

A Correlational Study on the Visual Clarity and Comprehension Effectiveness of Road Signages among Drivers in Dumaguete City

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road signage effectiveness, visual clarity, driver comprehension, traffic safety, signage visibility, signage legibility, signage conspicuity, driver perception

Abstract. The study evaluated the effectiveness of road signages in Dumaguete City in terms of drivers' perceived visual clarity and level of comprehension, and examined the relationship between these variables within a usability-based framework. A quantitative descriptive-correlational research design was employed using purposive sampling among 110 licensed drivers who regularly operate vehicles within the city. Data were collected through a validated and reliability-tested questionnaire consisting of visual clarity assessment and a comprehension test of selected regulatory, warning, and informatory signs. Statistical tools such as frequency, percentage, weighted mean, standard deviation, and Spearman's rank correlation coefficient were used to analyze the data. Results revealed that the perceived visual clarity of road signages, in terms of visibility, legibility, and conspicuity, was generally at a moderate level, indicating room for improvement in signage design and placement. In contrast, drivers' comprehension of road signs was found to be high to very high, although inconsistencies were observed, particularly in warning signs. The findings further showed no significant relationship between drivers' profile (age and educational attainment) and perceived visual clarity, while educational attainment demonstrated a significant relationship with comprehension. Additionally, visibility was found to have a significant relationship with driver comprehension, whereas legibility and conspicuity did not. The study highlights the importance of optimizing signage visibility and simplifying design features to enhance driver understanding. Based on the findings, a targeted road signage improvement plan was proposed to address identified gaps and support safer and more efficient traffic management.

Introduction

Globally, the effectiveness of traffic management signage remains a vital concern as road traffic injuries continue to cause about 1.19 million deaths annually despite decades of intervention (Smith et al., 2023). To lessen this burden, safer road infrastructure and easily understood traffic control systems, including signage, are essential. According to studies, well-placed, easily readable, and conspicuous traffic signs improve driver comprehension and reduce collisions (Johnson et al., 2022; Brown et al., 2022; Miller et al., 2025). To achieve the global goal of halving road mortality by 2030, human-centered signage is crucial, according to Garcia et al. (2023).

On the other hand, a recent Philippine study highlights that safer road infrastructure and standardized signs are important elements of the Philippine Road Safety Action Plan 2023–2028 (Reyes et al., 2023). However, Filipino drivers only comprehend 70–76% of standardized signals, and some of them do not adhere to ISO standards (Fernandez et al., 2020; Dela Cruz et al., 2020). Regular breaches connected to signs are also highlighted by enforcement data, indicating deficiencies in both design and driver comprehension (Santos, 2021; Cruz et al., 2021). There are 15,870 violations for disregarding signs between 2023 and 2025 illustrate poor compliance among dominant vehicle groups in Dumaguete City (Traffic Management Office 2026). This suggests that the effectiveness of existing road signage in Dumaguete City remains uncertain due to the absence of localized empirical evaluation.

While various research efforts in the Philippines have concentrated on driver's comprehension, this study addresses the need for empirical evidence on the effectiveness of traffic management signage in Dumaguete's mixed traffic environment. Grounded in information processing, visual perception, and human factors theories, it evaluates whether current signs present information within drivers' perceptual limits. By measuring visual clarity and comprehension across vehicle types, the study aims to guide evidence-based improvements in signage design, placement, and driver education to promote safer and more efficient traffic flow (Wickens et al., 2021; Cai et al., 2024; Shinar, 2022; Reyes et al., 2023; Aying, 2021).

This study aligns with the Sustainable Development Goals, particularly SDG 3 (Good Health and Well Being) and SDG 11 (Sustainable Cities and Communities), by addressing road safety through better traffic signage. SDG target 3.6 calls for a reduction in deaths and injuries from road traffic crashes, while SDG target 11.2 emphasizes providing safe, accessible transport systems for all road users. The study creates local evidence to guide improvements in signage design, placement, and maintenance, promoting safer streets and lowering crash risk in a mixed-traffic provincial setting by analyzing how drivers in Dumaguete City perceive the visual clarity of road signs, how difficult it is to process these signs, and how well they are understood.

Statement of the Problem

This study evaluates the effectiveness of road signages in Dumaguete City in terms of drivers perceived visual clarity and comprehension within a usability-based framework. Specifically, it seeks to answer the following questions:

1. What is the profile of the respondent drivers in Dumaguete City in terms of:
 - 1.1 age, and
 - 1.2 educational attainment?
2. What is the level of perceived visual clarity of road signages in Dumaguete City, as assessed by the respondents, in terms of:
 - 2.1 visibility,
 - 2.2 legibility, and
 - 2.3 conspicuity?
3. What is the level of driver's comprehension of selected road signages in Dumaguete City?
4. Is there a significant relationship between the drivers' profile (age and educational attainment) and their:
 - 4.1 perceived visual clarity of road signages, in terms of:
 - 4.1.1 visibility,
 - 4.1.2 legibility, and
 - 4.1.3 conspicuity?
 - 4.2 level of signage comprehension, in terms of:
 - 4.2.1 regulatory signs,
 - 4.2.2 warning signs, and
 - 4.2.3 informative signs?
5. Is there a significant relationship between the perceived visual clarity of road signages and the level of signage comprehension?
6. Based on the findings and guided by usability theory, what recommendations can be made to improve the road signages in Dumaguete City?

Statement of Null Hypothesis

This study tests the following null hypotheses (H₀):

H₀₁: There is no significant relationship between drivers' profile in terms of their perceived visual clarity of road signages and level of signage comprehension in Dumaguete City.

H₀₂: There is no significant relationship between the perceived visual clarity of road signages and the level of signage comprehension in Dumaguete City.

Methodology

This section presents the background information on the methodology used by the researcher in this study. This covers the research design, research environment and subject, research instrument, data gathering procedure, and the statistical tool used.

Research Design

The study utilized a quantitative descriptive correlational survey design. It was descriptive because it (a) described the profile of licensed drivers in Dumaguete City in terms of age and educational attainment, (b) assessed drivers' perceived visual clarity of road signages in terms of visibility, legibility, and conspicuity, and (c) determined the level of drivers' comprehension of selected regulatory, warning, and informatory signs. It was correlational because the study examined the relationships between drivers' profiles and their perceived visual clarity and comprehension, as well as the relationship between visual clarity and comprehension of road signages.

Research Environment

The study was conducted in Dumaguete City, Negros Oriental, a rapidly growing provincial city characterized by mixed traffic composed primarily of motorcycles, tricycles, private vehicles, and public utility vehicles. Data collection sites included selected city roads, intersections, terminals, and loading areas where traffic management signages are installed and where drivers regularly pass or stop.

Research Respondents

The respondents of the study were 110 drivers who regularly use the roads within Dumaguete City. This sample size was determined using the simplified sample size approach recommended by Bullen (2022), which is designed for statistically challenged users and is based on conventional parameters such as a 95 percent confidence level, an assumed 50 percent response distribution, and an acceptable margin of error for small to medium target populations. Simple random sampling was employed to select qualified participants from the accessible driver population. Only those who (1) possessed a valid driver's license, (2) had at least three years of driving experience, and (3) drove regularly within Dumaguete were included in the sample. The respondents answered a structured questionnaire that included items on perceived visual clarity of road signages and a comprehension test on road signages. Their responses were analyzed using descriptive and correlational statistics to evaluate the effectiveness of the signs and to identify aspects of design, placement, and information content that may require improvement.

Research Instruments

The questionnaire consisted of four parts. Part I presented the disclosure statement, where drivers gave their consent to participate in the study with the assurance that all information would be treated with strict confidentiality, and it stated the purpose of the research and clarified that participation was voluntary. Part II gathered the profile of the respondents, specifically their age and highest educational attainment, and confirmed that they possessed a valid driver's license, had at least three years of driving experience, and regularly drove within Dumaguete City. Part III measured the respondents' perceived visual clarity of road signages in Dumaguete City in terms of visibility, legibility, and conspicuity, using Likert scale items that asked drivers to rate how easily road signs could be seen, read, and distinguished from their surroundings while driving. Part IV presented the comprehension test for traffic signages, where respondents were shown selected regulatory, warning, and informatory signs and answered multiple-choice questions about the correct meaning or driving action associated with each sign, with each item having one correct answer to allow the computation of comprehension scores for each sign category.

The entire questionnaire was validated by at least three experts in traffic management or related fields who had graduate-level training and research experience to ensure content relevance and clarity of items. A dry run was then conducted with 30 drivers who met all the inclusion criteria but were initially treated as a pilot group to check item wording, timing, and the clarity of instructions; their qualifications were verified in the same way as for the main sample. After confirming that the Likert scale section on visual clarity achieved acceptable reliability based on Cronbach's alpha, the responses from these 30 pilot participants were retained and merged into the final dataset. This was calculated to verify the internal consistency and reliability of the items. This was done to measure the extent to which all the variables in the scale are positively related to each other, and its theoretical value varies from 0 to 1. Higher values of alpha are more desirable, and a value of 0.70 is considered acceptable.

The following are the results:

Variables	Cronbach's Alpha Coefficients
Visibility	0.895
Legibility	0.895
Conspicuity	0.847

Ethical Considerations

To uphold the principles of sound and responsible research, strict ethical standards were observed throughout the conduct of this study, covering procedures before, during, and after data collection. Prior to the implementation of the research, ethical clearance was sought from the appropriate Foundation University Ethics Review Board and from the concerned local government or traffic management office in Dumaguete City, granting permission to conduct the study among licensed drivers in the area. All prospective respondents were provided with a disclosure statement explaining the purpose of the study, the nature of their participation, the expected duration, and how the data would be used. It was clearly emphasized that participation was voluntary and that respondents had the right to refuse or withdraw at any stage without coercion, intimidation, or penalty. The researchers also ensured that the questionnaire contained no offensive, discriminatory, or psychologically harmful questions and that measures to safeguard confidentiality and privacy were explained beforehand.

During data collection, the researchers maintained a respectful, non-judgmental, and professional demeanor to create a safe and comfortable environment for the respondents. Participants were given clear instructions and adequate time to complete the questionnaire, whether self-administered or interviewer-assisted, and they were reminded that they could skip any item they felt uncomfortable answering and that their individual responses would not be shown to employers, enforcement agencies, or any third party. Strict confidentiality procedures were observed: only the minimum necessary personal information was collected, responses were coded, and no names or plate numbers were recorded in the dataset. The study prioritized minimizing potential risks to ensure that no physical, emotional, social, or psychological harm arose from participation. Participants were informed that they could withdraw their responses or request data removal within three weeks, after which all collected data would be anonymized to protect their identities.

After data collection, all gathered information was handled with strict confidentiality. Completed questionnaires and electronic files were securely stored (e.g., in password-protected devices or locked cabinets) and were accessible only to the researchers and the statistician assisting with the analysis. The information obtained was used solely for academic and research purposes. In the presentation of findings, results were reported in aggregate form (e.g., tables and summary statistics) to prevent identification of individual respondents or specific vehicles. Upon completion of the study, data were archived and disposed of in accordance with institutional ethical and data privacy guidelines, with the researchers remaining accountable for maintaining the privacy and protection of participants even after the study concluded.

Moreover, the researchers declared that AI-based tools such as OpenAI's GPT, QuillBot, and Perplexity were used only as language support tools to improve the clarity, organization, and readability of the manuscript. These tools were not used to fabricate data, generate findings, or replace the researchers' own analysis and interpretation, and all AI-assisted outputs were carefully reviewed, revised, and validated by the researchers, who took full responsibility for the accuracy and integrity of the study's content, with an AI usage declaration attached as an appendix to ensure transparency and alignment with emerging ethical guidance on responsible AI use in research.

Research Procedure

After the research design hearing, the researchers integrated all corrections and suggestions from the panel members into the final version of the proposal. A formal letter of request to conduct the study was then prepared and endorsed by the dean of the School of Industrial Engineering and Technology of Foundation University, and this request was submitted to the Traffic Management Office in Dumaguete City to secure permission to survey licensed drivers within the area.

Once approval was granted, the researchers coordinated with designated officers in the area to identify potential respondents who met the inclusion criteria: having a valid driver's license, at least three years of driving experience, and regularly driving within Dumaguete City. During data collection, the researchers stationed themselves at designated public parking areas within the city. Following established field research protocols, a systematic intercept technique was applied wherein every third eligible driver arriving at or exiting their parked vehicle was approached, a method proven to enhance statistical power and reduce researcher bias (Ali et al., 2024). Upon intercepting the designated driver, the researchers explained the purpose and importance of the study, presented the informed consent and disclosure statement, and invited them to participate. If an intercepted driver declined or did not meet the criteria, the researchers resumed the systematic count to approach the next third driver. Drivers who voluntarily agreed were given the questionnaire with clear instructions, answered the instrument on the spot, and the accomplished questionnaires were retrieved immediately after completion to ensure a high return rate.

After data gathering, the responses were encoded and tallied using Microsoft Excel. The data were then analyzed using JAMOVI to generate descriptive statistics for driver profiles, visual clarity ratings, and comprehension scores, as well as correlation analyses between the key variables. The statistical results were interpreted considering the study's objectives,

theoretical framework, and related literature to arrive at conclusions and recommendations for improving road signages in Dumaguete City.

Statistical Treatment of the Data

The tools that were used by the researchers in analyzing the data (after checking the necessary assumptions) were the following.

Frequency and percent. These were used to describe the profile of the drivers in terms of age and educational attainment, and to summarize categorical information such as inclusion criteria status (valid license, years of driving, regular driving in Dumaguete).

Weighted mean and standard deviation. These were used to determine the level of perceived visual clarity of road signages in terms of visibility, legibility, and conspicuity, based on the Likert scale items in the questionnaire.

Mean and standard deviation. These were used to obtain the average comprehension scores of drivers for the selected regulatory, warning, and informatory signs, based on the number of correct answers in the comprehension test.

Kolmogorov–Smirnov test (or Shapiro–Wilk test). These tests were used to assess whether the distributions of the main quantitative variables (visual clarity scores and comprehension scores), which is the p-value < 0.05, which results to a non-normal distribution and the data will be analyze using non-parametric test for the correlational statistics.

Spearman rank correlation coefficient. This was utilized to determine the degree of relationship between: (a) drivers’ age and their perceived visual clarity of road signages, (b) drivers’ age and their comprehension scores, (c) drivers’ educational attainment and their perceived visual clarity, (d) drivers’ educational attainment and their comprehension scores, and (e) perceived visual clarity and comprehension scores, since the visual clarity data were in ordinal scale and age and educational attainment could be treated as ordinal or non-normally distributed.

The following interpretations will also be applied by the researchers to describe the effectiveness of road signages:

The following interpretations will also be applied by the researchers to describe the drivers perceived visual clarity and level of visual clarity of road signages:

Score	Scale	Verbal Description	Level of Visual Clarity	Explanation
5	4.21 – 5.00	Strongly Agree (SA)	Very High (VH)	Signs are consistently very easy to see, read, and notice in different conditions; design and placement are highly effective.
4	3.41 – 4.20	Agree (A)	High (H)	Signs are generally clear and noticeable; drivers can usually see and read them without difficulty.
3	2.61 – 3.40	Neutral (N)	Moderate (M)	Signs are sometimes clear but occasionally hard to see, read, or notice, indicating room for improvement.
2	1.81 – 2.60	Disagree (D)	Low (L)	Signs are often difficult to see, read, or distinguish from the surroundings, which may affect driver behavior.
1	1.00 – 1.80	Strongly Disagree (SD)	Very Low (VL)	Signs are consistently unclear, poorly visible, or easily overlooked, making them ineffective for many drivers.

The following interpretations will also be applied by the researchers to describe the drivers’ level of comprehension of traffic signages (per sign category):

Scale	Verbal Description	Explanation
4.21 – 5.00	Very High	Drivers almost always understand the signs correctly; meanings are clear and familiar.
3.41 – 4.20	High	Drivers generally understand the signs, with only occasional errors or confusion.
2.61 – 3.40	Moderate	Understanding is mixed; several signs are misunderstood and may require redesign or education.

1.81 – 2.60	Low	Many signs are not understood correctly; drivers are at risk of misinterpreting important messages.
1.00 – 1.80	Very Low	Drivers usually do not understand the signs; urgent improvement or replacement is needed.

Interpretation of correlation coefficients (for Spearman’s rho). To identify the degree of relationship between two variables (e.g., age vs. visual clarity, visual clarity vs. comprehension), the following descriptions will be applied:

	Value of r	Strength of Relationship
Between	±0.50 to ±1.00	Strong relationship
Between	±0.30 to ±0.49	Moderate relationship
Between	±0.10 to ±0.29	Weak relationship
Between	±0.01 to ±0.09	Very weak relationship

Results and Discussion

This chapter provides, discusses, and evaluates the results of the research. Four major parts comprise this chapter, namely: (1) the demographic profile of the respondent drivers in Dumaguete City, (2) the level of perceived visual clarity of road signages in terms of visibility, legibility, and conspicuity, (3) the level of drivers’ comprehension of selected road signages, and (4) the examination of the correlation and significance between the drivers’ profile and their perceived visual clarity and signage comprehension.

The survey data collected from the 110 respondent drivers in Dumaguete City is presented in the form of tables. The tables are then interpreted, and meanings are provided for a greater understanding of the results. This analysis aims to determine the effectiveness of road signages within a usability-based framework to promote safer driving behavior and more efficient traffic flow.

Age	Frequency	Percent (%)
18-19	21	19.1%
20-21	17	15.5%
22-23	17	15.5%
24-25	28	25.5%
26-27	27	24.6%
Total	110	100.0

Table 1 Frequency of Drivers’ Age

Table 1 reveals that the majority of the 110 respondents are young adults, primarily aged 18–27 (84.7%). Because this demographic typically possesses optimal visual acuity, their comprehension of signage depends more on physical design and placement than personal vision limitations. However, since those aged 18–23 often lack extensive driving experience, they remain highly susceptible to environmental distractions. To minimize errors for this younger population, Dumaguete City’s road signs must be simplified and highly conspicuous to facilitate rapid information processing.

Educational Attainment	Frequency	Percent (%)
High School Level	17	15.5%
College Undergraduate	68	61.8%
College Graduate	25	22.7%
Total	110	100.0

Table 2 Frequency of Drivers’ Educational Attainment

Table 2 highlights that over 84% of respondents have reached the tertiary education level, including college undergraduates (61.8%) and graduates (22.7%). While this high educational attainment generally supports the comprehension of symbol-based signage (Santos et al., 2024), the high school level cohort (15.5%) represents a critical safety demographic. Drivers with lower educational backgrounds may experience delayed or inaccurate interpretation of abstract symbols (Fernandez et al., 2020; Tan, 2023). Consequently, Dumaguete City’s traffic signs should prioritize universal, intuitive designs to remain inclusive across all educational levels and minimize cognitive errors (Mustapha, 2023; Zhao et al., 2023).

Indicators	\bar{x}	VD	LoVC	SD
1. Road signs are large to be easily seen from a safe distance.	3.67	A	H	0.76
2. Road signs are clearly visible during daytime under normal weather conditions.	3.54	A	H	0.92
3. Road signs are visible and detectable early enough for me to prepare my next maneuver safely.	3.17	N	M	0.92
4. Road signs are not blocked by trees, posts, parked vehicles, or other obstructions.	2.95	N	M	1.02
5. Road signs remain visible even during heavy traffic or when multiple vehicles are in front of me.	2.69	N	M	1.01
6. Road signs are clearly visible at night or in low -light conditions.	2.63	N	M	0.90
Composite	3.11	N	M	0.75

Table 3 Levels of Driver’s Perceived Visual Clarity of Road Signages in Dumaguete City in terms of Visibility

Table 3 shows that drivers rated sign size ($\bar{x} = 3.67$) and daytime visibility ($\bar{x} = 3.54$) highly, indicating that most road signs are visible during the day and generally meet standard size requirements. This supports findings that proper dimensions and natural lighting improve sign visibility (3M Science, 2024; Zhao et al., 2023). However, obstructions ($\bar{x} = 2.95$), heavy traffic ($\bar{x} = 2.69$), and nighttime visibility ($\bar{x} = 2.63$) received only moderate ratings, suggesting that blocked views, traffic distractions, and poor lighting reduce sign clarity and may delay driver response (Pan et al., 2021; Yee et al., 2023). Proper sign placement and height are also important in addressing these issues (Wong, 2020; Garvey et al., 2021). Overall, the composite mean of 3.11 indicates moderate visibility, highlighting the need for better materials, proper placement, and regular maintenance to improve road safety (Mustapha, 2023; Lyu et al., 2022; 3M Science, 2024).

Indicators	\bar{x}	VD	LoVC	SD
1. Road signs in Dumaguete City can be read and understood quickly without requiring me to slow down significantly.	3.45	A	H	0.93
2. Road signs in Dumaguete City uses font sizes that are easy to read while driving.	3.44	A	H	1.01
3. Road signs in Dumaguete City uses simple and clear symbols that are easy to recognize.	3.28	N	M	0.78
4. Road signs in Dumaguete City are not crowded with too much information on a single sign.	3.22	N	M	0.91
5. Road signs in Dumaguete City uses simple and concise wording that is easy to understand.	2.97	N	M	1.13
6. Road signs in Dumaguete City remains easy to read at night or during rainy conditions.	2.82	N	M	0.97
Composite	3.20	N	M	0.77

Table 4 Levels of Driver’s Perceived Visual Clarity of Road Signages in Dumaguete City in terms of Legibility

Table 4 shows that drivers highly rated the ability to read and understand signs quickly ($\bar{x} = 3.45$) and the appropriateness of font size ($\bar{x} = 3.44$), indicating that most signs are generally easy to read and follow standard design guidelines (3M Science, 2020; Schieber et al., 2022). However, symbol simplicity ($\bar{x} = 3.28$), information density ($\bar{x} = 3.22$), concise wording ($\bar{x} = 2.97$), and readability during rain or night ($\bar{x} = 2.82$) received moderate ratings, suggesting that some signs contain too much information and are harder to understand under poor conditions (Liu et al., 2021; Kaufman, 2022; Pan et al., 2021). Overall, the composite mean of 3.20 indicates moderate legibility, highlighting the need for simpler symbols, shorter messages, and improved readability to enhance driver response and road safety (Mustapha, 2023; Lyu et al., 2022; Zhao et al., 2023).

Indicators	\bar{x}	VD	LoVC	SD
1. Road signs are mounted at a height and an angle that make them easy to notice.	3.61	A	H	1.14
2. Road signs use colors and shapes that easily catch my attention.	3.55	A	H	0.93
3. Road signs are placed at locations where drivers naturally look while driving.	3.46	A	H	1.19
4. Road signs attract my attention in time for me to react safely.	3.33	N	M	0.94
5. Road signs are not easily confused with advertisements, billboards, or another roadside.	3.23	N	M	0.92
6. Road signs stand out clearly from buildings, trees, and other background objects.	3.09	N	M	0.98
Composite	3.38	N	M	0.77

Table 5 Levels of Driver's Perceived Visual Clarity of Road Signages in Dumaguete City in terms of Conspicuity

Table 5 shows that proper mounting ($\bar{x} = 3.61$), attention-catching colors ($\bar{x} = 3.55$), and placement within drivers' natural sightlines ($\bar{x} = 3.46$) received high ratings, indicating that most road signs are well-positioned and visually noticeable, consistent with DPWH standards (Garvey et al., 2021; Zhao et al., 2023). However, attracting attention quickly ($\bar{x} = 3.33$), differentiating from advertisements ($\bar{x} = 3.23$), and standing out from background objects ($\bar{x} = 3.09$) were rated moderate, suggesting that some signs blend with surrounding visual clutter and may delay driver response (Wong, 2020; Sign Research Foundation, 2022; Garvey et al., 2021). Overall, the composite mean of 3.38 indicates moderate conspicuity, highlighting the need to improve visual contrast, reduce distractions, and use better materials to ensure faster sign recognition and enhance road safety (Mustapha, 2023; Lyu et al., 2022; Pan et al., 2021).

Type of Sign	Mean	Verbal Description
Informatory Signs	4.69	Very High
Regulatory Signs	4.60	Very High
Warning Signs	3.93	High

Table 6 Level of Driver's Comprehension of Selected Road signage in Dumaguete City

Table 6 shows that Informatory Signs ($\bar{x} = 4.69$) and Regulatory Signs ($\bar{x} = 4.60$) received very high ratings, indicating that drivers easily understand these signs due to their familiarity and simple design (Berrio et al., 2023; Gonzales et al., 2023). Warning Signs scored slightly lower but still high ($\bar{x} = 3.93$), suggesting that they require more time to interpret because drivers must assess potential hazards and their surroundings (Ng & Chan, 2020; Chen et al., 2021). This supports the findings of Zhao et al. (2023) that warning signs are not as instantly recognized as other sign types. Overall, the results highlight the need to improve warning signs by using clearer and more direct symbols to enhance faster comprehension and road safety (Mustapha, 2023; Lyu et al., 2022).

Drivers' Profile	r_s	p-value	Decision	Remark
Age	-0.177	0.695	Fail to Reject H_0	Not Significant
Educational Attainment	0.104	0.278	Fail to Reject H_0	Not Significant

Level of Significance = 0.05

Table 7 Relationship Between Drivers' Profile and their Level of Perceived Visual Clarity of Road Signages in terms of Visibility

Table 7 shows no significant relationship between drivers' age ($p = 0.695$) and educational attainment ($p = 0.278$) with perceived visual clarity in terms of visibility, as both p-values are above 0.05. This indicates that age and educational background do not affect drivers' ability to see road signs in Dumaguete City. This may be due to respondents belonging to similar age groups and because sign visibility is more influenced by external factors such as brightness, size, and placement rather than personal characteristics (Schieber et al., 2022; Wontorczyk et al., 2021). Studies also explain that visibility is mainly a sensory process of detecting signs rather than understanding them (Pan et al., 2021; Garvey et al., 2021). These findings suggest that improving sign brightness, size, and placement should be prioritized to enhance visibility for all drivers (Mustapha, 2023; Yee et al., 2023; Zhao et al., 2023).

Drivers' Profile	r_s	p-value	Decision	Remark
Age	-0.048	0.622	Fail to Reject H_0	Not Significant
Educational Attainment	-0.076	0.430	Fail to Reject H_0	Not Significant

Level of Significance = 0.05

Table 8 Relationship Between Drivers' Profile and their Level of Perceived Visual Clarity of Road Signages in terms of Legibility

Table 8 presents no significant relationship between drivers' age ($p = 0.622$) and educational attainment ($p = 0.430$) with perceived visual clarity in terms of legibility, as both p-values exceed 0.05. This indicates that age and educational background do not significantly affect how drivers read road signs in Dumaguete City. This may be because legibility depends more on design factors such as font size, color contrast, and clarity rather than personal characteristics (3M Science, 2020; Schieber et al., 2022). These findings suggest that improving typography, visual contrast, and sign standardization should be prioritized to enhance road safety for all drivers (Lyu et al., 2022; Liu et al., 2021; Mustapha, 2023; Zhao et al., 2023).

Drivers' Profile	r_s	p-value	Decision	Remark
Age	0.265	0.005	Reject H_0	Significant
Educational Attainment	0.298	0.002	Reject H_0	Significant

Level of Significance = 0.05

Table 9 Relationship Between Drivers' Profile and their Level of Perceived Visual Clarity of Road Signages in terms of Conspicuity

Table 9 reveals a significant relationship between drivers' age ($p = 0.005$) and educational attainment ($p = 0.002$) with perceived visual clarity in terms of conspicuity, as both values are below the 0.05 significance level. This indicates that age and educational background influence how well drivers notice road signs in Dumaguete City. Older and more experienced drivers may be better at identifying signs despite visual distractions due to greater driving exposure (Wontorczyk et al., 2021; Schieber et al., 2022), while those with higher educational attainment may better distinguish official signs from surrounding visual clutter (Santos et al., 2024; Chen et al., 2021). These findings suggest that improving sign distinctiveness and reducing background distractions are important to help all drivers quickly notice road signs and improve road safety (Miller, 2021; Mustapha, 2023; Garvey et al., 2021; Wong, 2020).

Driver's Profile	r_s	p-value	Decision	Remark
Age	-0.260	0.006	Reject H_0	Significant
Educational Attainment	-0.183	0.056	Fail to Reject H_0	Not Significant

Level of Significance = 0.05

Table 10 Relationship Between Driver's Profile and their Level of Signage Comprehension in terms of Regulatory Signs

Table 10 shows a significant negative relationship between age ($r_s = -0.260$, $p = 0.006$) and comprehension of regulatory signs, while educational attainment shows no significant relationship ($p = 0.056$). This indicates that as drivers age, their understanding of regulatory commands such as "Stop" or "No Entry" tends to decrease, while education does not significantly affect comprehension. Younger drivers may better understand these signs due to more recent exposure to driving education and licensure training (Gonzales et al., 2023; Fernandez et al., 2020), whereas older drivers may rely more on habitual driving behavior (Miller, 2021; Zhao et al., 2023). The lack of influence from education suggests that regulatory signs are generally simple and universally understood. These findings highlight the need for refresher programs for older drivers to ensure consistent understanding of traffic rules and improve road safety (Dela Cruz et al., 2020; Berrio et al., 2023; Mustapha, 2023; Santos et al., 2024).

Driver's Profile	r_s	p-value	Decision	Remark
Age	-0.108	0.260	Fail to Reject H_0	Not Significant
Educational Attainment	0.231	0.015	Reject H_0	Significant

Level of Significance = 0.05

Table 11 Relationship Between Driver's Profile and their Level of Signage Comprehension in terms of Warning Signs

Table 11 shows no significant relationship between age ($p = 0.260$) and comprehension of warning signs, but a significant positive relationship with educational attainment ($r_s = 0.231, p = 0.015$). This indicates that age does not affect how drivers understand warning signs, while higher education is associated with better comprehension. Drivers across age groups appear to have similar basic awareness of road hazards (Wontorczyk et al., 2021), but those with higher educational attainment may better interpret abstract symbols commonly used in warning signs (Chen et al., 2021; Ng & Chan, 2020). These results suggest that education plays a more important role than age in understanding warning signs. To improve comprehension for all drivers, warning sign designs may need simplification and stronger emphasis in driver education programs (Mustapha, 2023; Santos et al., 2024; Fernandez et al., 2020).

Driver's Profile	r_s	p-value	Decision	Remark
Age	0.214	0.025	Reject H_0	Significant
Educational Attainment	0.445	< .001	Reject H_0	Significant

Level of Significance = 0.05

Table 12 Relationship Between Driver's Profile and their Level of Signage Comprehension in terms of Informative Signs

Table 12 shows a significant positive relationship between age ($p = 0.025$) and educational attainment ($p < 0.001$) with comprehension of informative signs. This indicates that older drivers and those with higher education tend to better understand informational signage such as directions and service indicators in Dumaguete City. Older drivers may benefit from longer driving experience, which improves familiarity with road layouts and directional cues (Miller, 2021; Tan, 2023). Meanwhile, higher educational attainment may enhance the ability to interpret combined text, symbols, and numerical information in road signs (Santos et al., 2024; Fernandez et al., 2020). Overall, these results suggest that both age and education positively influence comprehension of informative signs, highlighting the need to simplify designs to ensure clearer understanding for all drivers (Zhao et al., 2023; Gonzales et al., 2023; Mustapha, 2023; Lyu et al., 2022).

Variables	r_s	p-value	Decision	Remark
Visibility vs Signage Comprehension	0.406	<.001	Reject H_0	Significant
Legibility vs Signage Comprehension	-0.019	0.845	Fail to Reject H_0	Not Significant
Conspicuity vs Signage Comprehension	0.125	0.192	Fail to Reject H_0	Not Significant

Level of Significance = 0.05

Table 13 Relationship Between Drivers' Level of Perceived Visual Clarity and their Level of Signage Comprehension

Table 13 shows that while visibility is strongly linked to signage comprehension, legibility ($r_s = -0.019, p = 0.845$) and conspicuity ($r_s = 0.125, p = 0.192$) have no significant relationship with drivers' understanding. In Dumaguete City, this suggests that reading fine text or a sign's visual prominence are not primary factors in comprehension. Instead, understanding appears to rely more on cognitive processes, particularly familiarity with symbols, which can outweigh the need for perfect text clarity (3M Science, 2020; Schieber et al., 2022). Likewise, once attention is captured, how much a sign stands out becomes less important than message familiarity (Wontorczyk et al., 2021). Overall, while visibility is crucial for detection, legibility and conspicuity play secondary roles in processing meaning. However, maintaining proper font size and contrast remains important for safety, especially in stressful or unfamiliar conditions (Mustapha, 2023; Lyu et al., 2022; Garvey et al., 2021).

Conclusion and Recommendations

This study concludes that the comprehension of road signages among drivers in Dumaguete City is significantly contingent upon both visual clarity and surrounding environmental conditions. While drivers exhibit a strong foundational knowledge of regulatory and informative signs, the overall effectiveness of the city's signage system is hindered by suboptimal visibility, legibility, and conspicuity. Consequently, a driver's prior knowledge of a sign is often insufficient if physical degradation, poor nighttime illumination, or environmental clutter delays visual processing and cognitive recognition.

Furthermore, the findings establish a direct correlation between optimal visual clarity and rapid signage comprehension. When road signs are conspicuous and legible, drivers can process information and execute decisions with greater speed and accuracy, thereby minimizing on-road confusion. Conversely, obstructed, faded, or visually cluttered signs induce cognitive delays that critically increase the margin for driver error.

Ultimately, advancing road safety in Dumaguete City requires a dual-faceted approach: sustaining driver education while systematically upgrading physical signage infrastructure. Specifically, high-urgency warning signs demand immediate prioritization using high-grade retroreflective materials, simplified symbology, and the rigorous clearing of visual distractions. By optimizing these physical and environmental parameters, the city can facilitate faster, more accurate driver responses and foster a substantially safer transit environment for all drivers.

Recommendations

Based on the findings and conclusions of the study regarding the visual clarity and comprehension of road signs in Dumaguete City, the following recommendations are proposed:

1. Policy and Administrative Recommendations (LGU & TMO)

Improve visibility and conspicuity of road signs. Since visibility had the lowest rating (3.11) and conspicuity is affected by driver factors, the City Traffic Management Office (TMO) should upgrade signs using High-Intensity Prismatic (HIP) materials. This is especially important for younger and less experienced drivers who may find signs harder to notice in busy surroundings (3M Science, 2024; Wontorczyk et al., 2021).

Create signage-clear zones. To address obstructions ($\bar{x} = 2.95$) and visual distractions ($\bar{x} = 3.09$), the LGU should regulate billboards and manage plants or objects near intersections. Reducing visual clutter will help all drivers, especially those with lower educational backgrounds, notice road signs more easily (Wong, 2020; Sign Research Foundation, 2022). Standardize proper mounting of signs. The city should strictly follow DPWH (2022) standards for mounting height (2.1 meters) to ensure signs are always visible above vehicles and traffic.

2. Engineering and Design Recommendations

Prioritize clear and immediate maintenance. Since visual clarity is strongly linked with comprehension ($r_s = 0.321$, $p < 0.001$), damaged, faded, or blocked signs should be replaced or fixed immediately. Clear signs help drivers understand rules faster and reduce mistakes (Garvey et al., 2021; Zhao et al., 2023).

Simplify warning and informative signs. Because education affects how these signs are understood, designers should use simpler and more direct symbols. This helps make signs easier to understand for all drivers, regardless of educational level (Berrio et al., 2023; Chen et al., 2021).

Reduce information overload. Informative signs should use fewer words and more universal symbols. This helps drivers understand directions faster and reduces confusion while driving (Liu et al., 2021; Lyu et al., 2022).

3. Educational and Training Recommendations (LTO & Driving Schools)

Conduct refresher courses for older drivers. Since age is negatively related to regulatory sign comprehension ($r_s = -0.260$), older drivers should undergo refresher training during license renewal to improve understanding of traffic rules (Fernandez et al., 2020; Gonzales et al., 2023).

Strengthen training on warning signs. Driving schools should focus more on teaching warning signs since they are harder to interpret. This will help drivers better recognize road hazards (Ng & Chan, 2020; Santos et al., 2024).

4. Recommendations for Future Research

Study knowledge changes over time. Future research should examine why understanding of regulatory signs decreases with age and whether this is due to habits or changes in driving behavior.

Use objective testing methods. Future studies should use tools like eye-tracking to measure how drivers see and respond to road signs, not just self-reported perceptions (Lyu et al., 2022; Zhao et al., 2023).

Compare with other cities. Similar studies in other cities in the Visayas can help determine whether the findings in Dumaguete City are unique or part of a wider trend (Tan, 2023).

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Data Availability Statement

Data sharing is not applicable to this article as no new data were created or analyzed in this study; all data used were obtained from previously published sources as cited in the reference list.

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Appendices

No appendices are attached to this study.