© Universiti Tun Hussein Onn Malaysia Publisher's Office

IJIE

Journal homepage: http://penerbit.uthm.edu.my/ojs/index.php/ijie

International Journal of Integrated Engineering

Development of Distraction Risk Index (DRI) Among the Intrastate Bus Driver in Kuala Lumpur, Malaysia

Muhammad Nur-Annuar[1], Jalil Azlis-Sani[1*], Musli Mohammad[1], Mohd Zamani Ngali[1], Munzilah Rohani[2], S.M. Sabri S.M. Ismail[3], Noor Aqilah Ahmad Tajedi[3]

[1]Faculty of Mechanical and Manufacturing Engineering,
Universiti Tun Hussein Onn Malaysia, 86400 Batu Pahat, Johor, MALAYSIA

[2]Faculty of Civil and Environment Engineering,
Universiti Tun Hussein Onn Malaysia, 86400 Batu Pahat, Johor, MALAYSIA

[3]Prasarana Malaysia Berhad, Wisma Monorail, Kuala Lumpur

*Corresponding Author

DOI: https://doi.org/10.30880/ijie.2020.12.08.010
Received 31 March 2020; Accepted 5 August 2020; Available online 30 August 2020

Abstract: Bus services is one of the main public transport chosen by the people all around the world especially in the big city such as Kuala Lumpur. However, the safety of the passenger of the bus services become main concern among the researchers due to increasing number of accidents among the bus services. Some researcher found that, the major factor of the accidents involving bus services was caused by the bus driver distraction. Therefore, the objective of this research was to develop the Distraction Risk Index (DRI) among the intrastate bus driver. This research only focussed on the intrastate bus driver in Kuala Lumpur. Survey which adapting the Hampton University Transportation Centre Bus Driver Distraction Survey was used and distributed to 215 intrastate bus drivers in Kuala Lumpur, Malaysia. It was found that there were four (4) sources of distraction which classified as very high risk which were (i) condition of the bus, (ii) traffic congestion, (iii) drivers' welfare and (iv) drivers' health. Findings of this research could be used as a platform for future improvement for the performance of the intrastate bus services. This research provided assistance to future researchers to design and provide solution to overcome sources of distraction.

Keywords: Driver distraction, risk index, intrastate bus driver

1. Introduction

Over the last few years, distraction has been widely discussed by many researchers around the world. However, most of the studies have only focused on conventional passenger vehicles and very few researches had discussed about public transportation [1]. Based on previous researches, driver distraction is recognized as a significant road safety issue that would influence the rate of traffic crashes [2]. The number of researches related to the distraction of bus drivers have been increasing gradually throughout these several years. This trend has provided a significant indication on the importance of studies on bus driver distraction. Intrastate buses are chosen as the main public transport by many people due to its affordable fares [3]

*Corresponding author: azlis@uthm.edu.my

2. Distraction Risk Index (DRI)

Distraction Risk Index (DRI) is conceptually similar to the Hazard Index which was developed in a previous research [4]. Distraction Risk Index (DRI) is computed based on the sources of distraction rated by the intrastate bus drivers through the survey and where been ranked from the highest to the lowest [5]. Then, the values were graded based on the highest value. The purpose of computing DRI was to classify all the sources of distraction into 4 risk levels which are very high risk, high risk, moderate risk and low risk.

A previous research has found that approximately 23 sources of distraction were being classified into risk level after computing the DRI. Table 2.1 shows the findings of the research and it was found that the DRI range for the very high risk is more than 66% while the low risk is less than 54%. There are four (4) sources of distraction in the very high risk which were (i) pedestrians, (ii) passengers (moving around, standing next to driver's cabin, talking next to driver's cabin), (iii) other road users and (iv) unruly kids. Meanwhile there were five sources of distraction were classified as low risk which were (i) dispatch broadcasts, (ii) food and other smells, (iii) passenger with infants, (iv) general broadcast's and (v) audible alerts.

Table 2.1 - Previous research on Distraction Risk Index (DRI) [5]

DRI Range	Type of Risk	Risk Zone	Sources of Distraction
More than 60%	Very High Risk	1	Pedestrians, Passengers (moving around, standing next to driver's cabin, talking next to driver's cabin), Other Road Users, Unruly Kids
More than 60% and up to 66%	High Risk	2	Passengers Using Mobile Phone, Mobile Data Terminals, Passengers not following etiquette (eating, drinking, smoking, noisy), Ticket Machine/ Farebox
More than 54% and up to 60%	Moderate Risk	3	On-board rattles, Communication with Dispatch, Looking at Advertisements, Passengers Trying to Talk to Driver, Fatigue/Sickness, Climate Controls, Driver's Mobile Phone, Disabled Passengers, Announcing Bus Stops, Reading (e.g. Route Sheet)
Less than 54%	Low Risk	4	Dispatch Broadcasts, Food and Other Smells, Passengers with Infants, General Broadcasts/ Other, Audible Alerts

3. Methodology

Distraction Risk Index (DRI) is calculated based on the information collected from the survey method which the content of the survey method was identified by underwent focus group interview [6]. Then, the survey was distributed to 215 random intrastate bus drivers at prominent intrastate bus services in Kuala Lumpur, Malaysia. The set of survey was adapting the established questionnaire from Hampton University Transportation Centre Bus Driver Distraction Survey [7]. Figure 3.1 shows the flowchart of the survey method. The survey method started with the modification of the established questionnaire. The sources of distraction which were found in the previous focus group interview would be used in this questionnaire [5]. This questionnaire was translated into Bahasa Malaysia to ease the intrastate bus drivers for answering. Before distributing the questionnaire, the modified set of questionnaires was sent to the prominent bus company to obtain verification on the content of the questionnaires for the content validity process. The modified questionnaire also was sent to the expert related with the research area to review. Then, the questionnaires were distributed to 215 intrastate bus drivers at seven different bus depots randomly. After all the questionnaires were answered, the researcher collected back and analyzed the data. The analysis was done by using SPSS software.

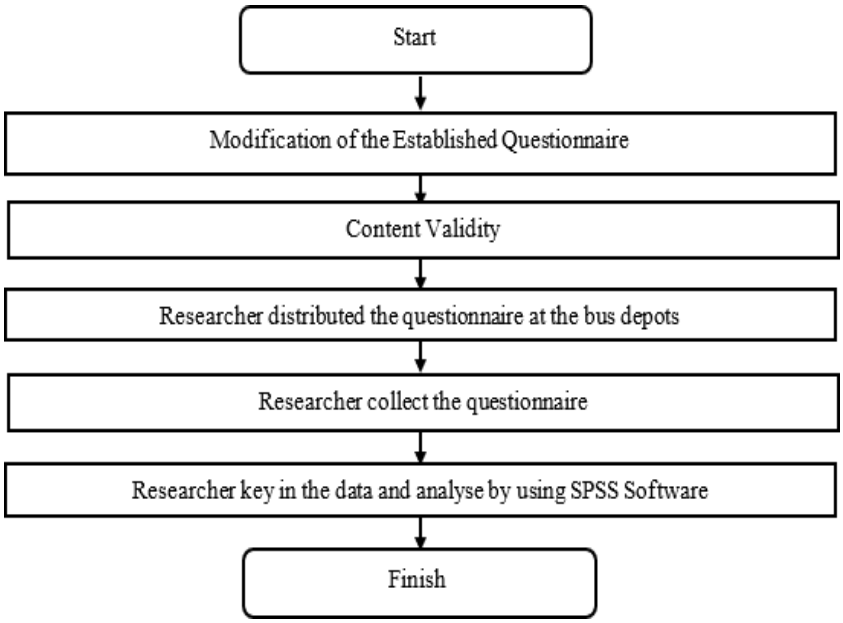

Fig.1 3.1 - Flowchart of survey method

4. Analysis

There are 4 types of risks and the average percentage of each risk depends on the mean and standard deviation of the result [8]. Peng & Nichols (2003) found that the score of Distraction Risk Index (DRI) can be identified as Risk Zone 1 (very high risk) if the average percentage of at least one standard deviation is above the mean. For example, this research has a mean of 70.5 % and standard deviation of 5.2 %. If the average percentage is more than 76 %, it would be classified as Risk Zone 1 (very high risk). Previous research which had been done by D'Souza (2012) was using this method to classify the source of distraction into risk index. Figure 4.1 shows the flowchart of development of Distraction Risk Index (DRI).

There were 4 steps for calculation of Distraction Risk Index (DRI). The first step is ranking the source of distraction. The list of sources of distraction which is from the focus group interview would be used in this survey. In the survey, the respondent would be asked regarding their opinions based on their experience about how severe the distracting sources would affect them. The respondents would need to rate the distracting sources by using 5 Likert scale which are very less distract, less distract, moderate distract, high distract and very high distract. After collecting the surveyed data, the average of rating for each source of distraction would be calculated and arranged based on the average rating from the highest to the lowest.

Step 2 is related to the driver's perception. There are 3 categories related with the driver distraction which are (i) visual, (ii) manual and (iii) cognitive [5]. The respondent would be asked about their perception on the effect of source of distraction towards them in the survey. The information would be collected and arranged from the highest to the lowest based on the number of driver selection in the category of distraction. In step 3, the source of distraction would be graded as a percentage relative to the highest number of drivers for each category of distraction which are (i) visual, (ii) manual and (iii) cognitive. After that, the average percentage of each source of distraction would be calculated and arranged from the highest to the lowest. The mean and standard deviation would also be calculated for the overall percentage. Lastly, DRI range is determined by referring to the overall mean and standard deviation. The mean value added with the standard deviation value are the DRI range for the high-risk zone, and greater than that would be for the very high-risk zone. Meanwhile, the mean subtract with the standard deviation was for the moderate risk zone, and less than that would be for the less risk zone. Then, all the sources of distraction were classified into the four DRI zone.

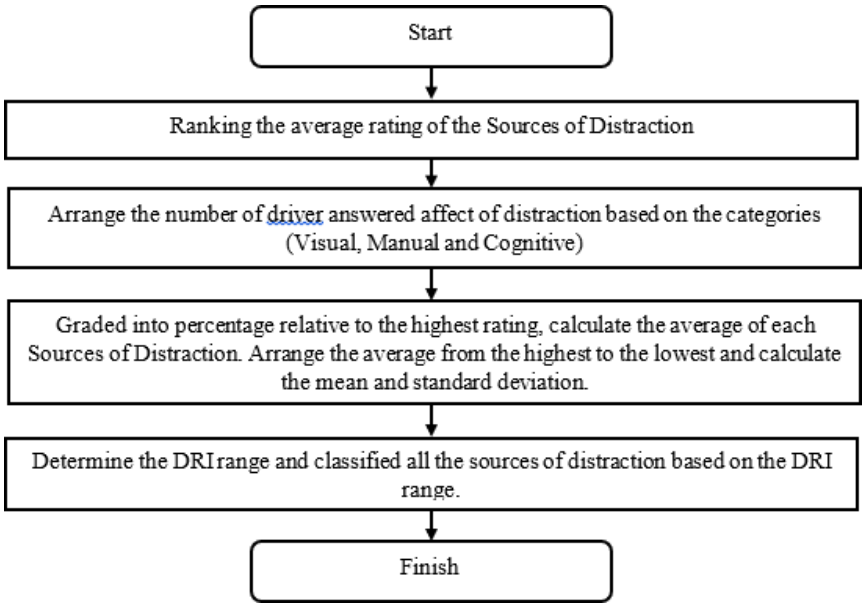

Fig. 4.1 - Flowchart of development of DRI

5. Result

First, the average rating of each source of distraction is calculated and arranged from the highest to the lowest. The result is tabulated in the Table 5.1. The highest average rating of source of distraction is 3.66 which is traffic congestion and the lowest is 1.96 which is advertisement along the roadside. All the average rating of the source of distraction are then graded into percentage relatively to the highest average rating which is 3.66.

Table 5.1 - Average rating of the source of distraction

Ranking	Source of Distraction	Average Rating
1	Traffic congestion	3.66
2	Other road users	3.38
3	Driver's salary	3.31
4	Driver's health	3.28
5	Distracted by passengers' behavior	3.17
6	Comfortability of the driver's seat	3.11
7	Driver's welfare	3.10
8	Identifying bus stop	3.03
9	Condition of bus	2.95
10	Less experienced driver	2.87
11	Smell from the passengers	2.73
12	The effectiveness of the working schedule	2.72
13	Troubled passengers	2.67
14	Systematicity of the management system	2.67
15	Changing of the route	2.60
16	Open trunked radio	2.53
17	Driver behavior	2.44
18	Communication between the passengers and the driver	2.36
19	Under-aged passengers	2.29
20	Personal issue	2.24
21	Video advertisement on the screen in the bus	2.20
22	Equipment recording in the bus	2.03
23	Advertisement along the roadside	1.96

Next, the information related to the driver's perception would be analyzed. All the sources of distraction are categorized into 3 distraction category which are visual, manual and cognitive. The process is done based on the number of drivers that categorize the source of distraction into the respective distraction category. After that, the source of distraction is arranged based on the highest number of drivers to the lowest number of drivers for each category of distraction. The result is tabulated in Table 5.2. The highest number of drivers for visual distraction category is 76, which is smell from the passengers. The lowest is 36 which is systematicity of the management system. The number of drivers for visual distraction category are then graded into percentage relatively to the highest number of drivers which is 76.

Table 5.2 - Number of drivers based on visual distraction

Ranking	Source of Distraction	Number of Drivers
1	Smell from the passengers	76
2	Advertisement along the roadside	73
3	Communication between the passengers and the driver	73
4	Video advertisement on the screen in the bus	65
5	Equipment recording in the bus	58
6	The effectiveness of the working schedule	58
7	Driver behavior	53
8	Identifying bus stop	53
9	Changing of the route	52
10	Distracted by passengers' behavior	51
11	Condition of bus	50
12	Open trunked radio	48
13	Driver's health	47
14	Troubled passengers	47
15	Under-aged passengers	45
16	Personal issue	44
17	Driver's welfare	44
18	Less experienced drivers	43
19	Traffic congestion	41
20	Driver's salary	41
21	Comfortability of the driver's seat	40
22	Other road users	39
23	Systematicity of the management system	36

Based on Table 5.3, the highest number of drivers for cognitive distraction category is 155, which is troubled passengers. The lowest is 120 which is condition of the bus. The number of drivers for cognitive distraction category are then graded into percentage relatively to the highest number of driver which is 155. Cognitive distraction is kind of distraction that related with the mental processess.

Table 5.3 - Number of drivers based on cognitive distraction

Ranking	Source of Distraction	Number Driver
1	Troubled passengers	155
2	Comfortability of the driver's seat	153
3	Under-aged passengers	153
4	Personal issue	152
5	Other road users	152
6	Driver's salary	151
7	Less experienced driver	149
8	Open trunked radio	148
9	Identifying bus stop	145
10	Systematicity of the management system	145
11	Changing of the route	143
12	Video advertisement on the screen in the bus	143
13	Equipment recording in the bus	143
14	Driver behavior	141
15	Driver's health	141
16	Traffic congestion	140
17	Distracted by passengers' behavior	139
18	Advertisement along the roadside	136
19	The effectiveness of the working schedule	136
20	Driver's welfare	134
21	Communication between the passengers and the driver	132
22	Smell from the passengers	125
23	Condition of bus	120

Based on Table 5.4, the highest number of drivers for manual distraction category is 45, which is condition of the bus. The lowest is 6 which is advertisement along the roadside. The number of drivers for manual distraction category are then graded into percentage relatively to the highest number of driver which is 45. This kind of category is related with the physical distraction to the driver.

Table 5.4 - Number of drivers based on manual distraction

Ranking	Source of Distraction	Number Driver
1	Condition of bus	45
2	Driver's welfare	34
3	Systematicity of the management system	34
4	Traffic congestion	37
5	Driver's health	25
6	Distracted by passengers' behavior	20
7	Other road users	21
8	Driver's salary	21
9	Less experienced driver	22
10	Comfortability of the driver's seat	23
11	The effectiveness of the working schedule	27
12	Driver behavior	24
13	Changing of the route	23
14	Open trunked radio	14
15	Personal issue	14
16	Identifying bus stop	19
17	Under-aged passengers	19
18	Smell from the passengers	13
19	Equipment recording in the bus	10
20	Troubled passengers	17
21	Communication between the passengers and the driver	17
22	Video advertisement on the screen in the bus	7
23	Advertisement along the roadside	6

Lastly, the average of all the percentage of the source of distraction was calculated. Based on Table 5.5, the highest average of percentage is 81 % which is condition of the bus and there are two sources of distraction with lowest average of percentage which are 63 %. They were video advertisement on the screen in the bus and advertisement along the roadside. The mean of the average percentage is 70.5 % and the standard variation is 5.2 %.

Table 5.5 - Average percentage for source of distraction

Rank	Source of Distraction	Percentage (%)				Average Percentage (%)
		Average rating	Visual	Cognitive	Manual	
1	Condition of bus	81	66	77	100	81
2	Traffic congestion	100	54	90	76	80
3	Driver's welfare	85	58	86	82	78
4	Driver's health	90	62	91	60	76
5	Distracted by passengers' behavior	87	67	90	56	75
6	Other road users	92	51	98	53	74
7	Driver's salary	90	54	97	51	73
8	Smell from the passengers	75	100	81	31	72
9	Systematicity of the management system	73	47	94	76	72
10	Comfortability of the driver's seat	85	53	99	49	71
11	Identifying bus stop	83	70	94	38	71
12	Less experienced driver	78	57	96	51	71
13	The effectiveness of the working schedule	74	76	88	47	71
14	Changing of the route	71	68	92	44	69
15	Driver behavior	67	70	91	47	69
16	Open trunked radio	69	63	95	42	68
17	Communication between the passengers and the driver	65	96	85	22	67
18	Troubled passengers	73	62	100	29	66
19	Under-aged passengers	63	59	99	38	65
20	Personal issue	61	58	98	42	65
21	Equipment recording in the bus	55	76	92	31	64
22	Video advertisement on the screen in the bus	60	86	92	16	63
23	Advertisement along the roadside	53	96	88	13	63
					Mean	70.5
					Standard Deviation	5.2

6. Conclusion

Figure 6.1 shows the distraction risk zone that was found in this research. This research had identified the scoring for each risk zone of the Distraction Risk Index (DRI) by referring to the mean and standard variation of the average percentage of each source of distraction. The mean is 70.5 % and the standard deviation is 5.2 % while the scoring is in between 81% to 63 %. From the Distraction Risk Index (DRI) that had been identified, there are four (4) sources of distraction which have been categorized into the first zone which are very high risk. The sources of distraction are condition of the bus, traffic congestion, driver's welfare and driver's health. The sources of distraction related with the conditions of the bus is when the intrastate bus drivers tend to be distracted whenever they noticed that the bus being operated is not in good condition especially on the mechanical parts including brakes and tires of the bus. Besides, traffic congestion is included in the very high-risk zone. It is a situation where the intrastate bus drivers are stuck in heavy traffic especially during the peak hours. The drivers' welfare is also one of the sources of distraction which is in the very high-risk zone. This included the resting areas provided at each depot which are not in proper conditions. Bus drivers may have gaps in between one trip to another. Thus, it is important for the resting areas to be in good conditions so that the drivers can have sufficient rest before proceeding with the next trip. Finally, the driver's health is also in the very high-risk zone. When there is a shortage of bus drivers, the on-duty drivers would have to work overtime to meet the demand of the services. This would eventually cause fatigue and sickness to the bus drivers which can affect their performance of driving. Besides, there are five (5) sources of distraction that are classified as low risk which are (i) under-aged passengers, (ii) personal issue, (iii) equipment recording in the bus, (iv) video advertisement on the screen in the bus and (v) the advertisement along the roadside.

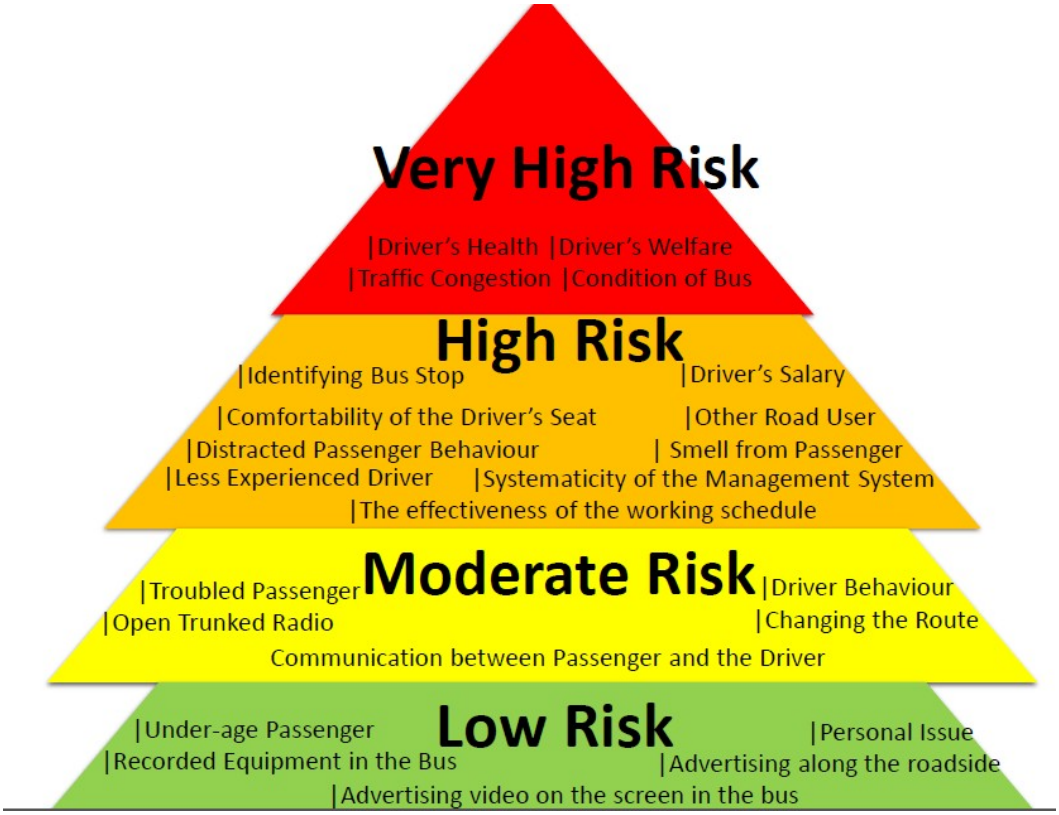

Figure 6.1 - Distraction risk zone

Besides, these are the recommendation provided to the government agency to overcome the sources of distraction found based on this research.

I. To inspect the intrastate buses regularly to ensure the conditions are always in good and safe conditions.
II. To provide alternatives and reduce traffic congestions especially during the peak hours.
III. To enforce the management of the bus companies to have their intrastate bus driver's health report every 6 months.
IV. To collaborate with the management of the bus company on improving the resting areas for the intrastate bus drivers at each central depot.

Finally, several recommendations for the industry of intrastate bus driver are as follows:

i. To study the level of workload on intrastate bus drivers.

ii. To conduct motivational sessions and classes periodically among the intrastate bus drivers.
iii. To propose the increase and upgrade of the temporary resting areas for the intrastate bus drivers at several depots.
iv. To develop a safety protocol for the drivers when facing troubled passengers.
v. To provide awareness to the passengers to have good habits while boarding intrastate buses.

Acknowledgement

The authors would like to acknowledge the Ministry of Education, Malaysia, and Universiti Tun Hussein Onn Malaysia for financial support under Fundamental Research Grant (FRGS) No. 1542. The authors declare that there is no conflict of interests.

References

[1] Horberry, T., Anderson, J., Regan, M. A., Triggs, T. J., & Brown, J. (2006). Driver distraction: The effects of concurrent in-vehicle tasks, road environment complexity and age on driving performance. Accident Analysis and Prevention, 38(1), 185–191.
[2] Regan, M. A., Lee, J. D., & Young, K. L. (2009). Driver Distraction: Theory, Effects and Mitigation.
[3] Nur, M., Yunos, A. M., Azlis-Sani, J., Zamani, M., Ngali, B., Mohammad, S. M. (2017). Understanding Factors of Distraction among Intrastate Bus Driver, 49.
[4] Smith, D. L., Chang, J., Cohen, D., Foley, J., & Glassco, R. (2005). A simulation approach for evaluating the relative safety impact of driver distraction during secondary tasks. Traffic Safety, (November), 6–10.
[5] Kelwyn A. D'Souza, & Sharad K. Maheshwari. (2012). An Analysis of Transit Bus Driver Distraction Using Multinomial Logistic Regression Models, 1–20.
[6] Nur, M., Mohd, A., Azlis-sani, J., & Mohammad, M. (2018). Investigation of Source of Distraction among the intrastate bus driver: Focus Group Interview
[7] DSouza, K. A., & Maheshwari, S. K. (2015). A methodological approach for studying public bus transit driver distraction. International Journal of Sustainable Development and Planning, 10(2), 229–244.
[8] Peng, C.-Y. J., & Nichols, R. N. (2003). Using Multinomial Logistic Models to Predict Adolescent Behavioral Risk. Journal of Modern Applied Statistical Methods, 2(1), 177–188.