

THE EFFECTIVENESS OF PROVISION OF NEW STATIC INFORMATION SIGNAGE: A CASE STUDY OF INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA, GOMBAK CAMPUS

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Abstract

The provision of road and highway traffic signage on public roads has been regulated in Malaysia, by the Department of Works and Departments of Road Transport Acts, Rules and Regulations 1987. Many studies have focused on the responses and impacts of these types of signage. However, for many private roads which are not regulated under these Acts, Rules and Regulations, several non-conventional types of signage have been provided. There is lack of study, however, on the impacts of and drivers' responses towards these signages. This study, hence, explores the types, contents and locations of these signage. Additionally, the impacts of and responses towards these signages are evaluated in a controlled campus environment. Using the International Islamic University Malaysia's young student drivers as the unique purposive samples, statistical tests including correlation and chi-square analyses have been conducted. It is preliminary reported that gender and observation frequency, to a certain extent, influenced drivers' responses towards the information conveyed by the signages.

Keywords: signage, drivers, information, static, non-conventional.

INTRODUCTION

Researchers have recognized the importance of traffic signs as one of the many traffic control devices on the roadway (Slinn, Matthews and Guest, 2005; Castro and Horberry, 2004; Bell, Bonsall, and O'Falberty, 1997). Traffic

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control devices subscribed to the detailed requirements or conditions affecting road use at specific places and times in order that proper actions may be taken so as to avoid accidents or delays (Cunard, 1999). Control devices are necessary for strangers to the locale or for the first time users. The underlying principles of traffic control devices are: 1) design factors, 2) position or placement, 3) maintenance of condition and visibility, and 4) uniformity of application and use (Cunard, 1999).

Traffic signs are signs erected at the side of roads to provide guidance to the road users. Traffic sign can be divided into four which are: 1) warning signs, 2) regulatory signs, 3) informatory signs and 4) direction signs (Slinn, Matthews and Guest, 2005). Traffic signs help creates a safer environment for road users by visually communicating information relating to regulations, warnings, directional and locational guidance to drivers and pedestrians. The information must be unambiguous and conveyed in a manner that is suited to the type of road condition and traffic characteristics. Traffic signs play an increasingly important role in daily traffic. Traffic Signs (Size, Colour and Type) Rules 1959 by Department of Works Malaysia prescribe the types, meaning, dimension, colour, placement and height of signs under Part I through to Part VI. Additionally, many studies have concentrated on the responses and impacts of these types of signage (Abdur Razzak and Tanweer Hasan, 2010; Baas, 2000; Ng and Chan, 2008). However, in many other private roads which are not regulated under these Acts, Rules and Regulations, several non-conventional types of signages have been provided. There however a lack of study is on the impacts and drivers' responses towards these signages.

Accordingly, this research is to assess the effectiveness of information signs provision in International Islamic University Malaysia (IUM), Gombak campus. The findings from this study are very useful in the enhancement on the understanding of traffic regulations among of several important groups; ranging from the urban planning studies, road users and the IUM community. Nevertheless, this research only focuses on the new informatory signs in IUM Gombak campus. The current informatory signs do not subscribe to the informative signs provision under Part IV of the Rules (1995). Therefore, it will be a useful reference for the campus management in providing better traffic signs system in the future. The traffic sign has to be considered carefully when 'designing the street'. It is essential that the campus design translates the university's education philosophy. Thus, the physical forms and configurations shall be conducive for the aims and objectives of the university.

Each campus and each individual faculty has its own unique architectural signature aimed at creating distinctive effect within the overall parts of the campus design. The principle adopted in IIUM is one of a unified campus architecture rather than single-building exhibitionism. The campus is a place of respite where one feels comfortable and relaxed, a place where the landscape of knowledge and the landscape of buildings and grounds synergistically meet. The campus design promotes optimum social dynamics among staffs and students (IIUM Master Plan, 1995). Some important principles of campus planning are the arrangement of faculties, central amenities, and physical environments. Additionally, one of the important safety elements of physical environment of a campus is the provision of effective static information signage. Studying the road user perceptions on the traffic sign provided an insight to behavioural responses to this provision. It can also promote convenience and safety. Future planning for traffic sign in the university needs also to consider better design of the street furniture.

STATIC INFORMATION SIGN

Informatory signs are erected on the road to provide information on direction, destination and roadside, facilities to the road user which may be of assistance to them in making their journey. These cover a wide range of sign messages, from one way signs to junction countdown signs. These sign tend to be rectangular blue signs with a white edge (Slinn, Matthews and Guest, 2005).

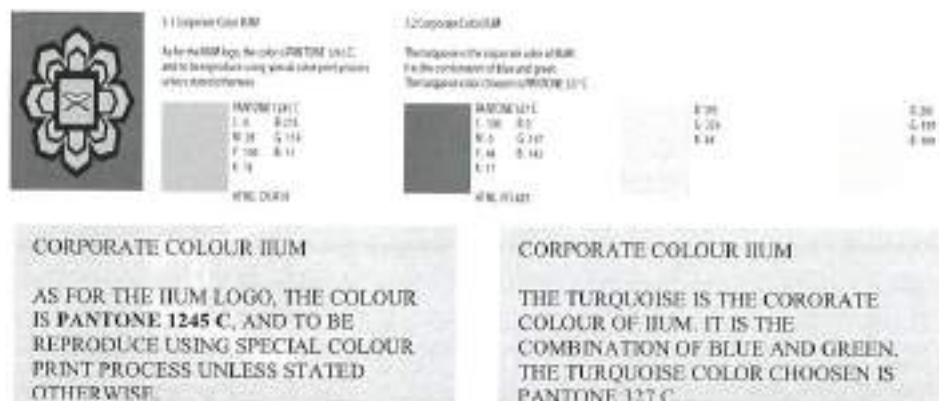
Based on Malaysia Guidelines, these signs are rectangular in shape, and the colours are generally either white letters or symbol and border on blue background (Manual of Traffic Control Devices JKR, 2006). In a general way, informatory signs give road users the information that will help them along their way to town, villages or other important destinations in the most simple, direct manner possible to them as well as to inform them of interesting routes.



Figure 1: Example of informatory sign

Information sign in International Islamic University Malaysia (IIUM)

Information signs in IIUM are provided in English most of the time, and on occasion bilingually. Staff, students, visitors and business community using the campus' traffic signs are of mixed ethnicity and nationality, representing an international perspective of traffic signs effectiveness. For this reason of distinctiveness, the IIUM Gombak campus has been chosen as a case study. The colours of the informatory traffic signs are the corporate colour for IIUM. The height of the informatory traffic signs in IIUM is 2,750mm. The width for the sign was 1,370mm (CBE, IIUM, 2011). The size of the traffic sign can be considered as appropriate to be seen by the road users.



Source: Centre for Built Environment, IIUM (2011)

Figure 2: Colour of information sign in IIUM

Tunnard and Pushkarev (1963) argued that human can easily predict objects with higher contrast. The colours of the informatory traffic signs are the corporate colour for IIUM. Colours that are used for traffic signs are the combination of turquoise and grey. The turquoise colour chosen was Pantone 327 C (Figure 2). By means of using the same colour code, the road users can easily identify and recognize the exact informatory traffic signs and the message delivered seemed to be very clear. The large signs should have light colour markings on a dark background of blue, green or yellow (Hobbs and Richardson, 1967). Small signs should have dark coloured markings on a light background either white or yellow (Hobbs and Richardson, 1967). Grey colour is used in background; hence the wording must use the dark colour such as black, to provide a contrasting effect in order to create attraction. However, the wording use turquoise colour. To increase detectability, the suitable colour of the wording could be black in order to contrast the colour of light grey.

In general, attentions are directed to simple, regular shapes because they can easily draw driver's attention. For instance, most road users were familiar with the standard shape and color of the traffic signs. If there are changes in the design and shape of traffic sign, the road users would be confused and these may lead to an accident. The shape for informatory traffic signs in IIUM was rectangular. The design should not be complex where the drivers can get confused (Figure 3).



The shape of the informatory signs is complex than the standard rectangular shape



Source: Field Survey in IIUM Gombak Campus, 2011

Figure 3: Example of informatory sign in IIUM

EFFECTIVENESS OF TRAFFIC SIGN

Matson, Smith, and Hurd (1955) identified that, the effectiveness of any sign depends upon its attention, meaning, response time, size, shape, contrast and illumination. Meanwhile, in order for traffic signs to be effective, signs must attract visual attention, sign lettering and legibility, maintenance, siting of signs, night visibility requirements and standards of traffic sign (Hobbs, 1979).

Visual attention

Visual attention is the characteristics of a sign that would make it be noticeable from its background as well as surrounding objects (Matson, Smith and Hurd, 1955).

- i. Size; Hobbs (1974) asserted that the larger the traffic sign, within the driver's visual cone, the greater its impact on driver's attention. However, there still a limit to size due to practical considerations of siting and lighting as well as aesthetic reasons. Hobbs highlighted that a minimum sign is about 0.3m^2 of white board area required for each 30m of viewing distance.
- ii. Contrast; The human can easily predict on the object with higher contrast (Tunnard and Pushkarev, 1963). Hobbs and Richardson (1967) identified that colour and contrast are the two basic requirements for the sign to stand out from the background and the message displayed stand out from the sign board. The large signs should have light colour markings (white) on a dark background of blue, green or yellow. Basically, two basic colours are used for the ground colour of traffic sign, yellow for all warning signs and white for all other standard signs (Hobbs and Richardson, 1979).
- iii. Shape; Irregular cut-out shape must be avoided as the basic shape for the traffic signs (Hobbs, 1974). The shapes are (1) the octagon for the stop regulations, (2) the square for warning, (3) the rectangle with major axis on the vertical to convey a regulatory message, (4) the rectangle with major axis on the horizontal to inform or guide road users and (5) a variety of forms for marking other routes (Matson, Smith and Hurd, 1955). Familiarity with legend, brevity and clarity of the message give traffic signs a sense of readability which affects the speed with which meaning is comprehended (Matson, Smith and Hurd, 1955).

Sign lettering and legibility

The sign and style of lettering and their spacing influences legibility. Matson, Smith and Hurd (1967) agreed that word messages including numbers and letters should be listed as simple as possible; not more than three or four familiar and practicable words should be conveyed at one glance. There are two basic forms of lettering that are used comprehensively. They are upper-case and lower-case. The upper-case (capital letters) is used as starting letters to the lower-case words. Meanwhile, the lower-case was used to complete the message. Basically, the height of the letter ascenders or descenders equals to the upper-case letters (Hobbs and Richardson, 1979). Indeed, analysis mentioned on the legibility depends upon size of letter, stroke width, letter and word spacing, and size of margins (Slinn, Matthews and Guest, 2005).

Response time

There exist three factors that may affect the adequate time for response which are the speed of the road users and his vehicle approach, the legibility distance of the sign and its message, and the longitudinal site of the sign (Matson, Smith and Hurd, 1955). Time is required by the road users for changing lanes, changing speed as well as to stop the vehicles. The simpler message may only need 1 sec to understand but the multiple choice of the message may require 3 to 4 sec to be understand (Khan, 2008). This shows that the human had limitation to memorize information and visualization. For example, a car was moving on a road with 110 km/hr which equals to 30.5 m/sec. Traffic sign was about 50m from the car and this minimum distance is required for the driver to get the clear image of a traffic sign. The time can be calculated by using the average velocity algorithm which is given as:-

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}} = \frac{50}{30.5} = 1.6 \text{ sec}$$

Source: Khan, M. T. (2008). *Real-Time Recognition System for Traffic Signs*, pg.12 (pp.12)

Therefore, factors such as speed of vehicles, time reaction, and drivers' visualisation give direct implications towards the size, location and design of the traffic signs (Khan, 2008).

Maintenance

Maintenance is a straightforward undertaking that requires no formal training or special skills. The cleaning and repainting of signs is of the utmost importance in order to stimulate the concentration of the driver and satisfactory of the functions (Hobbs, 1979).

Siting of signs

Other measure of effectiveness is the siting of traffic signs. The correct siting of the traffic sign from the hazard is also vital in relation to vehicle speeds. Locating a sign too close to a hazard is unlikely to give drivers sufficient warning and message (Hobbs, 1979).

Illumination

The application of lighting or illumination is the deliberation of light to achieve some aesthetic or practical effect. Lighting includes use of both artificial light sources such as lamps and natural illumination of interiors from daylight (Matson, Smith and Hurd, 1955). Practically all traffic signs use retro reflective sheeting. Retro reflective sheeting is designed to return light from the headlamps with just sufficient spread of beam to include the driver's eyes (Matson, Smith and Hurd, 1955).

GUIDELINES IMPLEMENTATION FOR TRAFFIC SIGNS

The authority of Department of Public Works (JKR) (2006), Malaysia has come out with crelevant guidelines that need to be observed in providing the traffic signs. The purpose of these guidelines is to establish uniformity in design and application of all traffic signs and control devices in Malaysia for the benefit of road users, road and traffic authorities, and manufacturers of traffic signs. The standardisation is very important in order for the road users to experience and be familiar with the traffic signs. The uniformity in design encompasses the shape, word messages, symbols, size, colour, illumination or reflectorization (Manual of Traffic Control Devices JKR, 2006).

Guidelines for Informatory signs

The informatory signs are provided for the convenience of road users as well as for improving the efficiency and safety for roadway. There are four classifications of informatory signs which are (1) destination signs, (2) distance Signs, (3) information signs and (4) route markers (Manual of Traffic Control Devices JKR, 2006). This study will be focusing more on the informatory sign.

i. Colours and Shapes of Guide Signs

Basically, the informatory signs are rectangular in shape and the colour generally either white letters or symbol and border on blue background. However, for local streets, the letterings and arrows should be yellow in colour.

ii. Size of Guide Signs

The size of informatory signs must be legible to road users and follow the standard size. However, for other guide signs, the legend is so varied that the size must be fixed in terms of the length of word messages and the size of lettering and spacing necessary for proper legibility are ensured.

iii. Lettering On Guide Signs

The lettering for the informatory sign should be clear, open capital letters of the type approved. The names of places and rivers should be in lower-case lettering with initial capitals.

CASE STUDY OF STATIC INFORMATION SYSTEM

Several criteria like conspicuity, legibility, distinctiveness, and comprehension must be met for a sign to be effective. There are five cognitive features are of central concern in sign research (Ng and Chan, 2008). They are familiarity, concreteness, complexity, meaningfulness, and semantic distance. Ng and Chan (2008) employed a 0 to 100 points scale for rating cognitive features. Familiarity is defined in terms of the frequency with which icons had been encountered. For a group of novice subjects, significant and positive relationships were found amongst the cognitive features of familiarity, concreteness, meaningfulness and semantic closeness (Ng and Chan, 2008).

Furthermore, the study by Schnell (2010) investigated the effect of luminance and letter size on the information acquisition time and transfer

accuracy from simulated traffic signs. Luminance on the sign legend was administered at five levels; 3.2 cd/m², 10 cd/m², 20 cd/m², 40 cd/m² and 80 cd/m², on positive-contrast textual traffic sign stimuli with contrast ratios of 6:1 and 10:1. The simulated signs were positioned at 33 foot/inch and 40 foot/inch legibility indices viewed under conditions simulating a night time driving environment. The findings suggested that increasing the sign luminance significantly reduced the time to acquire information. Similarly, increasing the sign size also reduced the information acquisition time (Schnell, 2010). Furthermore, as the text size decreased, the reading times showed a much more dramatic increase at lower luminance levels (Schnell, 2010). These findings suggest that larger and brighter signs are more efficient in transferring their message to the driver by reducing information acquisition time, or alternatively, by increasing the transfer accuracy. In return, reduced sign viewing durations and increased reading accuracy is likely to improve roadway safety.

METHODOLOGY

The primary data obtain were research derived from site observations and questionnaire surveys. The site observations were to identify the existing physical conditions of the informatory traffic signs in IIUM Gombak campus. Personal interviews can generate a very high response rate. The questionnaire survey was to gather the information of the respondents' perception and approach towards the effectiveness of the informatory traffic signs in IIUM. The respondents were selected from Zone 1: Ahmad Ibrahim Kulliyyah of Law (AIKOL) and Zone 2: Kulliyyah of Architecture and Environmental Design (KAED) areas in IIUM.

This research tends to focus of respondents form different faculties in order to identify the differences of perceptions of the students as they were form different background of study and characteristics. The selection was based on AIKOL students being knowledgeable and familiar with laws and regulations as they were studying in law. Meanwhile, the selections of KAED students were because they were knowledgeable and familiar with urban design setting and traffic and transportation matters as they were studying built environment and design. However, the analysis and findings may not be applicable to other universities due to IIUM signages being different from other universities. The population was divided into homogenous groups (based on faculties). Due to the large number of population, the purposive sampling has been used.

The questionnaire survey was divided into four sections. The first section was the revealed preference where the respondent provided their perception on the effectiveness of the traffic sign. These variables were the dependent variables. Meanwhile, the second section was on the trip characteristics. The third section dealt with the driving characteristics of the respondents. Trip and driving characteristics were independent variables. The last section was on the basic questions pertaining the respondent's backgrounds. Variables such as gender, age and faculties have been asked. These variables were the independent variables. Likert Scale was used for the relevant perception questions.

DATA ANALYSIS AND FINDINGS

Effectiveness of New Static Information Signage in IIUM

The questionnaire has been distributed to 130 respondents. 128 have been analysed after the data cleaning. The Relative Importance Index (RII) method was adopted by many researchers (Kometa, et al., 1994). This method was adopted to analyse the data collected from the questionnaire survey. The respondent's perception towards the traffic sign has been scaled by; 1=very unsatisfied, 2=unsatisfied, 3=satisfied and 4= very satisfied. The four-point scale 0-3 mentioned earlier was transformed into relative importance indices for each satisfaction of related question on font size, board size, illumination, colour of sign, language and siting of sign. The indices were then used to determine the rank of each item. These rankings made it possible to cross compare the relative importance of user's satisfaction and the measure of traffic sign effectiveness. The RII was used to determine the variables most effective for informatory traffic sign in IIUM.

Table 1: Relative Importance Index (R.I.I)

Measure of Effectiveness	Very Satisfied (Score of 3)		Satisfied (Score of 2)		Unsatisfied (Score of 1)		R.I.I	Rank
Language of sign	52	156	74	148	2	2	0.79	1
Board Size	30	90	86	172	12	12	0.71	2
Font Size	26	78	75	150	27	27	0.66	3
Colour of sign	28	84	58	116	42	42	0.63	4
Siting of sign	18	54	78	156	32	32	0.63	5
Luminance	24	72	52	104	52	52	0.63	6

Based on the findings, language of sign most effective, with a R.I.I scores 0.79 highlight in the Table 1. IIUM was known as international university, which was why English language was used as the main language.

Thus, it shows that the respondents were really satisfied with the use of English language on sign. The luminance has the lowest score as during the observation that has been done by the researcher, only certain time the lighting would be turned on.

Chi-Square test

The chi-square test analysis can be carried out with two different variables which are nominal and ordinal variables. In order to reject the null hypothesis, the p value (significant level) should be <0.05 . As for the chi-square test, the hypothesis tested was to identify whether respondent's profile gave an impact to the effectiveness of traffic signs.

An alternative form has been deduced as:

Hypothesis #1: "There is a relationship between gender and the perceptions of the respondents toward the effectiveness of traffic signs"

Table 2: Summary on hypotheses tested

Variables	Hypotheses Tested			Significant
	Chi-Square Value	df	Asymp. Sig. (2-sided)	
Font size versus gender	6.889	2	0.03	Significant
Board versus gender	5.885	2	0.05	Significant
Illumination versus gender	8.821	2	0.01	Significant
Colour of traffic signs versus gender	6.962	2	0.03	Significant

From the table, it can be seen that calculated chi-square for illumination versus gender was 8.8 which was higher than critical chi-square at two degree of freedom (5.99). In addition, the p-value was 0.01 which was lower than 0.05. The research alternative can be accepted. Therefore, satisfaction of illumination of the signage was influenced by being male or female. In other word, visual attention towards the luminance of traffic sign is different between genders. The same conclusion applies to board and font size where gender has significant influence on. In addition, the calculated chi-square for colour versus gender was 6.9 which were higher than critical chi-square at two degree of freedom (5.99). In addition, the p-value was 0.03 which is lower than 0.05. The alternative research hypothesis can be accepted. Therefore, satisfaction of colour of the signage was influenced by being male or female. In other word, visual attention towards the colour of traffic sign is different between genders. A research by

Dorcus (1926) found that yellow had a higher affective value for the men than women.

Kendall Tau-b Correlation analysis

Kendall's tau is a measure of correlation, i.e. the strength of the relationship between two variables. Kendall's coefficient ranges from 0 to 1. Larger values indicate a stronger association among appraisers' ratings. In order to reject the null hypothesis, the p value (significant level) should be <0.05.

An alternative form has been deduced as:

Hypothesis #2: "There is a relationship between frequency of signage observation and the perceptions of the respondents towards the effectiveness of traffic signs"

Table 3: Summary on hypotheses tested

Variables	Hypotheses Tested				Significant
	Kendall Tau-b Value	Asymp. Sid. Error ^a	Approx. T ^b	Approx. Sig.	
Font size versus frequency of observation	.178	.073	2.429	.015	Significant
Board size versus frequency of observation	.093	.082	1.131	.258	Insignificant
Illumination versus frequency of observation	.019	.073	0.256	.798	Insignificant
Colour versus frequency of observation	-.088	.079	-1.17	.264	Insignificant
Language versus frequency of observation	.045	.079	.569	.569	Insignificant
Siting versus frequency of observation	.078	.079	-.98	.323	Insignificant

From Table 3, it can be seen that the p-value for font size versus frequency of observation was 0.015 which is lower than 0.05. This shows that there was significant relationship between frequency of signage observation and the perception on font size of traffic sign. The alternative research hypothesis has been accepted. Therefore, satisfaction of luminance of the signage was influenced by frequency of signage observation. The variable of frequency been tested to perception on luminance, board size, language, colour as well as siting but none of this had a significant and relationship towards effectiveness of the

traffic signs. However, insignificant relationship may be due to the small number of sample size.

SYNTHESIS OF THE RESEARCH

The research was aimed at determining the effectiveness of the informative traffic signs in IIUM, which was guided by four objectives. Basically, the effectiveness of the traffic sign depends upon visual attention, sign lettering and legibility, response time, maintenance, siting of signs as well as illumination.

Analyses show that:

- i. It has been found that gender was the factor that influenced the perceptions of the respondents towards the effectiveness of the colour and illumination of traffic signs. Dorcus (1926) found yellow had a higher affective value for the men than women.
- ii. It can be concluded that the frequency of signage observation influenced the perceptions of respondents toward the font size of the traffic signs.
- iii. Familiarity with legend, brevity and clarity of the message give traffic signs a sense of readability which affects the speed with which meaning is comprehended (Matson, Smith and Hurd, 1955).

Thus, it can be concluded that, the effectiveness of the traffic signs depends upon the gender as well as the familiarity with the signs.

RECOMMENDATIONS

Visual Attention

One of the measures of effectiveness of traffic sign was visual attention. Comprehension must also take place in sufficient time so that the driver can act upon the sign message without distraction from the surrounding situation. That was why the standardisation of traffic sign should be taken into consideration by the agency involved. However, visibility often been impede by hedges, trees, curvature and others. The human ability in visualization was limited. It will be apparent on values such as on contrast and board size as highlighted below:

- i. **Contrast:** Hobbs and Richardson (1967), in their analysis of the traffic signs identified that colour and contrast were the two basic requirements for the sign stands out from the background and the message displayed stand out from the sign board. Contrast depended on the brightness of the colour. Contrast can be effective by the use of different colour and brightness. The existing background for the informatory traffic signs in IIUM was grey in colour, and the lettering are turquoise. For instance, lettering that used black colour and light grey colour for its sign's background is more legible compared to wording in turquoise colour (Figure 4 and 5).



Figure 4: Existing condition



Figure 5: Example of recommendation

In this context, the differences between letter and its background will enlighten the image due to the contrast of the background colour against dark lettering coloured of the sign. Even though the location of the signage is strategic, reasonable size and colour contrast are important for the sign to be effective.

Table 4: Recommendations of colour

Before	After
Background- grey in colour Lettering- turquoise	Background- light grey in colour Lettering- black

- ii. **Maintenance:** In order to achieve the necessary effectiveness, it is imperative that the traffic signs provided at any site are adequate in size for the speed of the road it is erected on. The correct siting of the traffic

sign from the hazard is also vital in relation to vehicle speeds. Locating a sign too close to a hazard is unlikely to give drivers sufficient message.

There were some traffic signs that were hidden by the trees. It is essential to reiterate that, the humans had their limitation in visualization. Basically, traffic sign were placed adjacent to the junctions. However, the placements of some of the traffic sign were hidden by the trees and shrubbery and this interrupted the drivers' view of the signs. The siting of traffic signs are recommended to be located at the right siting and follow the guidelines. The responsible agencies should maintain the vegetation growth (trees and shrubbery) so that they will not interrupt the drivers' attention. Trees and shrubbery need to be cut as the vegetations grow and obscure the line-of-sight to the signs.

CONCLUSIONS

Traffic signs are important in promoting road safety towards the road users. However, the effectiveness of the traffic sign must take into consideration. Several aspects including colours, contrast, legibility, maintenance, siting of signs, night visibility requirements and standards of traffic sign needs improvement measures through a systematic planning and implementation of proper guidelines must be imposed to create good image as well as enhancing the visual quality of traffic sign. Erection of traffic signs at inappropriate locations has produced some problems and issues, which need to be mitigated in the future. For instance in the case of IIUM, the resulted in applications of visual attention elements still need to be enhanced and increased for better legibility of traffic sign. Consideration has to be made in colour, gender of the users, familiarity with multilingual signage and legibility. This research has proven that these factors influenced the effectiveness of signage and recommended the respective of strategies.

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