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# Analyzing Transportation Safety: The Role of Signage in Preventing Accidents

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**ABSTRACT**

This article explores the critical role of signage in enhancing transportation safety and preventing accidents on roadways. Effective signage serves as a vital communication tool that informs drivers and pedestrians of regulations, hazards, and navigational guidance. Through a comprehensive analysis of existing literature and case studies, we examine how various factors—such as visibility, clarity, design, and positioning of signage—contribute to overall road safety. The article highlights the correlation between well-designed signage and a significant reduction in traffic incidents, particularly in high-risk areas. Furthermore, we discuss the psychological impact of signage on driver behavior and decision-making processes, emphasizing how clear and intuitive signage can lead to safer driving habits.The study also considers the role of technological advancements, such as digital and interactive signage, in enhancing the effectiveness of communication on the roads. By identifying the key elements that influence the effectiveness of transportation signage, this research aims to provide actionable insights for policymakers, urban planners, and transportation safety advocates to improve road safety measures. Recommendations for best practices in signage design and implementation are presented, along with case studies illustrating successful interventions. A quantitative approach was used using a Likert scale questionnaire to collect drivers' perceptions regarding safety regarding signage (traffic signs). This questionnaire focuses on identifying areas that frequently experience accidents, congestion and certain safety problems. A Likert scale was used to assess the level of satisfaction and perception regarding safety along the road. The research surveyed a total of 116 respondents who were residents of the city of Tegal.

***Keywords:*** *Transportation safety,Accident Prevention,Road Safety Measures,Visibility,Clarity*

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## INTRODUCTION

Traffic signs play a crucial role in ensuring road safety, guiding road users in an organized manner, and preventing accidents. In the city of Tegal,a significant rise in vehicle numbers and urbanization has led to increasing concerns regarding the effectiveness of traffic signage. Although traffic signs are designed to regulate, warn, and guide, improper installation, visibility issues, and lack of understanding by road users may diminish their potential to contribute to road safety. Land transportation activities are regulated under Law No. 22/2009 on Road Traffic and Transportation. The

introduction of this law is intended to ensure safety, comfort, order, and smoothness of all activities related to road traffic and transportation. Road safety is one of the most important components of a sustainable transportation system (ADB, 2010), and is often placed as the first priority. Road transportation accidents have become a serious problem in many countries, including Indonesia. Worldwide, approximately 95% of accidents occur in road transportation, and the rest in other modes of transportation (Miaou, Song, & K. Mallick, 2003)

In using transportation modes, traffic signs are needed. Traffic signs function to provide direction to drivers regarding traffic conditions to be traveled (Wahyuni, 2019). Traffic signs are part of road equipment that contains symbols, letters, numbers, and sentences and combinations therein and serves to provide warnings, prohibitions, orders and instructions for road users (Syakur & Anamisa, 2018; Saleh, 2018).Transportation users must understand the meaning contained in traffic signs. In the Regulation of the Minister of Transportation of the Republic of Indonesia Number 13 of 2014 concerning Traffic Chapter 1 Article 1 that traffic signs are part of road equipment in the form of symbols, letters, numbers, sentences, and / or combinations that function as warnings, prohibitions, orders, or instructions for road users.One of the factors leading to the increase in traffic accidents is the sharp increase in car ownership, especially motorcycle ownership, over the past decade. Another factor leading to the increasing number of traffic accidents is the lack of discipline of road users (Sugiyanto, Gito, & Santi, 2015).

With transportation system failures the leading cause of death among young people worldwide (Nirmala & Patria, 2016)Moreover, most road congestion, fatalities and injuries among young drivers aged 15-29 years occur in low- and middle-income countries (WHO, 2015). Traffic regulations, in this case (Achmad Sanusi, 1991) suggests that “low legal awareness tends to violate the law with various possible victims and losses suffered, the lower the legal awareness the more violations and the greater the victims”. Traffic control includes activities that aim to determine traffic regulations on a particular road network or road section. This form of regulation can be enforced by road facilities such as traffic islands, traffic signs, road markings, and traffic lights (traffic signals) or by authorities (traffic police and/or traffic and road transport services). Road equipment according to the Minister of Transportation Regulation number KM 14 of 2006 Chapter V Article 20, all road facilities and equipment include traffic signs, road markings, traffic signal devices (APILL) and road user control devices. Road equipment for school zones with the implementation of ZoSS has also not been very effective in reducing student crash rates (Dalono at all2012). The type of road in urban areas also affects the accident rate so it is necessary to separate the type and class of road to evaluate traffic accidents and safety (Widyastuti et al., 2016). According to Law No. 22 of 2009 article 1 paragraph (24), traffic safety is a condition of avoiding everyone from the risk of accidents during traffic caused by humans, vehicles, roads, and the environment. Law No. 22 of 2009 on road traffic and transportation aims to control traffic through engineering and other efforts to improve traffic safety. According to (Warpani, P Suwardjoko, 2002) the lack of safety attention is caused by various factors, namely

humans, vehicles, roads, and the environment. Humans play an important role in driving safety, so it is necessary to socialize driving from an early age to reduce the number of traffic accidents.

According to (Indriastuti K Amelia at all, 2011) accidents in Surabaya predominantly occur on roads which are human factors. Accidents are also dominated by motorcyclists. Accident data sourced from the Indonesian National Police (Department of Transportation, 2007) shows that more than 10,000 people died, and 32,000 people were injured, both minor and serious injuries due to traffic accidents. Seeing the large number of traffic accidents each year, good traffic awareness is needed for the community, especially among students and one of the efforts that can be made to reduce the number of traffic accidents is to behave safety riding (KARTIKA, Widyatuti, Buana, & Istiar, 2009).

From the description above, important factors in the implementation of traffic regulations are understanding of traffic norms and traffic signs in the community, knowledge of laws and regulations, knowledge of the content of laws and regulations, attitudes towards laws and regulations, and patterns of behavior in accordance with laws and regulations. Therefore, awareness of the law and compliance with traffic regulations must be instilled in all members of society who are road users. Creating a society that considers traffic safety.

This study focuses on analyzing the current situation of traffic signs in Tegal City, evaluating their effectiveness, and comparing it with the ideal standards set by transportation authorities.

Currently, Tegal City faces several challenges in maintaining and optimizing traffic signs. Despite having traffic signs in place, many are poorly maintained, faded, or obscured by infrastructure developments such as streetlights, trees, and billboards. Furthermore, road users often fail to comply with traffic signs, indicating a gap in understanding or enforcement. Inadequate education on the importance of road signs and inconsistency in signage across different parts of the city contribute to the problem. As a result, there is an observable rise in traffic violations and accidents, underlining the urgent need for a review and improvement of traffic signage.

The ideal situation would be a city where traffic signs are visible, properly maintained, and effectively guide all road users. In this ideal scenario, traffic signs would be strategically placed to ensure optimal visibility and legibility. Road users, whether pedestrians, cyclists, or drivers, would understand the signs' meanings and follow them consistently, thus reducing the number of accidents and improving overall traffic flow. A system of traffic signs aligned with national and international standards would contribute to an environment where road safety is prioritized and accidents are minimized. Several studies have explored the role of traffic signs in ensuring road safety. According to a study by Smith et al. (2020), effective traffic signage reduces the likelihood of accidents by providing clear guidance and warnings to road users. Similarly, Johnson and Miller (2018) found that the maintenance of traffic signs significantly impacts their effectiveness, with faded or damaged signs being a common factor contributing to road

accidents. Research by Ahmad et al. (2019) highlighted the importance of public education campaigns to raise awareness about the significance of traffic signs, emphasizing that knowledge and adherence are key to the success of any traffic safety system. Furthermore, studies such as those by Wibowo et al. (2021) have analyzed the urban context, showing that high-density areas like Tegal require a more strategic approach to signage placement and maintenance, considering the growing traffic volume and complexity of urban road systems.

## METHOD

This study adopts a descriptive case study approach to analyze the perspectives of city residents regarding the effectiveness of traffic signs in promoting road safety. The research employs a mixed-methods approach, combining quantitative data collection through surveys and qualitative insights gained from interviews. This methodology allows for a comprehensive understanding of how traffic signs are perceived and their impact on road safety from the viewpoint of the general public.

### Data Collection Method

The primary method of data collection will be through surveys, which will be distributed to 116 respondents living in the city of Tegal. The survey will utilize a Likert scale questionnaire, which is designed to measure the respondents' attitudes, knowledge, and opinions regarding traffic signs. The questionnaire will consist of a series of statements related to traffic sign visibility, understanding, and compliance, with response options ranging from "Strongly Agree" to "Strongly Disagree." This scale will allow the researcher to quantify the level of agreement or disagreement with various statements, facilitating the identification of key trends in public perceptions.

In addition to the surveys, interviews and observations will be conducted with a smaller sample of participants to gain deeper insights into their personal experiences with traffic signs. Interviews will be semi-structured, allowing for open-ended questions to encourage participants to elaborate on their thoughts. Observations will focus on how residents interact with traffic signs in real-life settings, noting their behaviors and reactions when encountering different types of signage.

### Instrument of Research

1. Survey/Questionnaire: A Likert scale questionnaire will be developed to assess participants' perceptions regarding the effectiveness, visibility, clarity and compliance of traffic signs. This instrument will be distributed to 116 respondents from Tegal City residents.
2. Interviews: Semi-structured interview questions will be used to gather in-depth responses from a selected group of participants. These interviews will help explore specific issues or concerns that may not be fully covered in this survey.

### Population and Sample

The study will focus on residents of Tegal City, selected for their familiarity with local traffic conditions. The total sample will consist of 116 respondents from various neighborhoods within the city. Participants will be chosen through a stratified random

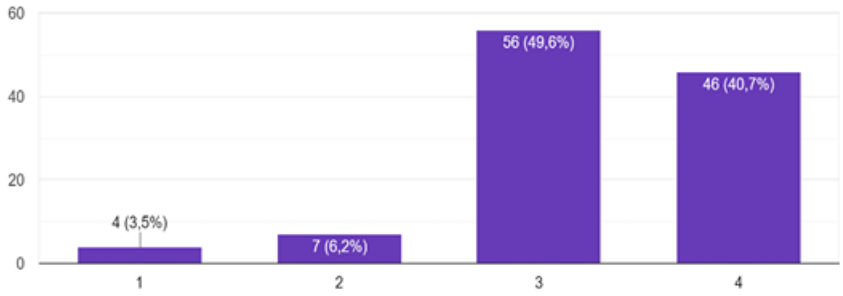
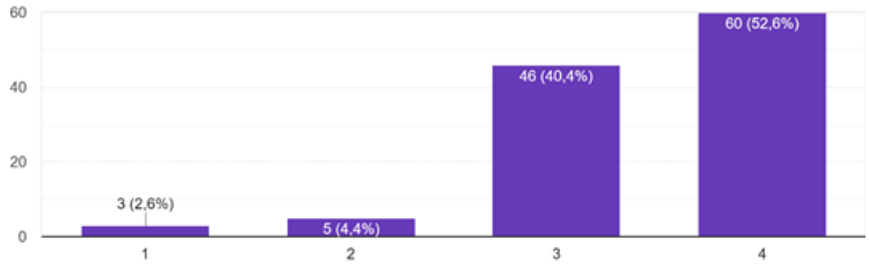
sampling technique to ensure diversity in terms of age, gender, occupation, and driving experience. This method ensures that the sample accurately represents the general population's perspectives on traffic signs.

The respondents will include both perspective (those who are actively engaged with traffic signs and follow them regularly) and non-perspective (those who may not fully adhere to or understand traffic signage). By including both groups, the study aims to compare and contrast different attitudes and behaviors towards road safety and traffic signage.

## FINDING AND DISCUSSION

### RESEARCH RESULT

Display of data used for research at the qualitative data analysis stage which presents data systematically using charts. This chart data display helps researchers to see the overall picture or a particular part of the research.

| No | Question |
|---|---|
| | **Road Condition Perception** |
| **1.** | I am familiar with the traffic signs in my area.<br>113 jawaban<br>  <br><br>**49.6% agreed that they familiar with traffic signs in their area.** |
| **2.** | I can easily recognize common traffic signs I encounter regularly<br>114 jawaban<br>  <br><br>**52.6% strongly agreed that they can easily recognize the traffic signs they usually encounter.** |

**3.** I usually notice when new signage is installed on roads I use.

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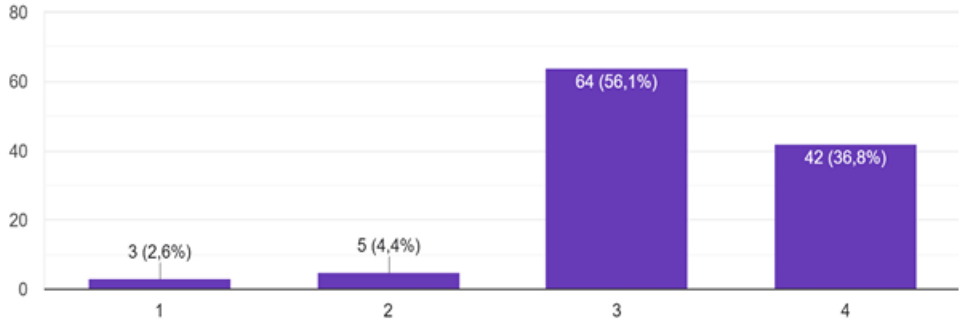


**A total of 36.8% strongly agreed that they usually pay attention when there are new signs posted on the roads they use.**

**4.** Current road signs in my area are clear and easy to understand.

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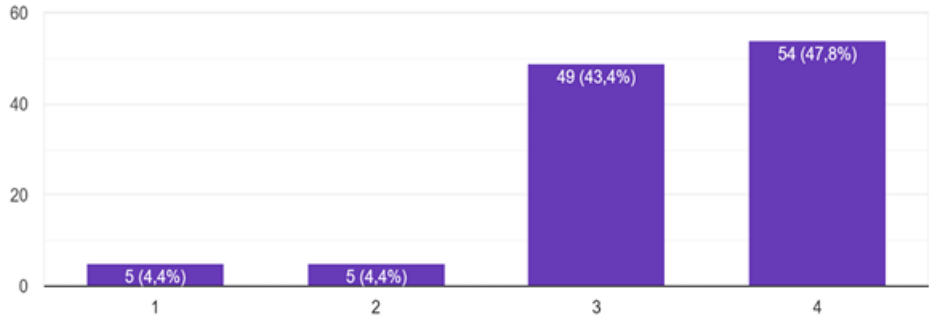


**A total of 47.8% strongly agreed that their road sign designs and colors make it easy to recognize their destination.**

**5.** The design and color of a road sign make it easy to recognize its purpose.

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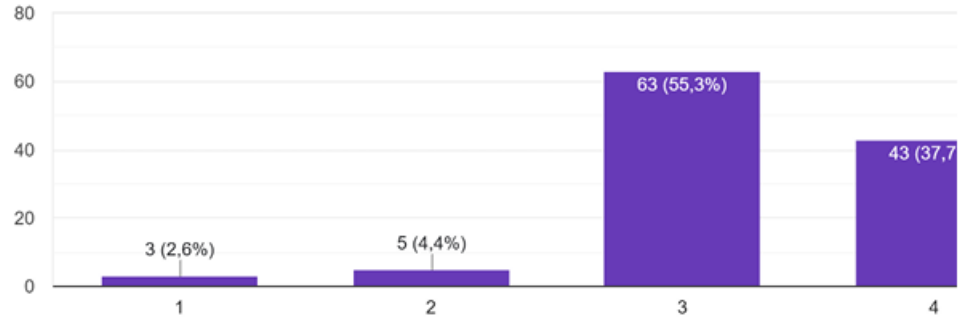


**A total of 55.3% agreed that The design and color of a road sign make it easy to recognize its purpose.**

**6.** Road signs in my area are visible from an adequate distance.

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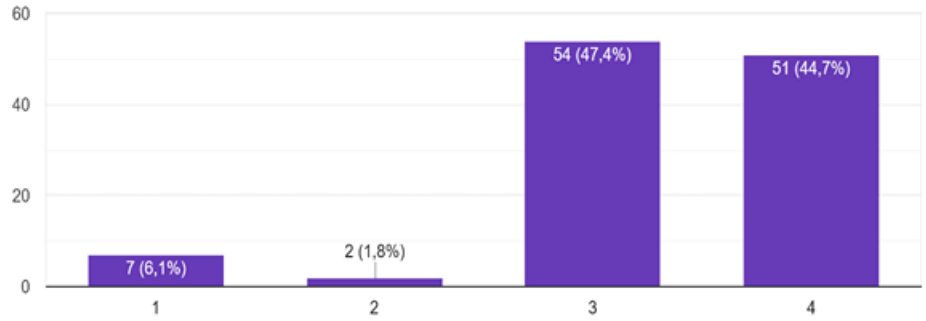


**47.4% agreed that road signs in their area are visible from a sufficient distance.**

**7.** I have changed my driving behavior based on a specific traffic sign.

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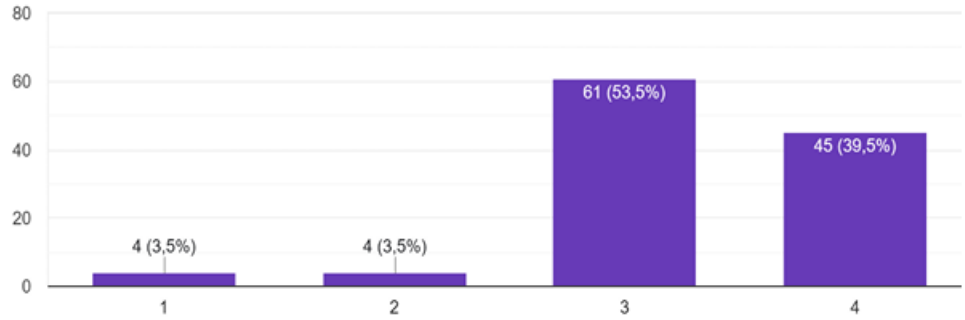


**53.5% agreed that they have changed their driving behavior based on specific traffic signs.**

**8.** Signage helps me make better driving decisions.

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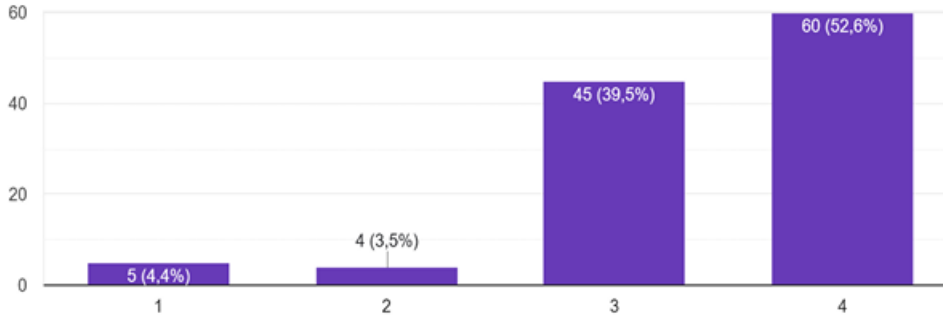


**52.6% strongly agreed that signs help them make better driving decisions.**

**9.** Warning signs prompt me to drive more cautiously than informational signs.

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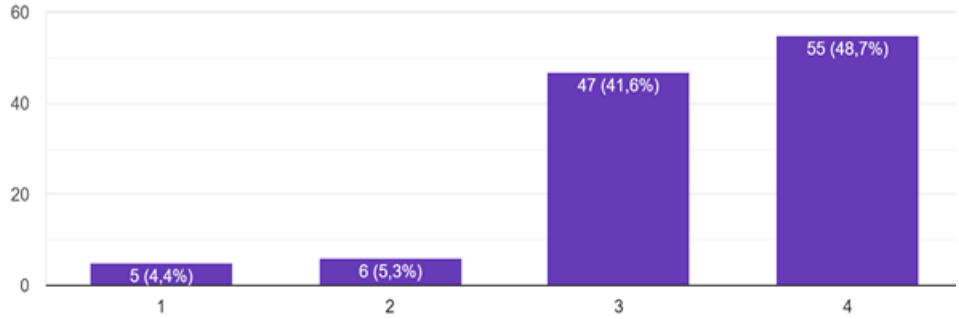


**A total of 48.7% strongly agreed that warning signs make me more careful in driving than informational signs.**

**10.** Road signs in my area effectively help prevent accidents.

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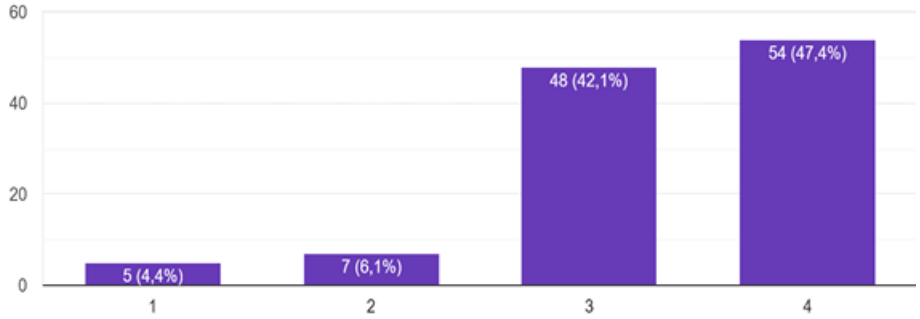


**A total of 47.4% strongly agreed that road signs in their area are effective in helping to prevent accidents.**

**11.** There was a time when I believe a road sign helped prevent a potential accident.

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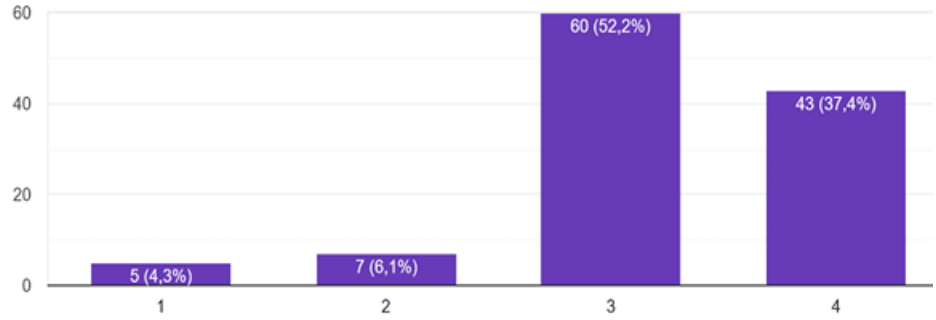


**52.2% agreed that there were times when they believed that road signs helped prevent potential accidents.**

**12.** Certain types of signage, like stop or warning signs, have a stronger impact on my driving behavior than others.

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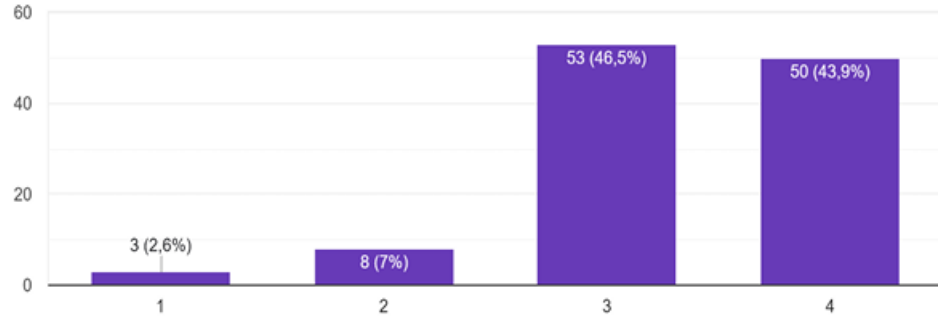


**A total of 46.5% agreed that certain types of signs, such as stop signs or warning signs, have a stronger impact on their driving behavior than others.**

**13.** Design elements (color, size, shape) are important for signage effectiveness.

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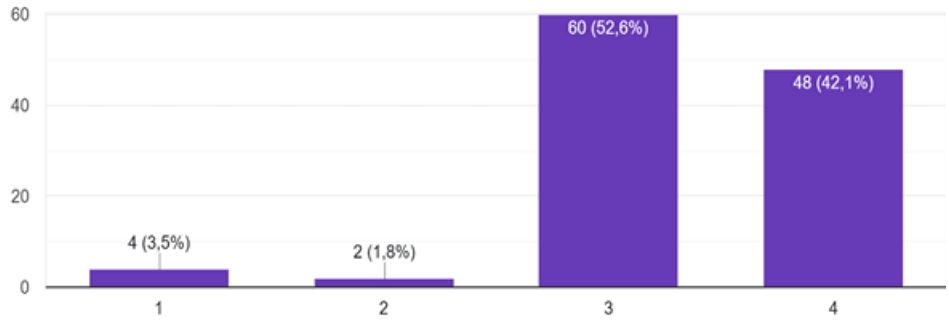


**52.6% agreed that design elements (color, size, shape) are important for signage effectiveness.**

**14.** Sign placement in my area is generally well thought-out and safe.

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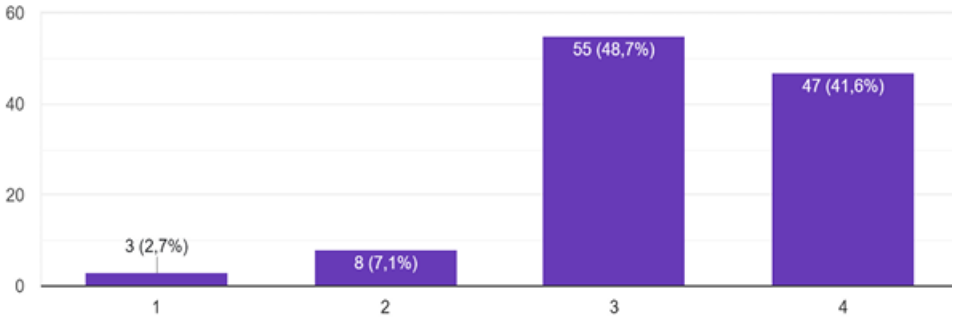


**A total of 48.7% agreed that the placement of signs in their area was generally well thought out and safe.**

**15.** I prefer digital/electronic signs over traditional signage for road safety.

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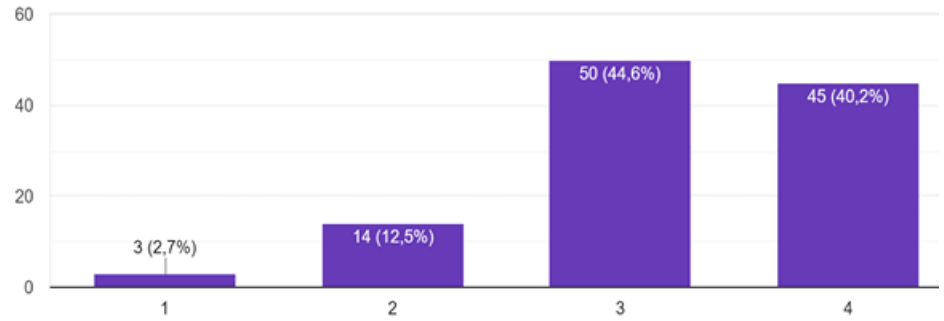


**44.6% agreed that they prefer digital/electronic signs over traditional signs for road safety.**

**16.** Interactive signage could improve my road safety experience

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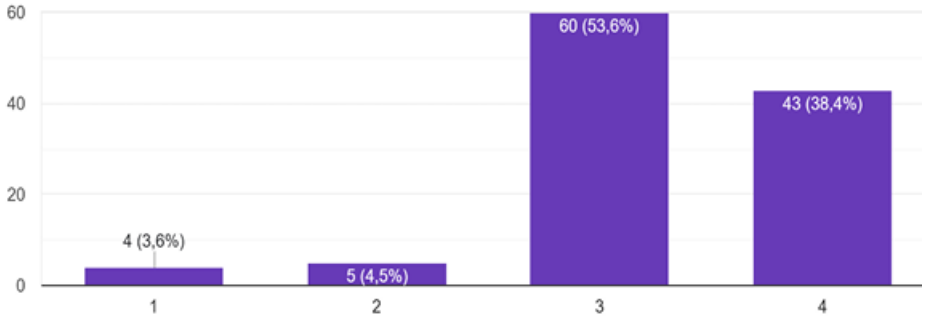


**53.6% agreed that interactive signs can enhance the road safety experience.**

**17.** I would like to see more advanced technology implemented in road signage.

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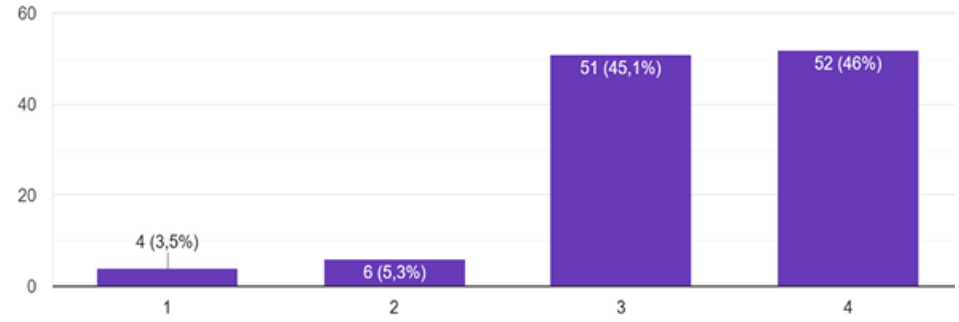


**46% strongly agreed that they would like to see more advanced technology applied to road signs.**

**18** Poorly designed or unclear signage is a common cause of accidents.

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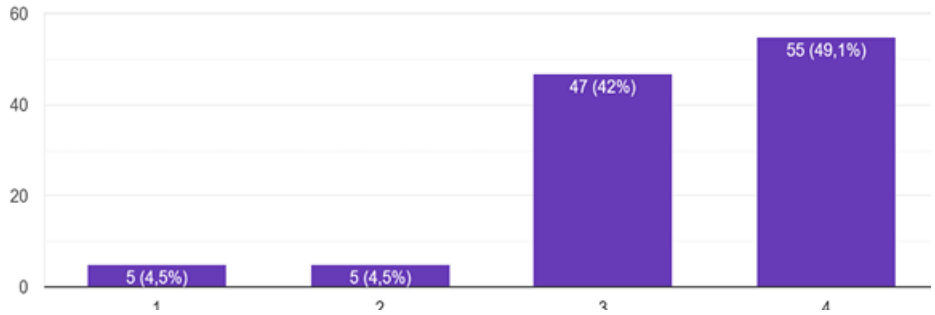


**49.1% strongly agreed that poorly designed or unclear signs are a common cause of accidents.**

**19.** Traffic signage should be updated frequently to maintain effectiveness.

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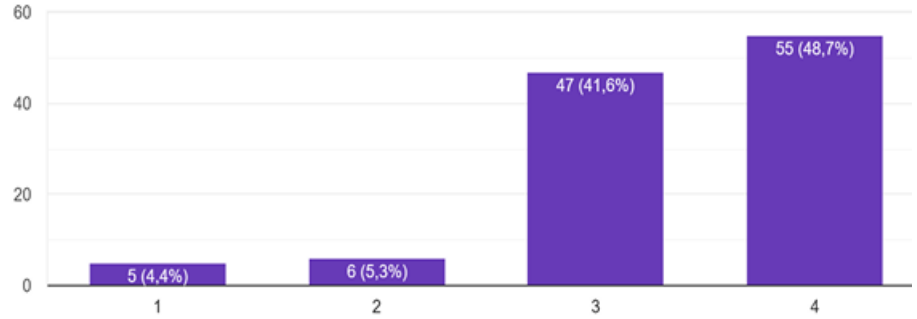


**48.7% strongly agreed that traffic signs should be updated frequently to maintain effectiveness.**

**20.** Government agencies play a key role in ensuring effective road signage.

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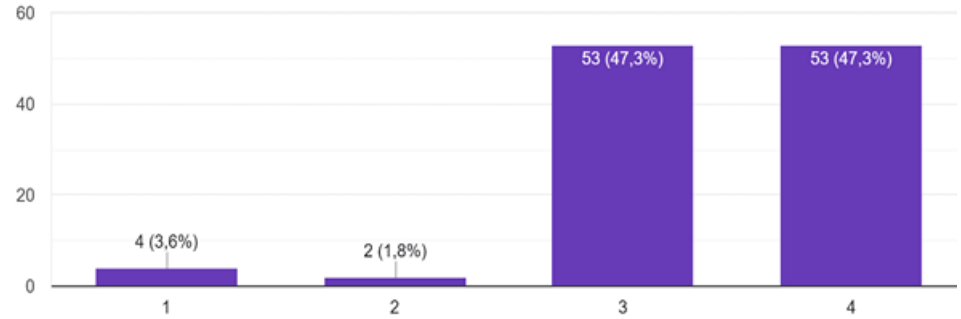


**47.3% strongly agreed and agreed that government agencies play a key role in ensuring effective road signage.**

The overview information collected from 116 respondents in Tegal City uncovered a few key discoveries with respect to the viability and recognition of activity signs in advancing street security. Underneath could be a outline of the most comes about:

1.Activity Sign Comprehension Fundamental activity signs, such as disallowance signs ("No Stopping"), were well-understood, with over 80% of respondents recognizing them accurately. More complex signs, such as caution signs (e.g., sharp bend notices) or directional signs, were less recognized, with as it were almost 50% of respondents illustrating legitimate understanding. 2.Statistic Impacts Instruction level and driving involvement were critical components affecting comprehension. Respondents with higher instruction levels and longer driving involvement appeared superior understanding of activity signs.More youthful respondents, especially those beneath 20 a long time ancient, had trouble deciphering more complex signage, highlighting a potential crevice in instruction or preparing.

3.Condition of Activity Signs Respondents as often as possible famous issues with the perceivability and support of activity signs. Common complaints included blurred signage, hindrance by vegetation or foundation, and destitute arrangement, making them troublesome to see, particularly at night.

4.Discernments of Security The larger part of respondents concurred that well-maintained and clear activity signs progress street security. Be that as it may, 40% communicated disappointment with the current condition of activity signs in Tegal City.

5.Behavioral Perceptions Perceptions indicated that many street clients ignored or misconstrued activity signs, driving to activity infringement and possibly hazardous conditions.

**DISCUSSION**

The comes about of this consider emphasize the basic part of activity signs in guaranteeing street security whereas highlighting a few crevices that require quick consideration.

1. Understanding and Compliance The consider affirmed that essential signs are moderately simple to comprehend, but complex signs stay a challenge, especially for more youthful or less experienced drivers. This finding adjusts with inquire about by Smith et al. (2020), which emphasized that natural plan and instruction are key to progressing activity sign comprehension. Focused on instruction campaigns might address this hole, centering on more youthful drivers and less experienced street clients through locks in strategies such as driving reenactments and intuitively learning apparatuses.
2. Affect of Perceivability and Upkeep Destitute upkeep and problematic situation essentially prevent the viability of activity signs in Tegal City. These discoveries are reliable with the ponder by Johnson and Mill operator (2018), which found that ineffectively kept up signs are less likely to impact driver behavior emphatically.Endeavors to frequently keep up and assess signage, combined with

the utilize of intelligent materials for way better night-time perceivability, seem address these issues.

3. Innovative Mediations Joining advanced signage and intelligently frameworks might upgrade the usefulness and versatility of activity signs. These frameworks can give real-time overhauls, making strides their adequacy in energetic activity conditions, especially in urban regions like Tegal.
4. Behavioral and Mental Components Drivers' behaviors and recognitions essentially impact the victory of activity signage in diminishing mishaps. Clear, natural signage can offer assistance cultivate more secure driving propensities. Besides, stricter requirement of activity laws, such as utilizing electronic ticketing frameworks, seem guarantee more prominent compliance.
5. Arrangement Suggestions Policymakers ought to prioritize the improvement of standardized activity signs that adjust with universal standards, guaranteeing consistency and nature for all street clients. In high-risk ranges, extra mediations such as speed cameras and activity calming measures may encourage upgrade street security.
6. Community Association Open mindfulness campaigns ought to effectively include the neighborhood community the significance of activity signs. This approach can offer assistance instill a culture of security and duty among street clients, as highlighted by Ahmad et al. (2019).

## CONCLUSION

The survey involving 116 respondents revealed significant variations in the understanding of traffic signs in Tegal City. While basic signs like prohibition signs (e.g., "No Parking") were well-recognized by over 80% of respondents, more complex signs, such as warning or directional signs, were less understood, with only around 50% of respondents identifying them correctly. Key demographic factors, including education level and driving experience, positively influenced comprehension. Conversely, younger respondents (under 20 years old) exhibited lower understanding, particularly of guide signs. These findings underscore the need for targeted interventions, as low comprehension of traffic signs can significantly increase accident risks in high-traffic areas.

## RECOMMENDATION

Based on the discoveries of this think about, a few key proposals can be made to make strides street security through way better activity signage in Tegal City:

1. Comprehensive Instruction and Mindfulness Programs It is pivotal to actualize instructive and mindfulness campaigns pointed at distinctive community bunches. This could be accomplished through school-based instruction, locks in social media campaigns, and workshops in neighborhood neighborhoods. Intelligently devices,such as driving reenactment apps and instructive recordings,

might assist move forward open understanding of activity signs and their significance.

2. Advancement of Signage Plan The complexity of a few activity signs ought to be tended to by utilizing more instinctive and effortlessly recognizable images. Clear and striking visual components ought to be joined into the plan of complex activity signs, making them more open to more youthful and less experienced street clients. Streamlining and modernizing activity signage will upgrade comprehension and adherence.
3. Customary Upkeep and Ideal Situation of Signs Activity signs ought to be frequently kept up to anticipate blurring or harm, which can ruin their viability. Furthermore, signs ought to be deliberately put to guarantee they are obvious and clear beneath different natural conditions, counting at night or amid unfavorable climate conditions. Legitimate situation will offer assistance minimize disarray and guarantee clear direction for all street clients.
4. More grounded Authorization of Activity Controls Authorization of activity directions must be upgraded to guarantee open compliance with signage. Executing stricter requirement measures, such as electronic ticketing frameworks, can offer assistance guarantee that road clients follow to activity signs and directions. This would too contribute to making a more secure driving environment.
5. Focused on Inquire about on Activity Sign Understanding and Mishap Relationships

Advance investigate ought to be conducted to investigate the relationship between activity sign comprehension and particular sorts of mishaps. This will empower policymakers to plan focused on mediations and more viable security procedures custom-made to particular activity challenges in high-risk ranges.

By receiving these measures, Tegal City can make strides street security, diminish mischances,and cultivate a more secure, more capable driving culture. These combined endeavors will contribute to a more educated open, superior activity stream, and a lessening in road-related mishaps

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