

The Effectiveness of School Safe Zones on Taman Siswa Street, Sekaran, Gunungpati District, Semarang City

Farhan Sholahudin^{1*} and Bambang Haryadi¹

¹Departement Civil Engineering, Universitas Negeri Semarang, Semarang, Indonesia

Abstract. The installation of School Safe Zones on Taman Siswa Street is considered suboptimal, given that many road users still travel at high speeds and pedestrians, especially students, teachers, and the surrounding community, have not utilized the School Safe Zones facilities. The purpose of this study is to determine the effectiveness of School Safe Zones on Taman Siswa Street, particularly in the school areas of SD N Sekaran 1 and SD N Sekaran 2. The urgency of this research is to evaluate the installation of School Safe Zones on Taman Siswa Street, especially in the school areas of SD N Sekaran 1 and SD N Sekaran 2. The approach taken includes surveys of vehicle speed, pedestrian behavior, drop-off behavior, and road equipment facilities. The results of this study are expected to benefit road users, particularly pedestrians in the school areas, by enhancing safety and security when walking and crossing the street. Based on the analysis results, it can be concluded that the effectiveness at both School Safe Zones locations is still inadequate, as many students are crossing improperly, and the behavior of escorts is also not ideal. Additionally, road users are still driving at high speeds despite the presence of School Safe Zones signage.

1 Introduction

The rate of accidents involving children on the roads continues to increase every year, particularly around school areas where students are walking and crossing the streets. This issue is caused not only by the negligence of students while on the road but also by drivers operating vehicles at high speeds, the lack of road safety facilities, and inadequate road safety measures, especially around school zones [1-2].

This situation is exacerbated by road users who are unwilling to yield and do not give the right of way to pedestrians. Additionally, pedestrians often cross the road outside of the designated facilities, such as zebra crossings [3-4].

On Taman Siswa Street, there are two elementary schools situated along the roadside, namely SD N Sekaran 1 and SD N Sekaran 2. This situation poses significant danger and potential traffic accidents given the traffic characteristics of the street, which include high volume and speed [5].

* Corresponding author: farhansholahudin@mail.unnes.ac.id

To create traffic comfort and safety, a program has been initiated to install School Safe Zones around school areas on that street. School Safe Zones are designated areas on specific road segments designed as time-based speed zones to regulate vehicle speeds in school environments [6-7]. School Safe Zones is designed to reduce vehicle speeds as they pass through these areas, enhancing safety for all road users, especially around schools [8].

However, under current conditions, the implementation of School Safe Zones is perceived as ineffective and suboptimal because many drivers still speed and pedestrians do not fully utilize the provided zebra crossings to cross the road [9-10].

Therefore, this study aims to assess the effectiveness of implementing School Safe Zones at SD N Sekaran 1 and SD N Sekaran 2 on Taman Siswa Street. The urgency of this research is to ensure that the implementation of School Safe Zones functions effectively and provides a sense of safety and comfort for road users, particularly pedestrians [11].

2 Research Methodology

2.1 Research Sites

This research activity will be carried out on the Taman Siswa Road section in the Sekaran area of Gunungpati, Semarang City, with a specific focus on the school areas including SD N Sekaran 1 and SD N Sekaran 2. The following are the research locations which can be seen in Figure 1 below :

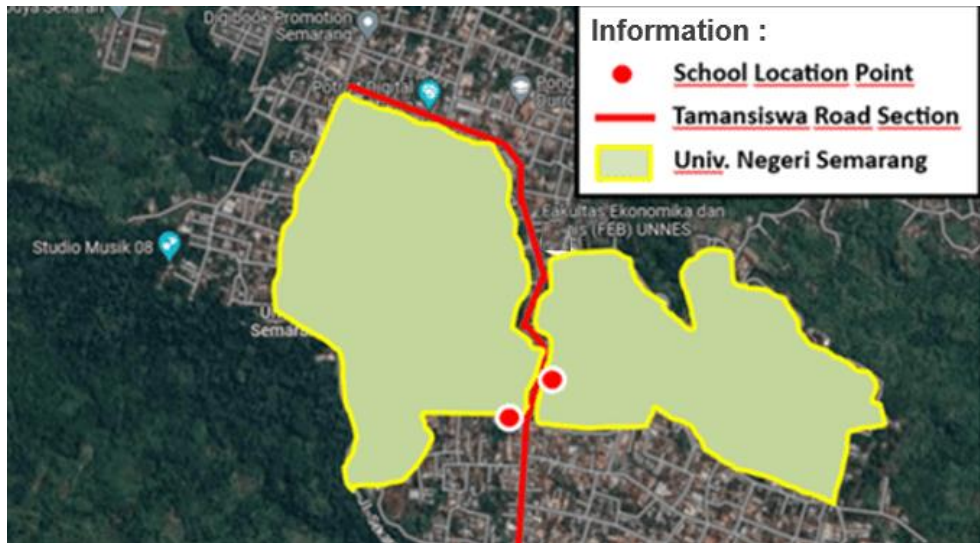


Fig. 1. Project Location

This location was chosen due to the high pedestrian activity and the need to enhance safety and traffic management for pedestrians, particularly students, in the school areas along the road. The following is a visualization of the existing conditions which can be seen in Figure 2 below:



Fig. 2. Location overview on Taman Siswa Road Section

2.2 Primary Data Collection Techniques

This research utilizes a traffic survey analysis method to understand traffic characteristics. It includes road inventory, traffic volume, vehicle speed, and level of service analysis based on the 1997 Indonesian Highway Capacity Manual [12]. For analyzing The effectiveness of the School Safe Zones program, the research involves conducting surveys on pedestrian volume and movement, as well as surveys on pedestrian behavior and characteristics, and the characteristics of the behavior of schoolchildren's guardians [13].

The road inventory survey is conducted to obtain geometric data of the road and data related to road facilities and equipment. This is done through field observations and direct measurements using road measuring tools on the Taman Siswa Road section. The road inventory survey aims to gather data for calculating road capacity [12].

The traffic volume calculation survey is conducted to determine the number of traffic flows and the population of vehicles moving at a research location [14]. This survey is performed by counting the vehicle composition that passes through the Taman Siswa Road section in Semarang City. Data collection for traffic volume and speed is carried out on weekdays for a 12-hour period (06:00-18:00 WIB) with the assistance of video cameras.

The speed survey is conducted with the aim of identifying the local traffic speed [15]. This survey is carried out by measuring the instantaneous vehicle speeds using a speed gun, which provides the average vehicle speed.

The pedestrian volume survey is divided into two classifications: crossing movements and walking along the road [16]. The survey is conducted for 4 hours with 15-minute intervals in the school areas. This takes place during school commuting hours from 06:00 to 08:00 WIB and during school dismissal hours from 12:00 to 14:00 WIB.

Observations of pedestrian behavior are based on pedestrian characteristics, including walking along the road and crossing the road [17]. As for the characteristics of road-crossing behavior:

- 1) Standard crossing procedure / 4 S (Stop, Look Right, Look Left, and Look Right again);
- 2) Crossing method (walking or running);
- 3) Facilities used (zebra cross, pedestrian overpass, or without facilities);
- 4) Pedestrian status (independent or assisted by crossing guards).

Observation of the behavior of schoolchildren's guardians involves assessing their conduct as road users, starting from stopping the vehicle, assisting the child, and resuming their journey. There are three criteria evaluated for the guardians, including:

- 1) Direction of approach by the guardian (across the school or in front of the school);
- 2) Stopping location (at designated areas or randomly);

- 3) Assisting the child out of the vehicle (left side/right side, on the sidewalk, or on the road).

After the survey, an analysis was conducted by observing the behavior of pedestrians and those who escort them. This analysis follows the guidelines from the Peraturan Direktur Jenderal Perhubungan Darat, No : SK 3236/AJ 403/DRJD/2006 concerning the trial implementation of School Safe Zones in 11 cities on the island of Java [18]. From this analysis, it will be determined whether the behavior of pedestrians and escorts in each School Safe Zones is safe or not, and it will compare the field behavior with the established standards, thereby assessing the effectiveness of the School Safe Zones implementation.

2.3 Secondary Data Collection Techniques

Road profile data are obtained from the Decree of Taman Siswa Road Sections in Semarang City, Number 621/9727/2016, which designates the status of these road sections as local roads and their functions within the city [19].

The number of students and staff at SD N Sekaran 1, SD N Sekaran 2, and MI Roudlotul Huda is required for traffic analysis and pedestrian movement. Based on the operational hours data for each school, these hours are from 07:00 to 16:00 WIB.

2.4 Data analysis technique

To determine the level of road service, you can compare traffic volume with road capacity. This comparison allows for the calculation of the Level of Service (LoS), which is a measure for assessing the performance of a road section.

According to the technical guidelines for the School Safety Zone program, there are 3 parameters for planning and determination using the Z-test [20], as follows:

- a. Vehicle Speed Analysis;

To determine the average speed on the Taman Siswa Road section, a spot speed survey is conducted. Below is the formula used for this purpose:

$$Z_{hit} = \frac{\bar{x}-20}{\frac{Sd}{\sqrt{n}}}$$

..... (equation 1)

$$\bar{x} = \frac{\sum Xi}{n}$$

..... (equation 2)

$$Sd = \sqrt{\frac{\sum (Xi-\bar{X})^2}{n-1}}$$

..... (equation 3)

- Information:
- Sd = Standard Deviation
- Xi = Speed
- (X) = Average Speed
- n = Number of sampels

- b. Analysis of Guardian Behavior Characteristics;

Based on the direction of approach, stopping location of the vehicle, and the side from which the child gets on/off the vehicle, here is the formula for analyzing the guardian behavior characteristics:

$$Z_{hit} = \frac{\bar{P}-0,5}{\sqrt{\frac{\bar{P}-0,5}{n}}}$$

$$\bar{P} = \sqrt{\frac{\Sigma group}{n}}$$

(equation 4)

(equation 5)

Information:

- Score = Vehicle position + stop location + child getting on/off the vehicle
- P⁻ = Average Score
- n = Number of sampels
- z = Test value

c. Analysis of pedestrians crossing the road;
 Characteristics of pedestrian behavior while crossing the road are based on behavior and crossing methods. Here is the formula for analyzing pedestrian crossing behavior:

$$Z_{hit} = \frac{\bar{P}-0,5}{\sqrt{\frac{\bar{P}(1-\bar{P})}{n}}}$$

(equation 6)

Information:

- Score = Vehicle position + stop location + child getting on/off the vehicle
- P⁻ = Average Score
- n = Number of sampels
- z = Test value

3 Results and Discussion

3.1 Road Capacity

Based on the conducted road inventory survey, the Taman Siswa Road section has a length of 1873 meters and a width of 5 meters with a road type of 2/2 UD. In this road section, there are 3 school areas that are the subjects of the upcoming research: SD N Sekaran 1 and SD N Sekaran 2. Here is the analysis of road capacity calculation on this road section:

$$C = Co \times Fcw \times Fcsp \times Fcsf \times Fccs.....$$

$$C = 2.900 \times 0.56 \times 0.97 \times 0.92 \times 0.9 = 1304.331 \text{ smp}$$

(equation 7)

3.2 Traffic Volume

The traffic volume data is obtained from the traffic survey by counting the vehicle composition passing through the Taman Siswa Road section in Semarang City. Data collection for traffic volume and speed is carried out on weekdays for a 12-hour period (06:00-18:00 WIB) with the assistance of video cameras. From the data processing results, the total traffic volume on the Taman Siswa Road section is 965 smp/hour during the morning peak hour from 06:30 to 07:30 WIB.

3.3 Level of Service

Based on the analysis of road capacity and traffic volume, the level of road service on the Taman Siswa Road section is as follows:

Level of Service (LoS) = Volume (V) / Capacity ©.....(equation 8)

= 965 / 1304.331

= 0.739 smp/hour

Based on the analysis of the road service level, a V/C Ratio value of 0.739 smp/hour was obtained, with a C level indicating that the traffic flow is stable, and the speed can be controlled by traffic conditions.

3.4 Speed

Based on the survey results and the processing of speed data with a sample size of 190 vehicles, the average speed on the Taman Siswa Road section is 40.75 km/h for Motorcycle (MC) and 29.65 km/h for Light Vehicle (LV).

3.5 The Effectiveness of School Safe Zones

Based on the survey results of deriver guardian behavior and pedestrian behavior at road intersections conducted at two school locations, an effectiveness analysis was carried out using the Z test at a 95% confidence level. Then the Z-table value = 1.645 is as follows:

Table 1. Analysis of the Effectiveness of School Safe Zones with Z-Test

Location Point	Pedestrian Behavior Analysis	Guardian Behavior Analysis
SD N Sekaran 1	-9.20	-8.18
SD N Sekaran 2	-10.65	-12.77

Source : Analysis results, 2024

Based on the two School Safe Zones locations, pedestrian safety levels are still unsatisfactory. The percentages of pedestrians who have not crossed using the proper road crossing procedure (the 4-T procedure: wait a moment, look right, look left, look right again) are 72.25% at the School Safe Zones location at SDN 1 Sekaran and 80.75% at the School Safe Zones location at SD 2 Sekaran. This indicates that the safety measures are not yet effective because many pedestrians are still not following the proper crossing procedure, and the awareness of safety among parents and school staff remains low.

The safety level of the behavior of the escorts at School Safe Zones) locations SDN 1 Sekaran and SD 2 Sekaran is also unsatisfactory, with the percentage of escorts who have not behaved safely being 70.64% at SDN 1 Sekaran and 80.12% at SD 2 Sekaran. In these locations, many drivers stop across from the school, which, due to the narrow road width, disrupts the traffic flow in front of the school since most of the escort vehicles are passenger cars. Furthermore, the stopping locations for vehicles at these two school locations are still random and unorganized, as it is not feasible for passenger cars to stop on the narrow road shoulders. Additionally, many passenger cars or motorcycles stop on the zebra crossing because the zebra crossing is located right in front of the school gate, which significantly disrupts the crossing activities of the students.

To improve the awareness and knowledge of students, parents, and school staff about the importance of student safety on the road, socialization and outreach on proper road crossing procedures and good traffic practices should be conducted. This effort should be supported by relevant agencies to provide early socialization to elementary school students, parents, and school staff. The socialization can take the form of educational seminars on traffic safety, inviting all elementary school students, teachers, and parents.

4 Conclusion

Based on the analysis results, it can be concluded that the effectiveness at both School Safe Zones locations is still inadequate, as many students are crossing improperly, and the behavior of escorts is also not ideal. Additionally, road users are still driving at high speeds despite the presence of School Safe Zones signage. The researcher recommends redesigning the School Safe Zones areas in accordance with previous research findings and aligning with relevant regulations, specifically the Regulation of the Peraturan Direktur Jenderal Perhubungan Darat, No : SK 3236/AJ 403/DRJD/2006.

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