Application of semiotics for health and safety signs comprehension on construction sites in Yola metropolis, Nigeria

S A Alara1, I I Inuwa2 and N Gambo2

1Department of Quantity Surveying, Federal Polytechnic Mubi, Adamawa State, Nigeria
2Department of Quantity Surveying, Abubakar Tafawa Balewa University, Bauchi State, Nigeria

Abstract. This study investigates how semiotics can be applied to enhance construction operatives’ health and safety (H&S) signs comprehension in Yola metropolis, Nigeria, with a view to improving on H&S management that will curtail the occurrence of accidents. Adopted ISO (9186-1) questionnaire for testing H&S signs comprehension were administered to 60 construction professionals and operatives that are executing 5 government building projects. Responses were subjected to descriptive and inferential statistics respectively. Findings revealed that 11 of the 15 H&S signs studied ranked highly relevant for curbing accidents on construction sites while the remaining ranked relevant. For factors influencing H&S signs; training ranked highly influential, experience ranked influential, education ranked moderately influential. While culture, age and gender were ranked least influential respectively. The study recommends: contractors H&S safety compliance records be considered as one of the bases for contract award, safety consciousness be integrated in the overall procurement process, H&S requirements compliance certificate should be introduced and issue to compliant contracting firms, erring contractors on non-adherence to H&S provisions on construction sites be sanction, and construction operatives should be continuously train on H&S signs comprehension.

1. Introduction
The risky nature of construction sites is continuously exposing operatives to injuries and death [1, 2]. To avert it, H&S signs are employed to create awareness [3]. Thus, the correct comprehension of H&S signs on construction sites are very important to avoid any mishap [2]. Studies reported poor safety education and awareness culture as the main causes of accidents on construction sites and that communication is the most relevant strategy for curbing hazards on construction sites [4-15]. Hare et al. [4] reported that pictorial aids are used as warning signs and symbol extensively to communicate hazards and controls on construction sites. Nonetheless, little attention has been paid at understanding their effectiveness in enhancing H&S awareness [4]. One area that can be explore to enhance H&S signs comprehension on construction sites is the theory of semiotics. Semiotics guides one on how meaning can be created from a sign, as well as ensures how communication can be effective using signs and symbols [16-18]. Nevertheless, accidents which could have been averted on construction sites still occur in developed and developing countries [2, 5, 6, 7]. In Australia, the construction industry constitutes 9%
of total workforce, but records a fatality rate twice that of all industries, and pays 11% of all serious workers’ compensation claims [5]. In Europe, 30% of fatal industrial accidents occurred in the construction industry, despite employing only 10% of the working population [7]. In the United State of America (USA), fatal injury rate increased from 9.8 per 100,000 full-time equivalent (FTE) workers in 2014 to 10.1 per 100,000 FTE in 2015 [6]. In Saudi Arabia, the industry accounts for 51.35% of the 69,241 total accidents cases recorded [7].

In Nigeria the fatalities recorded on construction sites are worse than what exists in developed countries due to lack of: concern, precise records, inadequate planning, H&S regulation enforcement, and H&S awareness among operatives [8, 19, 20]. The Nigerian construction industry losses 5 – 7% of her workforce annually to construction accidents [8]. According to Abdullahi, et al. [9], 76.40% of craftsmen in Nigeria had one form of accidents or the other on construction sites. According to the National Safety Council (NSC) [10], misperception of H&S signs is the third cause of accidents in the workplace. Talab et al. [11], revealed that training, job experience, work duration and time, type of safety signs, background color of safety signs and comprehension training are factors that influenced operatives H&S awareness on construction sites. Moreover, Alan, et al. [12] discovered that cultural differences influence the comprehension of H&S signs. However, most studies on H&S signs usability and comprehension were not conducted in Nigeria [2, 11, 12, 21-24]. Thus, this study investigates how semiotics can be applied to enhance construction operatives H&S signs awareness in Yola metropolis, Nigeria, with a view to improving on H&S management that will curtail the occurrence of accidents on construction sites. The study outlined the following objectives: to evaluate the relevance of H&S signs in curbing accidents on construction sites and, to evaluate factors influencing construction operatives H&S signs comprehension in Yola metropolis, Nigeria.

2. Literature review

2.1. Theoretical construct

This study is modelled on the theory of semiotic as advocated by Charles Sanders Peirce (1839-1914). Semiotics is the study of signs and their meanings; it is a field of research that studies signs as an essential part of cultural life and communication [16-18, 25-27]. Signs include words, gestures, images, sounds, and objects [16]. In semiotics, the word sign has special meaning; for instance, flowers are sign of affection, or symptom is a sign of illness in a sick person. Thus, sign is something which stands for something [17]. Peirce theory of semiotics conceptualized that a sign can effectively communicate a message if the target audience for which the message is directed to understands the relationship of the following factors within the context of the sign: representamen (signifier), interpretant (signified), and the object [18, 25-27]. Representamen is the physical form the sign takes; it refers to what we see, touch and smell in the objective and shared reality. The representamen is been characterized as a concrete object, an abstract entity, or both. It is a particular physical event or object; it is a psychological imprint [18]. According to Pierce, the representamen trigger's in the observer's mind another kind of mental sign of comprehending the intended message. This act is thus referred to as the interpretant (comprehension) [26]. The interpretant is the sense made of a sign; what we experience, think and feel about the form which the sign takes. While the object is the idea that the sign stands for. The sign stands for the referent in some respect, which is called ground (this somehow corresponds with 'code') [16, 18, 27]. Thus, for a sign to be effective in communicating a message to a person within the context of construction industry culture, the person must: recognize the form the sign takes (representamen), understands (interpretant) the message the signifier is conveying (signified; comprehension), and acknowledge the idea in which the sign stands for; the purpose of the sign (Object).

Peirce’s classic semiotic model can be applied in the area of construction industry safety management culture to create H&S awareness, as a theoretical foundation for understanding how the triad of representamen (features of sign/compliance), interpretant (comprehension) and object (conceptual sense/meaning) works in conveying H&S signs messages. The frequency of adhering to safety signs on construction sites will allow the mental images of the signs to be imprinted in construction operatives
mind; thus, serve as a medium of learning in understanding the physical nature of safety signs within
the cultural setting of the construction industry [25]. Understanding how construction operatives react
to safety signs will convey the message on how they comprehend safety sign [26]. Moreover, for the
signifier and the signified concept to be understood by the operative, the built environment must
establish H&S culture using the three lower levels of the cognitive domain of Bloom’s Revised
Taxonomy of Educational Objectives: Remembering, Understanding, and Applying [28]. Thus, there
should be a mechanism that will influence operatives to remember the physical nature of a safety sign
(representamen) and this will guide their comprehension (interpretant) that will trigger them to act in
accordance to the safety sign aim (object) (see table 1). This eventually enables an operative on site to
apply the information from remembering and understanding to comprehend the sign, consequently
attains the purpose of the sign [3, 16]. Despite many theories on semiotics [18], theories propounded
by Ferdinand de Saussure and Charles Sanders Pierce are basically the most accepted semiotic theories.
However, Pierce semiotic theory was adopted because it is an elaboration of the Saussure’s semiotic
theory, and is more basic and essential than Saussure’s semiotic theory [29].

| S/N | Subjects of semiotics | Corresponding study objectives |
|-----|----------------------|-------------------------------|
| 1   | Representamen (signifier) | relevance of H&S sign in curbing accidents |
| 2   | Interpretant (signified) | factors influencing H&S sign comprehension |
| 3   | Object (aim) | factors influencing H&S sign comprehension |

2.2. Relevance of H&S signs used on construction sites
According to HSE [3], H&S sign provides information or instruction about safety or health at work by
means of a signboard, a colour, an illuminated sign or acoustic signal, a verbal communication or hand
signal. They are categorized into five: prohibition signs, warning signs, mandatory signs, fire equipment
& fire action signs, and emergency escape/safe condition or first-aid signs [3]. Table 2 captures some
selected H&S signs reviewed from literature.

| H&S signs | function | types | symbol | source |
|-----------|----------|-------|--------|--------|
| 1 Prohibition | forbids behaviour likely to increase or cause danger. | no access for unauthorized persons, no smoking, no fighting, etc. | red circle & red diagonal on white background with black standardized pictogram on signboard. | [3] |
| 2 Warning | precautions where hazards exist on construction sites | danger; toxic material, overhead obstacle, biological hazard, etc. | black triangle on yellow background with standardized black pictogram. | [3] |
| 3 Mandatory | prescribing specific behaviour | respiratory protection must be worn, foot protection must be worn, face mask must be worn, etc. | white circle on a blue background with a standardised white pictogram | [3] |

2.3. Factors influencing H&S signs comprehension
Studies revealed that H&S signs comprehension can be influence by training, job experience, work
duration and time, type of safety signs, background color of safety signs and training [23, 30]. In Iran,
Zamanian et al. [2] discovered a pre-existing level of sign comprehension among industrial workers,
however there was a noticeable difference between comprehensions of safety signs, because the
perceived pattern of safety signs was different. Zhang and Chan [21] observed that user characteristics
like age, gender, experience, educational background can significantly influence comprehension level. They claimed that the effects of sign cognitive features including familiarity, concreteness, simplicity, meaningfulness and semantic distance play significant role in H&S signs comprehension. Other studies also reported that the strength of individuals’ comprehension of H&S signs can be enhanced by level of education, working experience, working time, background colour of safety signs, and level of H&S training requirements [30-33]. According to Alan et al. [12], cultural differences can also affect H&S signs comprehension. Their study in the US shows that the Chinese and Korean resident of US comprehend H&S signs less than the Americans. Besides, comprehension of some signs was quite difficult for non-Americans. The fact that comprehension level varies among individuals encouraged researchers to explore the relations between understanding and characteristics that are associated with the users themselves of H&S signs [12]. Hence, factors like age, gender, experience, culture, and education background have most often been studied, as well as marital status, monthly income, and experience [30-32]. However, results concerning the influence of user characteristics have not been unanimous due to the use of different study sample populations, diverse experimental and analytical methods or other various uncontrolled conditions [21]. Literature reviewed indicated that little or no studies have been carried out on the factors that influences H&S signs comprehension in Nigeria. Thus, there is a need to evaluate factors influencing construction operatives’ level of H&S signs comprehension on construction sites in Nigeria.

3. Methodology

Literature were reviewed to identify H&S signs used on construction sites and factors that can influence their comprehension. Subsequently, ISO (9186-1) [34] questionnaire for testing H&S signs comprehension was adopted to collate data from construction contracting and consulting firms (professionals & operatives) that are executing 5 public building projects in Yola metropolis, Nigeria. The signs studied were delimited to 15 selected safety signs under: mandatory, prohibition, & warning signs respectively. Sixty questionnaires were disproportionately administered and, attains 100% response rate. This exceeds ISO (9186-1) [34] requirement of 50 questionnaires for testing H&S signs comprehension. Questions were closed and open-ended respectively. Opinions were based on a 5-point Likert scales: highly relevant/very influential (4.50-5.00), relevant/influential (3.50-4.44), moderately relevant/moderately influential (2.50-3.44), least relevant/least influential (1.50-2.44), & irrelevant/not influential (0.00-1.44). Data obtained were analyzed using SPSS to conduct descriptive (percentages, frequencies, & mean scores) and inferential (ANOVA with post hoc) statistics respectively.

4. Result and discussions

4.1. Respondents’ demographic profiles

Ninety-eight percent of the respondents are 31 years old and above, while the remaining are 31 years or less. This shows that most of the respondents are matured enough to be safety conscious. Ninety-five percent of the respondents are males while the remaining are females. This depicts the nature of the construction industry as a male dominated industry. Fifty percent of the respondents have a degree or higher degrees, while craftsmen who constitutes 50% of the respondents have their educational qualification distributed in the following order: no education (28.3%), primary education (3.3%), junior high school (5%), while those with secondary school education and diploma have 1.7% respectively. None of the respondents has any form of disability. Above 8% of the respondents are site managers, a little above 33% are out-source consultants, while slightly over 8% are in-house consultants. This result revealed that these categories of respondents are the one’s mostly affected by H&S signs on construction sites. About 87% of the respondents have over 10 years’ experience in the construction industry. The respondents have an average of above 12 years working experience in the industry. This shows that the respondents are experience in the industry to respond to the study of this nature.
4.2. Relevance of H&S signs for curbing accidents on construction sites

Table 3 depicts individual categories and their average responses on the relevance of H&S signs for curbing accidents on construction sites using ANOVA with post hoc at 95% confidence level. The following signs were averagely ranked highly relevant: respiratory protection must be worn, wear safety helmet, danger; toxic material, bad scaffold, caution; electrical shock, no smoking, wear high visibility clothing, don’t use ladder, arm entanglement, overhead obstacle, and foot protection must be worn. While the following signs were collectively ranked relevant: face mask must be worn, fighting is prohibited, high speed moving and, biological hazard. This result confirms HSE [3] assertion that H&S sign is used to create awareness on the dangers in the workplace, so as to curtail accidents. According to Stocksigns [35], the introduction of safety sign and signal regulations has cut down the number of fatal injuries by 50%. Moreover, H&S signs give construction personnels the opportunity to comprehend the hazard that exists in their workplaces through the awareness it creates, and as such, curtail accident occurrence [3]. Table 3 also shows low scores of standard deviations which reveals that there is agreement among the respondents. Though there are significant difference (p<0.05) among the categories of respondents in the ranking of 6 out of the 15 H&S signs. These signs are: wear high visibility clothing, toxic materials, bad scaffold, caution; electric shock, no smoking, and biological hazard. The multiple comparison (Table not presented) shows that the difference in the mean scores is between in house consultants and craftsmen. These indicated that all the H&S signs studied are relevant for curbing accidents on construction sites and this result agrees with studies by Arphorn, et al. [36], Talab et al., [11], Zamanian et al. [2]. However, their studies were conducted in Thailand and Iran respectively.

Table 3. Responses on the relevance of H&S signs for curbing accidents on construction sites

| S/N | H&S Signs                              | Respondents mean scores | F Statistics | Sig. | LS |
|-----|----------------------------------------|-------------------------|--------------|------|----|
|     |                                        | ctr | crfm | smgr | osc | ihc | T X | SD | F  | Sig. | LS |
| 1   | Respiratory protection must be worn    | m   | 4.87 | 5.00 | 4.85 | 4.80 | 4.87 | 0.34 | 0.32 | 0.81 | NS |
| 2   | Wear high visibility clothing          | m   | 4.87 | 5.00 | 4.90 | 4.20 | 4.83 | 0.46 | 4.20 | 0.01 | S  |
| 3   | Wear safety helmet                     | m   | 4.77 | 4.80 | 4.65 | 5.00 | 4.75 | 0.51 | 0.68 | 0.57 | NS |
| 4   | Danger; toxic material                 | w   | 4.90 | 4.80 | 4.65 | 4.20 | 4.75 | 0.47 | 4.13 | 0.01 | S  |
| 5   | Bad scaffold                           | p   | 4.87 | 3.80 | 4.50 | 4.60 | 4.63 | 0.58 | 7.05 | 0.00 | S  |
| 6   | Caution; Electrical shock              | p   | 4.43 | 4.40 | 4.90 | 4.80 | 4.62 | 0.56 | 3.71 | 0.02 | S  |
| 7   | No smoking                             | p   | 4.87 | 4.20 | 4.40 | 4.00 | 4.58 | 0.62 | 6.03 | 0.00 | S  |
| 8   | Overhead obstacle                      | w   | 4.63 | 4.60 | 4.60 | 4.00 | 4.57 | 0.69 | 1.22 | 0.31 | NS |
| 9   | Don’t use ladder                       | p   | 4.50 | 4.80 | 4.50 | 4.80 | 4.55 | 0.59 | 0.70 | 0.56 | NS |
| 10  | Arm entanglement                       | w   | 4.50 | 5.00 | 4.50 | 4.60 | 4.55 | 0.72 | 0.72 | 0.54 | NS |
| 11  | Foot protection must be worn           | m   | 4.40 | 4.80 | 4.50 | 4.20 | 4.50 | 0.62 | 0.10 | 0.45 | NS |
| 12  | Face mask must be worn                 | m   | 4.40 | 4.40 | 4.50 | 4.20 | 4.42 | 0.56 | 0.39 | 0.76 | NS |
| 13  | Fighting is prohibited                 | p   | 4.43 | 4.20 | 4.55 | 3.60 | 4.38 | 0.76 | 2.38 | 0.08 | NS |
| 14  | High speed moving                      | w   | 4.37 | 4.40 | 4.35 | 4.60 | 4.38 | 0.72 | 0.17 | 0.92 | NS |
| 15  | Biological hazard                      | w   | 4.37 | 4.40 | 4.50 | 3.60 | 4.35 | 0.61 | 3.34 | 0.03 | S  |

Key: crfm–craftsmen, smgr–site managers, osc–out-source consultants, ihc–in-house consultants, ctr–category, m–mandatory, p–prohibitory, w–warning sign, T X – total mean, F–F statistics, LS–level of significance, NS–Not significant, S–significant
4.3. Factors influencing operatives’ H&S signs level of comprehension

Table 4 depicts responses on the individual and combined categories responses on the factors influencing operatives’ level of H&S signs comprehension using ANOVA with post hoc at 95% confidence level. On the average, training ranked very influential, experience ranked influential, education ranked moderately influential, while age, culture and, gender ranked least influential respectively. The result reveals that training and experience influence H&S signs comprehension. This concurs with the study of Arphorn et al. [36]. Training and experience improve comprehension rates of H&S signs because they raise awareness of hazards and safety risks [22, 37]. Similarly, experience improves comprehension rates of H&S signs because it enhances acquaintance with safety signs. Studies suggest that familiarity with various signs is a contributing factor on comprehension [23]; familiarity is the level of exposure to various signs throughout a worker’s career [24, 30], the frequency of encounters enables better learning and recollection of previously encountered safety signs. This reveals that work experience improves familiarity with signs and, it is an effective measure for compensating weak sign comprehension [38, 39]. Table 4 reveals that all factors but culture have no statistically significant difference (p>0.05) in their mean scores ranking. This concurs with the study conducted by Al-Madani and Al-Janahi [40]. However, there is a statistically significant (p<0.038) difference in the respondents mean scores on culture. This contradicts the findings of Alan et al. [12] that cultural differences influence comprehension of H&S signs. Multiple comparison Table (not presented) shows that the statistically significant difference is as a result of the mean scores difference between in-house consultants and craftsmen.

5. Conclusion and recommendation

This study investigates how semiotics can be applied to enhance construction operatives’ H&S signs comprehension on construction sites in Yola metropolis, Nigeria, with a view to improving on H&S management that will curtail the occurrence of accidents. A survey of construction professionals and operatives using adopted ISO (9186-1) [34] questionnaire for testing H&S signs comprehension. revealed that H&S Signs evaluated are highly relevant for curbing accidents on construction sites. Education, age and gender influence H&S sign comprehension. Training and experience significantly influence construction operatives’ level of H&S sign comprehension. The study recommends: contractors H&S safety compliance records be considered as one of the bases for contract award, safety consciousness be integrated in the overall procurement process, H&S requirements compliance certificate should be introduced and issue to compliant contracting firms, erring contractors on non-adherence to H&S provisions on construction sites be sanction, and construction operatives should be continuously train on H&S signs comprehension.

References

[1] Aniekwu N and Ozochi C A 2010 Restructuring education, training and human-resource development in the Nigerian construction industry J. of Science and Technology Education Research 1(5) 92–98

[2] Zamanian Z, Afshin A, Davoudiantalab A and Hashemi H 2014 Comprehension of workplace
safety signs: A case study in Shiraz industrial park J. of Health and Safety at Work, Winter-spring 2(1) 1–2

[3] Health & Safety Executive (HSE) 2015 The Health and Safety (Safety Signs and Signals) Regulations 1996

[4] Hare B, Cameron I, Real K J and Maloney W F 2012 Exploratory case study of pictorial aids for communicating health and safety for migrant construction workers J. of Construction Engineering and Management 139(7) 818–25

[5] Greuter S, Tepe S, Peterson J F, Boukamp F, Amazing K, Quigley K, Waerden R, Harris T, Goschnick T and Wakefield R 2012 Designing a game for occupational health and safety in the construction industry J. of Australian Construction Management 1(1) 1–9

[6] Bureau Of Labor Statistics 2016 National Census Of Fatal Occupational Injuries In 2015 (United States of America: Bureau Of Labor Statistics, Sylvania)

[7] General Organisation for Social Insurance (GOSI) 2015 Annual Statistical Report 1435h (Saudi Arabia: Riyadh)

[8] Olatunji O A, Aje O I and Odugboye F 2007 Evaluating health and safety performance of Nigerian construction site The CIB World Building Congress p 1176–88 (South Africa: Cape town)

[9] Abdullahi U, Anum I, Adole A M and Williams F N 2015 Artisans working conditions in the Nigerian construction industry: A Case Study Of Some States In Northern Nigeria ATBU. J. of Environmental Technology (A’JET) 8(1) 16–25

[10] National Safety Council 2008 Annual Report Retrieved May 21, 2018 from National Safety Council (http://www.nsc.org/news)

[11] Talab A D, Meshkani M, Mofidi A and Mollakazemiha M 2013 Evaluation of the perception of workplace safety signs and effective factors Int. J. of Occupational Hygiene (Ijoh) 5(3) 117–22

[12] Alan H S C, Sung H H, Annie W Y N and Wonkyu P 2009 Hong Kong Chinese and Korean comprehension of American security safety symbols Int. J. Ind Ergon 39(5) 835–50

[13] Albert A, Hallowell M R and Kleiner B M 2014 Emerging strategies for construction safety & health hazard recognition J. of Safety, Health & Environmental Research 10(2) 152–61

[14] Umeokafor N, Umeadi B B N and Jones K 2014 Compliance With Occupational Safety And Health Regulations: A Review Of Nigeria’s Construction Industry 3rd Int. Conf. on Infrastructure Development in Africa 17-19th March (Nigeria: Abeokuta)

[15] Solís-Carcaño R G and Franco-Poot R J 2014 Construction workers’ perceptions of safety practices: A case study in Mexico J. of Building Construction and Planning Research 2 1–11

[16] Henley M, Keddy M, Kinsman B, Muggridge M and Shields K 2015 Semiotic Analysis: A Research Guide Retrieved March 3, 2018, from Imogen Charles (http://fr.scribd.com/presentations)

[17] Crow D 2017 Visible Signs Intro to Semiotics From David Crow’s Visible Signs Retrieved November 3, 2017 from (http://www.amazon.co.uk)

[18] Noth W 1990 Handbook Of Semiotics Bloomington and Indianapolis (Indiana Universtiy Press)

[19] Windapo A O and Jegede O P 2013 A study of health, safety and environment (HSE) practices of Nigerian construction companies The Professional Builder 4(1) 92–103

[20] Idoro G I 2008 Health and safety management efforts as correlates of performance in the Nigerian construction industry J. of Civil Engineering And Management 14(4) 277–85

[21] Zhang T and Chan A H S 2013 Traffic sign comprehension: A review of influential factors and future direction for research Proceedings of the International MultiConference of Engineers and Computer Scientists, IMECS March 13 - 15 2013 (Hong Kong)

[22] Lesch M 2008 A Comparison Of Two Training Methods For Improving Warning Symbol Comprehension J. of Applied Ergonomics 39(2) 135–43

[23] Hancock E, Rogers W, Schroeder D and Fisk A 2004 Safety Symbol Comprehension: Effects Of Symbol Type, Familiarity And Age The J. of the Human Factors and Ergonomics Society 46(2) 183–95
[24] Ben-Bassat T and Shinar D 2006 Ergonomic Guidelines For Traffic Sign Design Increase Sign Comprehension J. of Human Factors 48(1) 182–95
[25] Lukianova N A and Fell E V 2015 Meaning Making in Communication Processes: the Role of a Human Agency The XXVI Annual International Academic Conference Language and Culture 2015: Social and Behavioral Sciences (Russia)
[26] Huhtamo E 2003 Visual Communication And Semiotics. DESMA 103 Visual Communication Spring Retrieved June 12, 2017 from (http://www.erkkihuhtamo.com)
[27] Ogunmola A A 2013 Signs and symbols as communication strategy: A semiotic study of highway codes in Nigeria J. of New Media and Mass Communication 19(1) 62–68
[28] Churches A 2009 Bloom’s Taxonomy of Education by Lorin Anderson and David Krathwohl Paper presented at the The Correspondence School (Wellington)
[29] Leeds-Hurwitz W 1993 Semiotics and Communication: Signs, Codes, Cultures Retrieved October 10, 2017 from (http://www.scholar.google.com)
[30] Rumpagaporn A 1996 Factors Affecting The Understanding Of Safety Sign In The Workplace Ph.d Thesis (Thailand: Mahidol University)
[31] McKenzie J, Gibb A G F and Bouchlaghem N M 1999 Communication of Health and Safety in Design Phase: Implementation of Safety and Health on Construction Sites 2nd Int. Conference of Int. Council for Research and Innovation in Building and Cons. (CIB) Working Commission W99 (Honolulu)
[32] Kukoyi P O and Smallwood J J 2017 A Qualitative Study of Health and Safety Construction Practices in Lagos J. of Construction Business and Management 1(1) 1–7
[33] Saremi M and Rezapoor T 2011 Road Safety Symbols Ergonomic Design and Traffic and Accident Decrease Rahvar (Persia)
[34] International Organization for Standardization 2014 ISO 9186- 1: Graphic1al Symbols-Test Methods-Part 1: Methods For Testing Comprehensibility (Switzerland: Geneva)
[35] Stocksigns 2017 The Importance of Health & Safety Signage to your Business 17 February 2017 [Online] Available: info@stocksigns.co.uk. [Accessed 15 June 2018]
[36] Arphorn S, Augsornpeug N, Srisorrachatr S and Pruktharathikul V 2003 Comprehension of safety signs for construction workers: comparison of existing and newly designed signs J. Human Ergonomics 32(7) 87–94
[37] Ward S, Wogalter S and Mercer A 2004 Comprehension And Training Of International Road Signs Paper presented at the 48th Annual Meeting On Human Factors And Ergonomics Society (United States: North Carolina)
[38] Shinar D, Dewar R, Summala H and Zakowska L 2003 Traffic sign symbol comprehension: A cross-cultural study J. of Ergonomics 46(15) 1549–65
[39] Liu L and Hoelscher U 2006 Evaluation of graphical symbols Int. Encyclopedia of Ergonomics and Human Factors 1(1) 30–3
[40] Al-Madani H, Al-Janahi and Rahman A 2002 Role of drivers' personal characteristics in understanding traffic sign symbols Accident; analysis and prevention 34 185–96