

An Intervention of Safety Signs in Selected Primary School Pupils in Perak State, Malaysia.

Murugan S., Anita A.R., Suhainizam M.S., Mohd Rafee B.B.

ABSTRACT--- *In Malaysia, there are number of incidents highlighted by the media on school children incidents which caused injuries and death. Majority of incidents happen due to poor safety signage at the particular area where the hazards present.. Current school guidelines did not specify any details on type of safety sign boards that should be in schools. So, the objective of this study is to develop, implement and evaluate the knowledge on safety signage on intervention and control group among the primary schools pupils in Perak state, Malaysia. The new design of safety signs will be intervene to reduce the unsafe act by school pupils and also to reduce the risk from unsafe condition. A cross sectional study was carried at 102 schools (91.9%) out of 111 schools in LMS district. The safety signage was designed according to MS2558:2014 standard. All the signages was added pictures and texts according to identified hazards from selected school. A self-administered questionnaires form was used to ask about the safety signage and risks. Intervention on new safety signs showed significant different between pretest, post-test 1 and post-test 2 ($p < 0.001$). The pre-test, post-test 1 and post-test 2 result showed significant results and pupils were able to sustain the meaning of safety signage after three months' time. The new design of safety signage able to promote safety among primary schools pupils.*

Index terms– hazards, risks, safety signage.

I. INTRODUCTION

Malaysia had given concern on safety issues in schools [1]. Therefore they came out with Education Act, 1996 which also focused on safety aspect in schools [2]. Furthermore, few circulars also were directed to schools to ensure health and safety of students during their present in school (MOE Circular 5/2016, MOE Circular 4/2002, MOE Circular 8/2011, MOE Circular 7/2011, , MOE Circular 7/2000, MOE Circular 8/2009, MOE Circular 10/2009 [3-9]. A part of that, School Concept and Safety Manual was implemented for the sake of student's safety [10]. Study in Malaysia found that just in three months period of time, a total of 1,846 school injuries with six deaths were reported at government hospitals and clinics in Malaysia [11]. It consist of 69.5% of injuries due to outdoor activities. 63.1%

of indoor and 43.2% of outdoor injuries caused by falls. Injuries due to falls were 60.6% of preschool and 61.8% of primary school children [11]. Third National Health and Mobility Survey (NHMS III) (2006) by Ministry of Health shows that incident rate for 900 schools were 7.0 and for age group 7 to 14 years old was 6.6. Their survey also indicate that unintentional injuries or accident contributed 79.8% of all type of injuries in school [12]. Those injuries may due to unsafe act and unsafe condition in the school area. Specific actions are needed to prevent and control child injuries and to minimize their consequences. World report on child injury outlined that child injuries were predictable and preventable [13]. Thus, safety signs can be one of method to minimize child injuries, prevent accidents, guide on emergency evacuation and give hazard information for school children. This supported by several successful studies on using of safety signage at workplace and public area to prevent accident and incidents [14-18]. Objective of this study is to develop, implement and evaluate the knowledge on safety signage on intervention and control group among the primary schools pupils in Larut, Matang and Selama (LMS) district, Perak state, Malaysia.

II. METHODOLOGY

Larut, Matang and Selama (LMS) district was selected randomly from nine districts in Perak state. LMS district serves as the sampling frame. List of primary schools were obtained from the Education Office of Perak state [19]. All the 111 schools in LMS district were approached to participate in this study which served as cluster. A cluster sampling and randomization procedures were used to select an intervention and control school from 110 schools (99% school responded). The selection of schools for intervention was done using multistage sampling method (figure 1). All the schools were assessed using risk assessment form which

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was adapted from Ewart (2009) [20] and Department of Occupational Safety and Health Malaysia (DOSH) [21]. Here, baseline data was collected on schools population, hazards in the schools and risk relative value (RR) for hazards was calculated using risk assessment formula [21]. High risk school selected as intervention group while low risk school selected as control group (Figure 1).

A. Safety signs design

Safety signs design and layout for intervention schools was based mainly from the description given by Malaysian Standard MS2558:2014 (safety and health signage used in the workplace – Specification, 2014) on general graphical symbols: safety colours and safety signs [22]. Other supporting references were from ISO 3864-1:2011 (Graphical symbols – safety colours and safety signs – Part 1) [23], Signs and Safety at Work guide [24] and Safety Signs and Signals [25]. These were including the size of sign board, safe observation distance and minimum height of the safety signs.

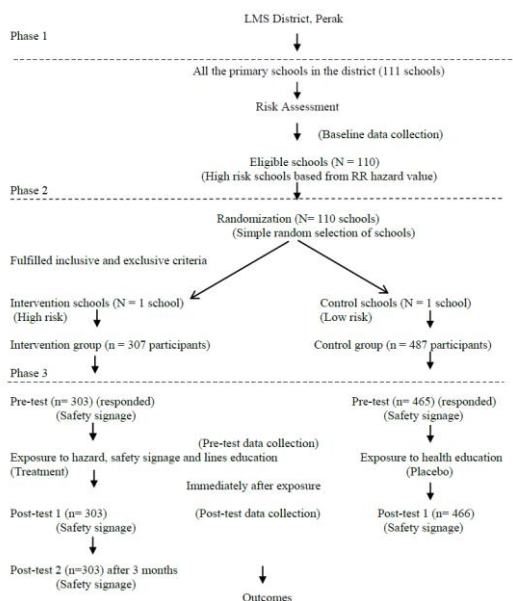


Fig. 1: Consort flow chart of intervention and control groups.

Those layouts of safety signs and design references were for the purpose of accident prevention, fire protection, health hazard information and emergency evacuation at the workplace and public place but was modified and used for the same purpose for primary school community. The safety symbol in actual safety signage was modified in comic forms to attract pupil's attention and be noticeable. It was allowed to use new safety symbol as in clause 6.2 (b)(p.6) and 6.2 (d)(p.7), MS2558:2014 according to target group [22]. The intention of picture in safety signage is to capture attention and attraction and to convey hazard information to pupils [26-28].

For this study, all the layout of safety signs was accompanied by additional text (in English (second language) and Malay language (first language)) to further explain or clarify the meaning of safety signs. Dual language, BahasaMelayu and English were allowed by MS2558:2014 (clause 4.1, p.3) [22] and ISO 3864-1:2011

[23]. Using of first language (national language) was encourage by Waterson [28] for better understanding of the text or signage. Intervention on safety signage design was referred to MS2558 (2014) [22] and ISO3864-1 (2011) [23]. Without changing the background colour and the frame format the newly designed safety symbol was drawn inside the frame. All the newly designed safety symbol was developed according to hazards that identified during risk assessment in intervention school. Design of new safety symbol are according to clause 6.2, 6.3, 6.5 and 6.6, MS2558:2014 (p.6-26) standard [22]. Some of the currently used safety symbols which were in black colour were replaced with coloured safety symbol.

The size of safety signage was designed following the layout requirement given in clause 6.4 (p.18-22), MS2558:2014 [22]. Placement of safety signage was located as near as possible to the hazard that identified. It will help the pupils to take quick action to prevent injuries or accidents. Some of the signage were put up on the wall and some were put up with stand. Distance factor (z) from MS2558:2014, p.36 was used to measure the observation distance (l) by pupils (figure 2). Observation distance, $l = z_0 h$ whereby 'h' is height of the safety sign (h for caution sign, d for prohibition and mandatory sign and a for safe condition sign)[22].

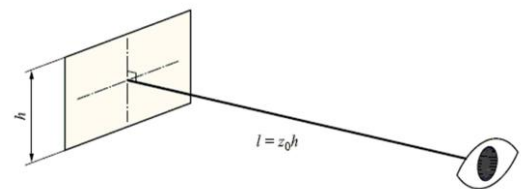


Fig. 2: Observation distance factor
Source: MS2558:2014 [22]

B. Intervention Safety signage

After the pre-test, the researcher gave a talk about safety signs and lines using a power point presentation. Pupils were divided into two groups, level 1 (pupils from Year 1, 2 and 3) and level 2 (pupils from Year 4, 5 and 6) for the safety signage and lines talk. The purpose of making it in small groups is to ensure that the pupils can concentrate and viewing the power point presentation closely. During the summary of the talk, quizzes were given to the pupils to test their understanding. Pupils whom can answer correctly were given token.

All the briefing sections (talks and instruction for the test) were conducted in simple local language dialect (BahasaMelayu), so that they can easily understand and remember the safety signage and lines.

Before data collection, an informed consent was obtained from the respondent. All the collected data was analyzed using SPSS version 21 software. Normality test was done as prerequisite for many statistical tests for normality of data. Kolmogorov-Smirnov test was used to determine the distribution of studied variables before performing any parametric analysis. There were no objectionable ethical issues involved in this study as Ethics Committee of



Research, University Putra Malaysia approved. The research also approved by School Educational Sector, Ministry of Education, Malaysia.

III. RESULTS

A. Socio-demography data of respondents

Normality was done for respondent's age and safety signage scores for both intervention and control group. Both intervention and control group age distribution, and safety signage scores of respondent shows significant ($p < 0.05$) for Kolmogorov-Smirnov and Shapiro-Wilk test. It shows that none of the variables (per-test, post-test and post-test 2) have normal distributions. Post-test and post-test 2 for intervention group, the distribution had negative skewness which was extremely left skewed with long tail. For control group, the distribution was right skewed which is positive skewness with short tail. Furthermore, the studied variables also failed for both Kolmogorov-Smirnov test and Shapiro-Wilk normality test with p-value below 0.05. Since the distributions were not satisfied, non-parametric test was used for this research data analysis

All the respondents involved was Malay ethnic group for both groups. Both schools also were categorized as suburban school. The schools that had been selected in intervention and control groups had both male and female pupils. The gender were almost equally divided among intervention group and control group (not statistically significantly, $p > 0.05$). Mean and standard deviation for age were similar for both group 9.57 (SD 1.766) and 9.68 (SD 1.699). It did not show much differences (not significant) (table 1).

Table 1: Gender and age description for intervention and control group.

Variable	Intervention (N=303)	Control (465)	Mann-Whitney U test	p
Gender:				
Male	155 (51.2)	234 (50.3)	69861.0	0.822
Female	148 (48.8)	231 (49.7)		
Age:				
Mean	9.57	9.68	68096.0	0.427
Median	10.00	10.00		
S.D.	1.766	1.699		

B. Background colour of safety signage

There were 4 geometric shapes with different background colours tested among the intervention and control groups, yellow triangle shape (warning), red circle with slash (prohibition), blue round (mandatory instruction) and green square (safety condition). Pupils from both groups had little previous knowledge on warning and prohibition background colour but not for mandatory and safety condition signage. Wilcoxon signed ranks test used to identify the differences between two groups. Q1 until Q4 signages for meaning of geometric shape shows significant differences between pre-test score and post-test score with p less than 0.05. Intervention group showed good score (more than 90%) on background colour of the signage after intervention (p value less than 0.05). More than 80% of the pupils were still able

to remember the meaning of the background colour of the safety signage after 3 months (post-test 2). Pupils in control group showed 10% increase in prohibition signage scores due to their previous knowledge (Table 2). When compared the mean score between intervention and control groups using Mann Whitney U test, it showed high difference in mean score (p value less than 0.05). Those differences were due to the exposure of the intervention group about the knowledge of safety signages.

C. Warning safety signage

Pupils from both groups had some previous knowledge on warning safety signage. Some pupils were able to identify the meaning by looking at the action sign shown on the signage. For example, many of the pupils from both groups were able to identify the "Caution Slippery Floor", "Caution Open Drain or Hole", "Watch Your Step" and "Caution, Venomous Snake Area" through the pictures showed with action on those signages (table 3). Intervention group shows highly significant differences between pretest and post-test 1 (p value < 0.001) for warning sign questions. Some of the warning safety signages were able to be recognized by the pupils after 3 months. Questions 7, 8 and 10 did not show any differences compared to post-test (table 3). However, some pupils were unable to recognize questions Q5, Q6, Q9 and Q11 for post-test 2 with p value shows below 0.001 and 0.01. Pupils from the control group, 10-25% were able to identify the "Caution Slippery Floor" and "Caution, Venomous snake area" warning signage easily compared with other signages. However, majority of them were unable to recognize the meaning of signage even though the picture in signage itself showed some action or message. More than 70% of them had never seen any safety signages in pictorial forms before.

D. Prohibition safety signage

Pupils from both group were easily able to identify (more than 30%) prohibited signage, "no running" and "no playing or climbing on fence" compared with other prohibited safety signs. After intervention, more than 90% of intervention group were able to recognize all the signages very well. Post-test 2, after 3 months, 5-10% of the pupils did not remember the signage for Q13, Q14, Q15, Q17 and Q18 (p value < 0.001) except question 12 "Prohibited area, no admittance" and 16 "no playing or climbing on fence" (table 3).

E. Instruction safety signage

Two important safety instruction signage that intervene were "use handrail" and "no pushing". Even though the signages easily can be recognized by pictorial, but more than 80% of the pupils could not identify them. Majority of the pupils answered "don't know", giving wrong answer (going up stairs; no playing, no bullying, etc.). After the intervention, more than 80% of the pupils were still able to remember the signages meanings (table 3). There is significant different between intervention and control group ($p < 0.05$) due to majority of control group was not exposed to these signages (table 4).







F. Pupils' knowledge on safety condition signage

More than 15% of the pupils were able to identify two important safety condition signage during pretest for both group. 90% of the pupils were able to remember it after three months. It may due to these signage were put up at every corridor, and the pupils were used to see them

regularly. 15-20% of the pupils from the control group were still able to recognize the safety condition signages (table 3) which they might see before those signs elsewhere. Since intervention group already exposed to safe condition signs, comparison with control group shows significantly different (table 4).








Table 2: Pupil's response on background colour of safety sign among the intervention and control group

Question	Geometric shape	Intervention group ^a (N=303)			Control group ^b (N=465)	
		Pretest (%)	Post-test (%)	Post-test 2 (%)	Pretest (%)	Post-test (%)
Q1. Warning sign		66 (21.8)	297 (98.0)*	294 (97.0)*	4 (0.9)	4 (0.9)
Q2. Prohibition sign		149 (49.2)	299 (98.7)*	294 (97.0)*	121 (26.0)	170 (36.6)*
Q3. Mandatory sign		0 (0.0)	283 (93.4)*	260 (85.8)*	0 (100)	0 (100)
Q4. Safety condition		3 (1.0)	285 (94.1)*	269 (88.8)*	0 (100)	4 (0.9)

Note (*) - statistically significant at $p < 0.05$

a. Friedman test; b Wilcoxon signed ranks test

Table 3: Pupil's response on safety signage's among the intervention and control group.

Question	Safety sign	Intervention group ^a (N=303)			Control group ^b (N=465)	
		Pretest (%)	Post-test (%)	Post-test 2 (%)	Pretest (%)	Post-test (%)
Q5 Danger, high voltage		28 (9.2)	278 (91.7)*	241 (79.5)*	2 (0.4)	4 (0.9)
Q6 Danger, trip hazard		21 (6.6)	291 (96.0) *	257 (84.8) *	0 (100)	1 (0.2)
Q7 Caution, slippery surface		121 (39.9)	297 (98.0) *	290 (95.7)	84 (18.1)	118 (25.4)*
Q8 Caution, open drain or hole		65 (21.5)	297 (98.0) *	288 (95.0)	27 (5.8)	34 (7.3)*
Q9 Caution, when thunder roars, go indoors		36 (11.9)	283 (93.4) *	257 (84.8) *	9 (1.9)	9 (1.9)
Q10 Caution, venomous snake area		76 (25.1)	298 (98.3) *	294 (97.0)	24 (5.2)	50 (10.8)*
Q11 Caution, may fall off the stairs		65 (21.5)	286 (94.4) *	267 (88.1)*	11 (2.4)	19 (4.1)*

Q12. No admittance to unauthorized persons		78 (25.7)	281 (92.7) *	278 (91.7)	11 (2.4)	16 (3.4)
Q13. Danger, septic tank area, prohibited area		7 (2.3)	287 (94.7) *	256 (84.5) *	13 (2.8)	17 (3.7)
Q14. Prohibited area, no admittance		63 (20.8)	286 (94.4) *	247 (81.5) *	8 (1.7)	10 (2.2)
Q15. No running		129(42.6)	300 (99.0) *	283 (93.4) *	135 (29.0)	158 (34.0)*
Q16. No playing or climbing on fence		119 (39.3)	300 (99.0) *	295 (97.4)	138 (29.7)	168 (36.1)*
Q17. Do not put your finger in the socket		39 (12.9)	291 (96.0) *	266 (87.8) *	8 (1.7)	21 (4.5)*
Q18. Do not put finger in air conditioner fan.		74 (24.4)	287 (94.7) *	272 (89.8)*	59 (12.7)	64 (13.8)
Q19. Use handrail		37 (12.2)	289 (95.4)*	269 (88.8)*	4 (0.9)	9 (1.9)
Q20. No pushing		80 (26.4)	269 (96.7) *	286 (94.4)	9 (4.9)	45 (9.7)*
Q21. Emergency exit sign		77 (25.7)	290 (95.7)*	275(90.8)**	95 (20.4)	98 (21.1)
Q22. Emergency assembly area		57 (18.8)	292 (96.4)*	95.0 (4.4)	98 (17.2)	71 (15.3)

Note (*) - statistically significant at $p < 0.05$

a. Friedman test; b Wilcoxon signed ranks test

Table 4: Comparison of difference scores between post-test of intervention and control group.

Variables	Intervention Mean rank (N=303)	Control Mean rank (465)	Mann-Whitney U test	p
Q5. Danger, high voltage	595.82	246.80	6418.50	0.001*
Qb. Danger, trip hazard	607.29	239.33	2941.50	0.001*
Q7. Caution, slippery surface	553.4	274.45	19272.00	0.001*
Q8. Caution, open drain or hole	595.4	247.08	6546.00	0.001*
Q9. Caution, when thunder roars, go indoors	597.15	245.93	6013.50	0.001*
Q10. Caution, venomous snake area	588.16	251.79	8737.50	0.001*
Q11. Caution, may fall off the stairs	594.46	247.69	6831.00	0.001*

Q12. No admittance to unauthorized persons	592.12	249.21	7639.00	0.001*
Q13. Danger, septic tank area, prohibited area	596.22	246.54	6295.50	0.001*
Q14. Prohibited area, no admittance	598.96	244.76	5467.50	0.001*
Q15. No running	535.7	285.98	24634.50	0.001*
Q16. No playing or climbing on fence	530.7	289.24	26149.50	0.001*
Q17. Do not put your finger in the socket	597.29	245.84	5971.50	0.001*
Q18. Do not put finger in air conditioner fan	572.72	261.85	13416.00	0.001*
Q19. Use handrail	601.76	242.93	4618.50	0.001*
Q20. No pushing	586.83	252.66	9142.50	0.001*
Q21. Emergencyexit sign	558.02	271.43	17869.50	0.001*
Q22. Emergency assembly area	573.06	261.63	13314.00	0.001*

Table 5: Descriptive analysis of pre-test, post-test and post-test 2 for intervention group.

Variables	Intervention group (N=303)				Control group (N=465)			
	Pretest	Post-test	Post-test 2	Mean Different Pre-test and Post-test 2	Mean Different Post-test and Post-test 2	Pretest	Post-test	Mean Different Pre-test and Post-test
Mean score	4.64	23.27	22.67	18.63	0.6	1.84	2.35	0.51
Mode	1	25	25			0	0	
S.D.	4.190	2.461	3.029			1.995	2.291	

Table 6: Mean different on safety signs knowledge among intervention and control group

Variables	Intervention Mean rank (N=303)	Control Mean rank (465)	Wilcoxon test (W)	p
Score pre-test	478.62	323.17	150275.50	0.001*
Score post-test	617.00	233.00	108345.00	0.001*

Note (*) - statistically significant at $p < 0.05$

G. Safety signs knowledge comparison among intervention and control group.

The score increased (mean score 18.63 different between pre-test and post-test) after the pupils gain the knowledge on safety signage and lines. The mean score significant increased for post-test compared to pre-test (mean different 18.03) and still maintained after 3 months although there was slightly decreased in mean score (mean different 0.60) between post-test 1 and post-test 2. Control group mean different shows 0.51, which showed some different between pre-test and post-test. The mean score increased slightly after post-test (table 5). Knowledge on safety signage among the intervention and control groups show significant different between mean scores for both pre-test and post-test (table 6). Intervention group have more knowledge on safety signage compare with control group. Hypothesis that there is a different between intervention and control groups on safety signage knowledge accepted.

IV. DISCUSSION

The new intervention of safety signages and lines were successfully attract the pupils’ attention on safety behavior when they are in the school. This study also achieved the objectives of research intended. The pre-test and post-test results show significantly differences and sustain the meaning of safety signages and lines after three months period of time. It well shows that safety signages and lines can reduce the number of injuries among the pupils in the primary schools. To sustain the

memory of the pupils on safety signage and lines, school administrative should always remind them about the important of safety signage in reducing incidents and to improve safety behavior. The symbols in the safety signage can alert the users about the danger or hazard [29]. Currently used non symbol-based signs or other type of symbols have serious weakness as proved by [30]. To further promotion of safety in schools, redesigned of current safeysignages are needed. Presence of pictorials in safety signages will increased compliance, compared with signages without pictorials. Study on safety signages had created awareness among the primary school pupils based on the training and result of post-test. Pupils gave their feedbacks and their own interpretation on safety signage. This was also founded by Waterson [28] in his study. Pupils were attracted with different safety colours background, minimum words used about safety mesaage and pictograms or comic illustration with facial expression and the character conveyed good or bad behaviour made pupils to remember the safety signage message even after three months. These are what outlined in designing signs for children[31]. Several studies shows that signage with illustration or pictogram with facial or emotion expression will capture or attract pupils or children easily and will remembered it for some times [26, 31, 32]. Other than the content of safety signs, training also playing a role in pupils to remember the



message carried by the safety signage. Significant benefit of training on safety signage shown by Lesch and Alan in their studies [32- 33].

Warning thought as safety communication and conveyed good behavior safety message. Purpose of this warnings will make the world safer place [26]. Pupils will take precaution and will be very careful when they are at the particular area which have risk. Furthermore, it will alert them to avoid accidents or injuries. For example, when pupils pass by safety signage with visual picture shows slippery floor (Q7), they will walk through carefully the particular area. Pupils who always passed by the area with safety signage remembered better than the pupils who did not pass by the area or did not notice the signage [31].

Significant different ($p < 0.05$) shown on prohibited signages compared to control group. Prohibition sign or symbol are more familiar with the pupils compared with other type of safety signages. Even, control group was able to give the meaning of familiarize prohibited signage (Q15 and Q16). This is supported by Hancock [34] in his study that prohibition symbol was better understood by respondents compared to the other type of symbols. Young children have strong association with colours [31].

Instruction safety signage plays role in promoting safety behaviour as unsafe behaviour can put the pupils in high risk of injuries [35]. For example, "No pushing" signage when put up at queuing location of school canteen, it will reduced pupils from pushing each other while buying food and at the same time reduce injuries due to fall. Using of handrail when going up or going down from stairs will reduce injuries also. Fall down from stairs are common among the children as stated in studies by Pierce and Pilla [36-37]. Since pupils like to run and play on staircase, instruction signs using of handrail is vital to reduce injuries and promote safety behaviour.

Fire exit signage and emergency assembly point must presence in every building and the fire exit signage will help to escape from fire [38]. Ministry of Education's Schools Secular No. 7/2000 and Safe School Concept and Manual [7, 10] also stated about fire drill. The understanding of fire exit signs very important during fire evacuation [39]. Location of fire exit sign should place appropriately, so that pupils will be able to escape in time of fire by looking to the nearest fire exit sign. A systematically fire evacuation plan with fire exit sign guidance needed to promote fire safety in schools as supported by Kobes [38].

The hypothesis null that there is a different between pre-test 1, post-test and post-test 2 on knowledge of safety signage and lines among the intervention group is accepted. It proved that the pupils were always noticed or saw the safety signages when they passed by the area of signage located. The slightly increased scores for post-test among the control group may due to the discussion among the pupils that had been done after the pre-test. The pupils were able to remember the signage and may saw it somewhere else caused them to answer more questions correctly. The pupils easily noticed the hazard symbols rather the regulation or other instruction at located area [46]. Furthermore, it ensured that the pupils

obeyed those safety signages and lines instructions or commands. Study by Lesch, Alan, Gielen and Wang [32, 33, 41] show that intervention, training and education background will increase the knowledge about safety signage and able to recall the signage even after some months. Knowledge on safety signage also reduce number of incidents (accidents and injuries) and improve safety behaviour among the school children [35].

Knowledge on safety signage among the intervention and control groups show significant different between mean scores for both pre-test and post-test. Intervention group have more knowledge on safety signage compare with control group. Hypothesis that there is a different between intervention and control groups on safety signage knowledge accepted. The same result obtained by Lesch and Alan [32-33] whereby trained group on safety signage have more knowledge compared with control group. Furthermore, the short safety message that carried by the signage with colorful comic illustration and emotion were conveyed good and bad behavior [31].

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