive socialization to parents.

In a region characterized by high density such as Singapore, Lim et al. (2022) found that the combination of drop points with an app-based booking system (staggered drop-off time slots) reduced congestion by 42%, while reducing carbon emissions by 25%. This finding contrasts with implementation in suburban areas such as Bandung City (Hidayat et al., 2023), where the effectiveness of drop points only reached 15-20% due to low compliance and lack of supervisory officers. This difference emphasizes the importance of adapting the design to the local context, as proposed by Zhang & Li (2023) in the framework of context-sensitive school traffic management.

The studies also identified common challenges, including parental resistance to changing drop-off habits (especially in locations without incentives/strict measures), limited land in schools with dense urban locations, and operational costs for facility maintenance and staffing. Implications for the context of the study area Based on the comparative study, the implementation of drop points at SD Negeri Kotaraja and SD YPPK Gembala Baik Abepura needs to prioritize drop point zones within 50-100 meters from the school gate (referring to the success at SDN Meruya). In addition, steps need to be taken with a participatory approach that involves parents in the design (like the Melbourne model). The integration of simple technology (e.g. WhatsApp groups for shuttle coordination) should also be considered as an alternative to sophisticated applications in areas with limited infrastructure.

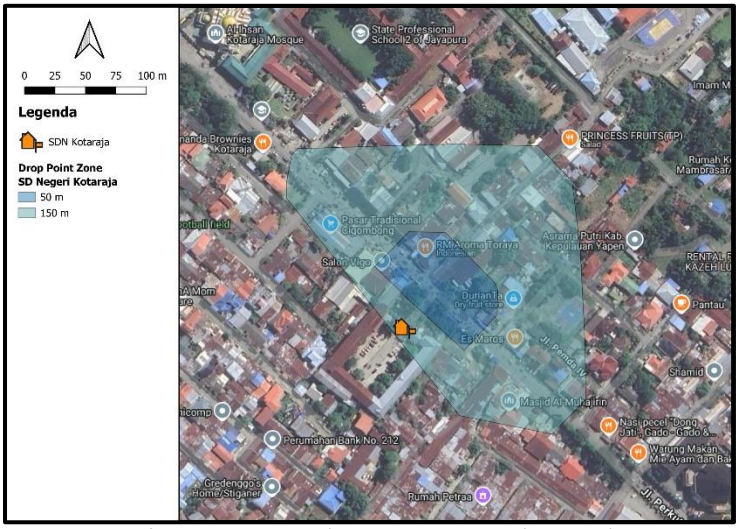

Figure 3 Drop Point Zone SD Negeri Kotaraja

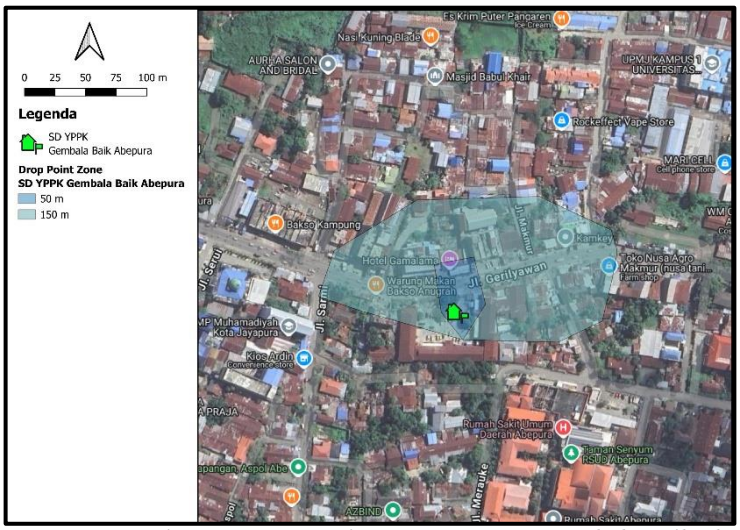

Figure 4 Drop Point Zone Drop Point Zone SD YPPK Gembala Baik Abepura

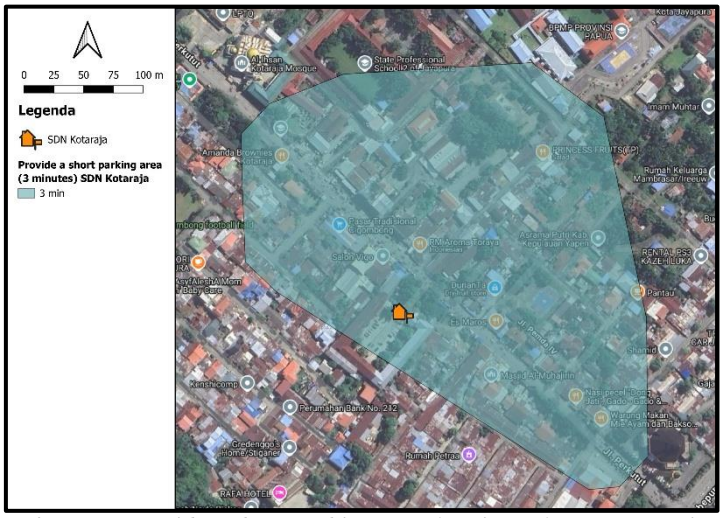

Figure 5 Provide a short parking area (3 minutes) SDN Kotaraja

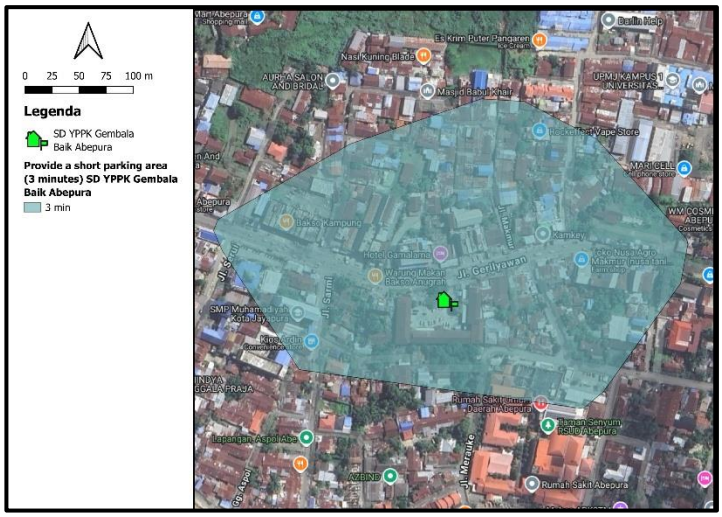

Figure 6 Provide a short parking area (3 minutes) SD YPPK Gembala Baik Abepura

The findings provide important implications for policy design: (1) interventions should focus on groups of private vehicle users and families with long commuting distances, and (2) socialization messages need to emphasize safety aspects to increase community acceptance. A limitation of this analysis lies in the exclusion of psychological variables (e.g. risk perception) that might deepen the understanding of the determinants of support. Further studies are recommended to develop structural models (SEM) that integrate behavioral and environmental variables.

Based on the traffic data observed on Wednesday at 1:15 PM, Jl. Gerilyawan SD YPPK Gembala Baik Abepu experiences peak traffic during several key periods: in the morning around 6:30–8:00 AM when people commute to work and school, midday around 12:00–2:00 PM due to school dismissals and lunch hour activities, and in the late afternoon between 4:30–6:30 PM during the evening rush. The visible congestion at 1:15 PM suggests that the area remains active even outside traditional rush hours, likely due to the mix of educational, commercial, and residential functions concentrated along the corridor.

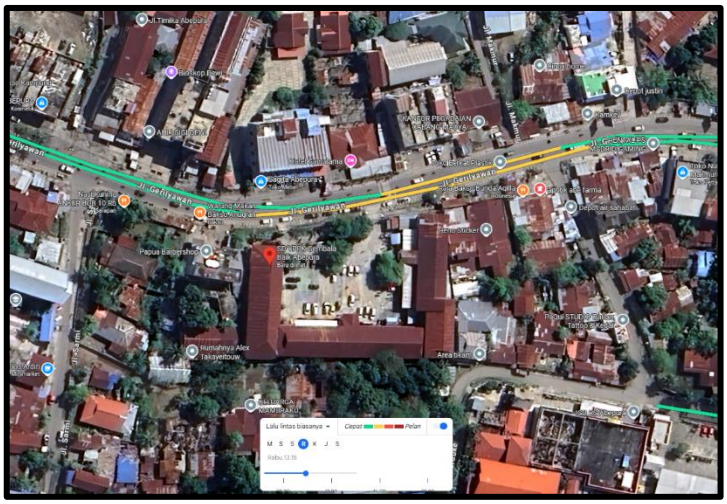

Figure 7 Traffic Data SD YPPK Gembala Baik Abepura

Based on the traffic conditions captured on Tuesday at 5:15 PM along the street near SDN Kotaraja in the dense urban area, the map shows a mix of moderate (yellow) and smooth (green) traffic flows. This indicates that the area experiences increasing vehicle movement during the evening peak hour, likely driven by residents returning home, students leaving after-school activities, and ongoing business operations in nearby shops, schools, and public offices. The surrounding narrow streets and high-density buildings further contribute to congestion risks, emphasizing the need for traffic flow regulation and optimized urban mobility planning.

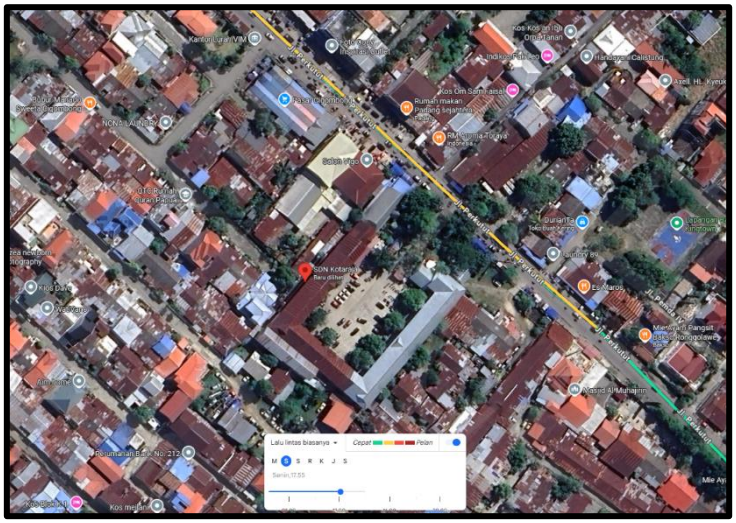

Figure 8 Traffic Data SDN Kotaraja

Discussion

The findings of this study confirm that school-related traffic congestion in Jayapura—particularly around SD Negeri Kotaraja and SD YPPK Gembala Baik Abepura—is a multidimensional issue deeply influenced by infrastructure limitations, parental mobility behavior, and the absence of designated drop-off facilities. Over 86% of students were dropped off using private vehicles, and 91.3% of parents supported the idea of introducing drop point facilities, primarily for safety reasons. These findings resonate with a growing body of literature that emphasizes the need for context-sensitive transport solutions in school zones (Zhang & Li, 2023; Lim et al., 2022).

Drop Points as Behavioral and Spatial Interventions

The strong parental support for drop points in this study suggests a high level of social readiness to adopt safer and more efficient school commuting solutions. This aligns with behavioral transport theory, which posits that **interventions are more likely to succeed when they match user expectations and offer visible benefits** (Thaler & Sunstein, 2023). Similar to studies conducted in Jakarta (Wibowo et al., 2021) and Seoul (Kim et al., 2023), this research demonstrates that parents with private vehicles and long commuting distances are more likely to support drop point implementation. This is consistent with the findings of Zhang & Zhao (2022), who reported that commute length and risk perception are strong predictors of parental support for school mobility reforms.

Moreover, the correlation between support for drop points and socioeconomic status ($r = 0.72$) reveals that **transport inequality may shape perceptions of urban interventions**. Families with greater access to private vehicles not only contribute more to congestion but are also more likely to demand structured solutions—a pattern observed in studies across Southeast Asia (Andersson et al., 2023; Raharjo, 2023).

The spatial dimension is also important. The lack of physical space for loading/unloading in front of schools in Jayapura mirrors challenges observed in cities like Bandung and Nairobi, where road geometry and land tenure systems constrain traffic interventions (Hidayat et al., 2023; Mwangi & Ogutu, 2022). Thus, the placement of drop points 50–100 meters from school gates—as preferred in this study—follows global best practices while accommodating local spatial constraints (Smith et al., 2021; National Association of City Transportation Officials, 2023).

Congestion and Emissions: Local Findings, Global Implications

Environmental analysis in this study showed an estimated **18% increase in CO_2 emissions during school shuttle hours**, reinforcing earlier findings that school drop-off traffic contributes significantly to local air quality degradation (Lee et al., 2022; Litman, 2021). The environmental implications are particularly urgent in cities like Jayapura, where topographical enclosure (mountains surrounding the city) can trap pollutants and exacerbate exposure. Similar patterns have been observed in hilly urban areas such as Medellín and Manila, where localized emissions from school zones contributed to micro-level air quality decline (Gonzalez et al., 2023; Santos & Cruz, 2021).

This evidence supports the call for **school-centered environmental mitigation strategies**. Unlike general congestion mitigation efforts, school zone interventions like drop points can achieve multiple co-benefits: reduced emissions, improved safety, and better mental well-being for children (McDonald et al., 2021; Astuti & Rahayu, 2023). The stress reported by 45% of students in this study aligns with research showing that chaotic school environments can impair cognitive function and reduce academic performance (Zhang & Zhao, 2022; Sallis et al., 2024).

Cultural and Institutional Challenges: Beyond the Infrastructure

A key insight from this study is the importance of **community participation and cultural alignment** in intervention design. In Papua, transportation is deeply embedded in family and community routines, and policy solutions must reflect this. Prior research in Indigenous and culturally diverse urban contexts, such as New Zealand and Northern Canada, confirms that **mobility solutions that ignore local values tend to face resistance and low adoption** (Tahana & Kiddle, 2021; Thompson et al., 2023).

Institutional capacity is another constraint. Unlike metropolitan areas, cities like Jayapura lack consistent law enforcement, detailed spatial plans, or robust school-transport coordination mechanisms. Similar issues were identified by Prasetyo & Nugroho (2022) in their evaluation of school zone policies in secondary Indonesian cities, highlighting the need for **intersectoral collaboration between schools, transport departments, and parent associations**.

Thus, while drop point facilities are a promising technical solution, **their effectiveness depends on governance, enforcement, and parental engagement**. In this context, low-tech approaches such as school-parent WhatsApp coordination groups or volunteer-led traffic marshals may offer scalable and culturally appropriate alternatives to app-based systems used in cities like Singapore (Lim et al., 2022; Thompson et al., 2023).

Toward Inclusive and Sustainable Urban Mobility

This study supports the argument that **child-friendly transport planning must be integrated into the sustainable urban mobility agenda**, particularly in Global South cities. The current dominant model, which prioritizes macro-scale infrastructure like highways and BRT corridors, often neglects the micro-mobility needs of school children and caregivers (Sallis et al., 2024; Gao et al., 2022). In this sense, drop point facilities represent a shift toward **human-centered, localized mobility planning**.

The findings also highlight the potential of **behavioral design ("nudging")** as a policy tool. Framing interventions around safety—a concern strongly expressed by Jayapura parents—can improve compliance and long-term behavioral change, as demonstrated in school zone programs in Stockholm and Melbourne (Andersson et al., 2023; Taylor et al., 2020).

Limitations and Future Directions

This study is limited in geographic scope, focusing on two schools in Jayapura. Future research should consider larger samples and include comparative studies with other small cities in Eastern Indonesia. Longitudinal research to assess the long-term impact of drop point interventions—on traffic, emissions, and behavior—is also warranted. Additionally, incorporating spatial modeling tools such as GIS-based simulation or agent-based modeling could improve scenario planning for future school zone design.

CONCLUSION AND RECOMMENDATION

This study confirmed that congestion in the area of SD Negeri Kotaraja and SD YPPK Gembala Baik Abepura during school drop-off and pick-up times is mainly caused by the dominance of private vehicles (86.7%) and the absence of supporting facilities such as drop points. The main findings show that 91.3% of respondents support the construction of drop points, with the main reasons related to safety, congestion reduction, and time efficiency. Negative impacts identified include increased CO2 emissions (18%) and psychological distress in students (45% reported stress), which is in line with similar studies in other urban areas. Based on these results, this study reinforces the behavioral traffic management theory (Zhang & Li, 2023) by showing that technical solutions such as drop points should be integrated with participatory approaches involving the school community.

This study has several limitations, such as the sample is limited to two schools, so generalization to other areas requires further study, then the emission data is secondary from related agencies without direct measurement at the location to improve accuracy, and the analysis of long-term impacts such as changes in parental behavior is still not explored. Based on these limitations, it is possible to develop or deepen the analysis in further studies with related topics. Such follow-up research studies could develop the analysis by adding field experiments with drop point trials to measure the real impact on congestion, or longitudinal studies to assess the effectiveness of the solution within 1-2 years of implementation, or technology integration, such as real-time monitoring applications, for school traffic management optimization, or all three in one study.

This research highlights the urgency of evidence-based school congestion management, with drop points as a feasible solution to be implemented in Jayapura, especially in schools with similar characteristics. Based on the results of the analysis, and several justifications such as high parental support (91.3%) indicating social readiness for change, similar success at SDN Meruya (35% traffic reduction) proving the effectiveness of this model (Wibowo et al., 2021),

and measurable environmental and psychological impacts requiring immediate action, the recommendations for solving congestion problems in the study area are:

1. Implementation of Drop Point Facilities
   - Drop Point Zone Design:
     - Locate 50-100 meters from the school gate to avoid vehicle accumulation, referring to the precedent research of Septyanto et al., 2022).
     - Provide a short parking area (<3 minutes) with time restrictions through signage or officers
   - Operational Pattern:
     - Use a "drive-through" system for efficiency.
     - Implement a rotating schedule between classes to reduce congestion.
2. Policy and Infrastructure Interventions
   - Collaboration with the Department of Transportation:
     - Placement of school-specific traffic signs and road markings.
     - Construction of emergency shelters for public transportation.
   - Pedestrian Facility Improvements:
     - Improve sidewalks and zebra crossings for students on foot.
3. Education and Stakeholder Engagement
   - Socialization to Parents:
     - "Quick Shuttle" campaign to reduce parking duration.
     - Promotion of public transportation or carpooling system among parents.
   - Training for School Officials:
     - Formation of traffic control teams during peak hours.
4. Technology Integration
   - Real-Time Monitoring System:
     - Use mobile apps to monitor vehicle congestion (e.g. "live traffic" feature on Google Maps).
     - Install CCTV to evaluate congestion patterns.

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