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MOBILITY AND PROXIMITY COEFFICIENT TO HIGH-TRAFFIC VOLUME IN DAILY SCHOOL OPERATIONS

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Abstract

Heavy traffic volume especially in peak time led to bigger issue during daily school operating time. Drivers' behaviours are often seen as the central cause to the increased number of road accidents around school, particularly during morning hours when accompanying adults are in a rush to office. Good accessibility and connectivity are the main consent in a school planning guideline. However, the proximity to major roads results in a higher level of traffic around the school. The research hypothesis is to investigate whether the proximity distance playing a significant role in determining mobility choice to school. The Geographical Information System software was used to analyse the safety measures such as distance, coverage area and routes to school, while the mobility analysis is done using the SPSS. 553 samples of questionnaires have been distributed at six identified schools in Johor Bahru. The result from analysis shows 79.39% of children use motorised vehicle thus, contributing to poor traffic flow during peak hour. While in comparing the coverage of each school to the guidelines, 99.45% of children's houses are within the accepted radius distance. The findings of this study will highlight to some poor driving habits among parents, which are a major contributor to the heavy traffic flow surrounding schools.

Keyword: School location, traffic, proximity, accessibility, mobility

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INTRODUCTION

The statistics of road accident involving children around the world reported an overwhelming number of 500 death every day, thousands of injuries, and many sufferings lifelong disabilities (World Health Organization [WHO], 2013). The status has reached to 1.35 million in 2018 and most cases were associated to the age range from 5 to 29 years old (WHO, 2018). In the latest update report, the World Health Organization presented the percentage of road accidents involving children and young adult had increased and becoming the leading cause of death in that age group (WHO, 2021). It is also reported that 93% of road crashes are from the low and middle-income countries which made up of approximately 60% of world's vehicles. This has urged a call for global gathering ministers to determine road safety agenda 2030 targeting to halving the total number of road injuries and death cases (WHO, 2021).

In response to the Sustainable Development Goals (SDGs) agenda for targeting to reduce half of the number of road injuries and death in Malaysia, the Eleventh Malaysia Plan (2016-2020) has added the road safety strategy in *"Chapter Three; Improving Wellbeing for All"*. The key results in the year of 2016- 2017 have shown a slightly reduce in road fatalities index from 2.59 to 2.34 although the number of accident cases from 7152 to 6740 are still considered to be high as compared to other countries. In the mid-term of the plan reviewing period, it is stated that the reduction of accidents cases is due to the improvement of road at black spotted areas, road safety education, and the shortened emergency response time from 20 minutes in 2015 to 14.5 minutes in 2017 (Economic Planning Unit, 2020). However, having a more comprehensive statistical road fatalities data from 2016 to 2020 to obtain accurate road fatalities pattern within the 5-year plans will be beneficial in resolving the issue.

The strengthening of children protection and wellbeing agenda continues to be highlighted as the development of programmes to separate children from crimes or injuries and be given priority in the latest Twelfth Malaysia Plan (2021-2025) (Economic Planning Unit, 2021). In addition to this, the government's next recommendation is to have an effective urban planning model that encourage green mobility. The aim is to reduce congestion in urban area and the focus were on public transport, walking, cycling or the use of environmental-friendly vehicles. In relation to the research topic, currently most of parents are hesitant to allow their children walk to school because of traffic congestion near schools, road crashes, as well as other safety issues such as criminal activity, and a lack of safety measures that make them feel their children is unsafe walking or cycling alone on the road. A new approach of green mobility is expected to promote children to free walking or cycling where this could help reduce the volume of traffic to school in the future. However, safety measures must be seriously considered as to ensure the children are at utmost safest condition. In a research of the safe city programme, Lim et al. (2020) stated that

safety measures in all aspects must be thoroughly reviewed in all environments. A comprehensive plan for a safe environment especially for school children practices active mobility to school should be strategized.

Understanding the Safety Measures in Daily School Operations

Safety measures should be made aware to children at the very young age, and they must be continuously educated parallel to the present safety issues in preparing them to be alert at any situations. School safety anticipates the students to feel free, either physically, emotionally, or psychologically (Tabancali & Bektas, 2009). Not only to the school children, the drivers too, should also be educated with the safety measures aspects, especially when driving involve the road near the school.

Safety measures are not limited to providing good road condition or the availability of road infrastructure, but it needs to extend to the understanding theory that the children had small physical size, particularly primary school age children which make it difficult for the drivers to see them. The children also tend to be active and inexperienced in making prompt responses in risky situations and more inclined to make errors in their decision making (Yue, 2018). With the numerous accident cases involving school-aged children, in addition to the lack of assurance regarding the safety of the children walking to school among parents, thus the use of motorised vehicle is seen as the most viable option. A study on mobility choices to school reported that more than 60% of parents choose to send their children to school by own motorised vehicle (Yusoff et al., 2017). The percentage appears to be steadily rising, making school a high-risk location for accidents.

According to the Clinical Research Centre Malaysia, 1 in 3 primary school students were dropped off and picked up in a dangerous manner (The Borneopost, 2018). Some of the parents quickly drop and went off while the children are crossing the road. Even though awareness is an important element, the safety component should also be regulated and made a priority matter of safety parameters in a school planning guideline (Zhu & Lee, 2008). Schools that are located near major road are presumed to be at the highest risk for accident cases due to the road connectivity allowing the motorised vehicle to reach other junctions easily. There should be a limit number for each road to be linked especially near the school area. The common issues to be undertake for school safety measure are the increase off-site parking cars, the drop-off cars, and the public road user. The traffic volume at the roads around the schools is inevitably higher than any public spaces which makes it difficult to control. The demand of mobility and accessibility nowadays often sees as parallel to urban growth rate and effect to road efficiency (Abd Rahman et al., 2018).

Malaysia School Planning Guidelines

In Malaysia, school planning guidelines is classified under amenities, and it is falls under the responsibility of PLANMalaysia or previously known as the Town and Country Planning Department. The decision to develop a new school is made by the District Education Office (DEO), the State Education Department (SED), and the Ministry of Education Malaysia (MoE) where all of them are involved in the procedures at the earlier stage. When a school is overcrowded with pupils and surpassed the allowance number, the school management will send a report to the DEO. Then, a meeting will be held to discuss the issue together with the SED before sending over to the MoE for a consideration and approval allotment. If agreed, the next process would be handled by the PLANMalaysia and local authority for the area identification and implementation following the school planning guidelines.

The guidelines are divided into two sections, the first of which outlines broad requirements and the second of which focuses on specific restrictions. The extracted points in table 1 are from the public daily school category. Eleven elements were identified as the most relevant to safety measures and the requirement for each primary and secondary schools were similar with the exception to the walking distance. The first important point to be highlighted in this research is the school coverage area. The limits of school coverage area indicate the allowable number of children in each class. This guideline was strictly applied, to ensure that the school is not overcrowded, and it can be easy controlled by the school management. Overcrowded school will also affect to the road congestion during peak hours.

Next is to study the school location by comparing the school planning guideline with the current implementation. According to the guidelines, a school is required to be placed at acceptable walking distance and it should be in the range of 400m to 800m for the primary school; while 800m to 1600m for the secondary school. The guidelines were designed with the intention to encourage children to walk or cycle to school and this is in line with the government policy, to promote a healthy lifestyle. Moreover, students who practise active mobility will benefit to a healthy body and could also prevent from being obese (Yusoff et al., 2017). Therefore, other than the school coverage area and mobility analysis, the proximity distance between houses and school is also part of safety measures, and this will be the main research focus.

Table 1 shows the criteria related to safety measures that were summarized from the school planning guidelines and interview with the officer of PLANMalaysia.

Table 1: Safety measures of school planning guidelines

School Planning Guidelines	Primary School	Secondary School
Coverage from the total number of populations	10% Category A:45/class Category B:35/class	13% Category A:45/class Category B:35/class
Located at walking distance	400m to 800m	800m to 1600m
Located at conducive area, far from noise of industry, airport, highway	Not mentioning the req. of buffer zone	Not mentioning the req. of buffer zone
Located separately to the high rise residential/flat houses but closer to school	No specific minimum of distance	No specific minimum of distance
Crime Prevention Through Environmental Design (CPTED) based design	No specific items and measurement	No specific items and measurement
Safety environment	Avoid form crime hotspot	Avoid form crime hotspot
Safe connectivity road	Near collector road and avoid direct access from major road	Near collector road and avoid direct access from major road
Near to public transport; bus/LRT	No specific distance	No specific distance
Providing a drop off and pick up point	Separate lane/road	Separate lane/road
No school located near front/main road	Specific category of road (major/collector/arterial)	Specific category of road (major/collector/arterial)
No school located at risky area such as flood flash area, landslide, high volume of electricity cable	Avoid from steep slope ≥25°	Avoid from steep slope ≥25°

Source: PLANMalaysia (2018)

Aim and Objectives

The research aim is to study the mobility and proximity effects to heavy traffic flow around school during peak time. Three objectives were laid out that are:

i. To identify the safety elements in school planning guidelines and the practices among the selected school
ii. To analyse the mobility mode to school for primary and secondary school children
iii. To explore the relationship between the mobility mode choice with proximity factor.

The Study Area

The study area is in Johor Bahru district, Malaysia located at coordinate $1^0$29'00'N $103^0$44'00'E, consisting of sub-district Plentong, Pulai and Tebrau. Six schools were selected with three secondary schools which are SMK Bandar Baru Uda, SMK Sri Rahmat and SMK Taman Daya. The remaining three schools are the primary school namely SK Kompleks Uda, SK Taman Bukit Mewah and SK Taman Daya 2. These schools were selected because of its location that is near of major road and have direct access. Table 2 shows the calculation of the total sample number.

Table 2: Total number of samples for each school

No	School's Name	Number of Students (N)	Sample size 1+N (0.01)	N / 1+N (0.01)	Sample Number
1	SMK BBU	1959	20.59	95.143	95
2	SMK Sri Rahmat	1901	20.01	95.002	95
3	SMK Taman Daya	1437	15.37	93.363	93
4	SK Kompleks Uda	1090	11.9	91.596	92
5	SK Taman Bkt Mewah	681	7.81	87.195	87
6	SK Taman Daya 2	1008	11.08	90.974	91
	Total				**553**

DATA AND METHODOLOGY

This research employs the quantitative methods for the statistical analysis that will involve the mobility studies. This phase begins with the interviews and distribution of questionnaires at six schools. The total of respondents involved are 553 school-aged children with 270 respondents are from the primary school and 283 are from the secondary school. Specific questions about safety measures and children background were also structured. Next phase is the study on the coverage and proximity using the GIS. The data were gained from a series of topographic Johor Bahru map that was obtained from the Department of Surveying and Mapping Malaysia or *Jabatan Ukur dan Pemetaan Malaysia* (JUPEM). Buffering analysis was employed to check the school coverage area and house distribution. Finally, the results are discussed in phase four. Figure 1 shows the overall research methodology.

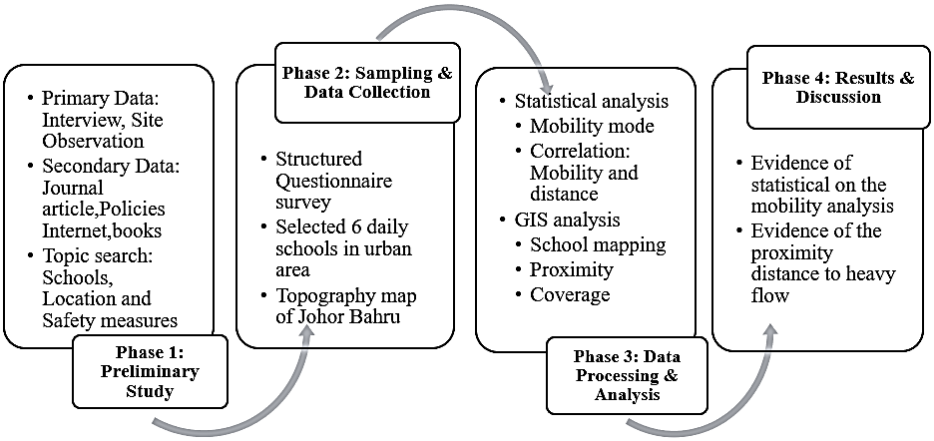


Figure 1: Research methodology

RESEARCH FINDINGS

This section discusses the findings from the mobility, proximity, and the coefficient correlation analysis as the main caused to the congested problem around school.

Mobility Mode Analysis

The mobility to school pattern graph in figure 2 clearly shown that all schools had similar pattern. Motorised vehicles are the most favoured mode of transport, while walking and cycling were the least favoured choice in mobility mode although the location between houses is within walking distance. This proved that distance is not necessarily the key factor in choosing mobility mode to school. From the graph, 42.8% respondents are sent to school with parents' vehicle, 36.5% respondents riding the school bus, 18.8% respondents are walking, and 0.02% respondents are riding bicycle to school. This result signifies that the total of 439 respondents or 79.4% of respondents uses motorised vehicles on daily basis even though the distance to school is within walking distance.

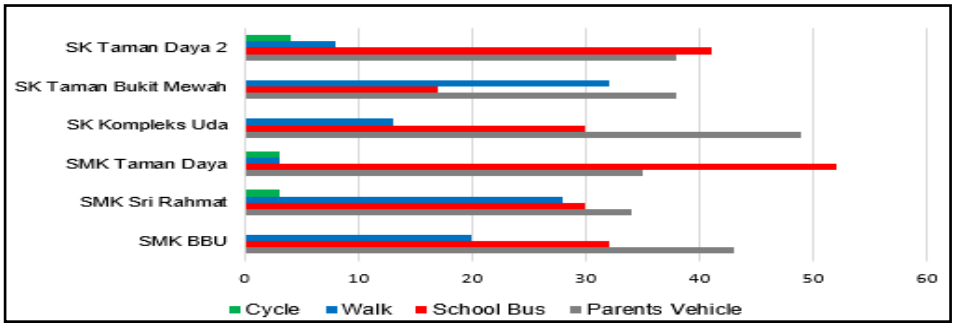


Figure 2: Mobility mode analysis

Mobility Mode and Distance Cross Tabulation Analysis

This analysis is to identify the individual percentage between the mobility mode used and distance from house to school. Table 4 shows the results by each individual. The percentage (%) in the column of within distance is the percentage value of a distance categorized by mobility mode, while the percentage (%) within mobility mode is the percentage value for each category of mobility mode used. From the analysis, 39.8% of school children live at 1600m from school. Within the distance, 50% of the students use parent's vehicle and 36.4% travel by bus. The chosen of motorised vehicle is as expected, because the distance is beyond the acceptable walking distance, and it is not safe. At the distance of 400m from the school, it was tabulated that 21% children lived here. The distance is the shortest from the school and it had been clarified as a suitable walking distance. Surprisingly, 37.9% children sent to school by parent's vehicle. These results proved that, even for a short distance, motorised vehicles are still preferred by parents.

Table 4: Mobility mode and distance cross tabulation

Distance		**Mobility mode (%)**				**Total (%)**
		Bus	Parents Vehicle	Walk	Cycle	
<400m	%within Distance	25.0	37.9	37.1	0.0	21.0
	%within Mobility Mode	14.3	18.6	41.0	0.0	
<800m	%within Distance	53.3	23.3	23.3	0.0	5.4
	%within Mobility Mode	7.9	3.0	6.7	0.0	
<1200m	%within Distance	40.3	34.9	20.9	3.9	23.3
	%within Mobility Mode	25.6	19.1	25.7	55.6	
<1600m	%within Distance	44.8	51.7	3.4	0.0	10.5
	%within Mobility Mode	12.8	12.7	1.9	0.0	
≥1600m	%within Distance	36.4	50.0	11.8	1.8	39.8
	%within Mobility Mode	39.4	46.6	24.8	44.4	

School Coverage and Proximity Analysis

The school coverage analysis was carried out to study the admission of students in each school. This analysis is to look at the practises by the school management whether the admission to the school is followed the rules as stated in the guidelines. Figure 3 shows the number of respondents and the distance to school location.

As shown in Figure 3, almost all respondents are within radius distance suggested by the planning guidelines with only minimal cases that the school management must accept with strong justifications from parents or legal guardians. 2 cases or 0.004% from secondary school are from Taman Cempaka and Taman Dahlia respectively, which are outside the radius distance in the planning guidelines. While for the primary school, only 1 case or 0.002% from Taman Munsyi with similar situation to the cases in the secondary school.

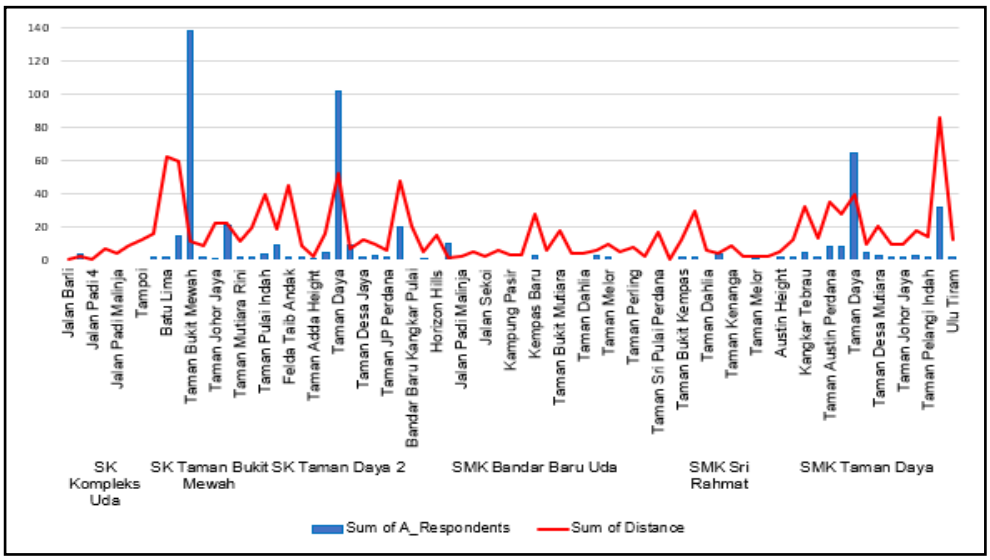


Figure 3: Number of respondents and distance to school location

Next analysis is the proximity analysis calculation from the map using GIS. Each of the schools was mapped and buffered by the maximum of 800 meter for the primary school and 1600 meter for the secondary school. The route names were extracted from the map where the school children are also using it. Analysis shows that two secondary schools; SMK BBU, SMK Taman Daya and one primary school; SK Taman Daya 2 are in good coverage of walking distance. Other school's route shows that 1 out of three is not in acceptable walking distance.

Figure 4 shows the school location, chosen routes by children and the proximity distance compared to the acceptable walking distance.

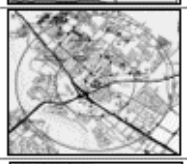
Name of School	*Proximity Max of 800m-primary& 1600 m- secondary*	*Route*	*Distance to School (Meter)*	*Compared to Acceptable Walking Distance*
SMK BBU		Jalan Padi Ria 18 Jalan Padi Malinja 1 Jalan Mahsuri 2	1148m 1076m 688m	√ √ √
SMK Sri Rahmat		Taman Cempaka Taman Dahlia Taman Kenanga	1806m 1979m 901m	x x √
SMK Taman Daya		Jalan Rumbia 39 Jalan Rumbia 18 Jalan Nibong 20	362m 550m 947m	√ √ √
SK Kompleks Uda		Jalan Susur Barli Jalan Barli 1 Jalan Padi 4	979m 950m 307m	x x √
SK Taman Bukit Mewah		15C Flats Taman Munsyi Ibrahim Jalan Mewah Ria 3/8	1252m 708m 466m	x x √
SK Taman Daya 2		Taman Delima 2 Taman Delima Jalan Nipah 8	382m 540m 646m	√ √ √

Figure 4: School, housing location and acceptable walking distance

Correlation Coefficient of Mobility Mode and the Proximity Factor

The correlation results present the number of sampling size, where r is the correlation coefficient sign, (2-tailed) is the significant level, and α of mobility mode when the distance changes. The value of correlation coefficient, r was -0.50, which suggests that there is a negative relationship between distance and mobility mode choice because -0.05 is approaching 0. However, the relationship was very weak considering that -0.05 is approaching 0. The significant level was 0.25, which is bigger than 0.05, this means that the significant level falls outside the critical region. H_o is not rejected as it is proved that there is no significant relationship between distance and mobility factor. This signifies that the choice

of mobility mode is not affected by the distance from house to school.

The setting of school location to be near the houses is to encourage the students to walk to school is implied to be not relevant in this case. From the interview with school children and parents, the road condition and safety are the main factors for not choosing to walk or cycle to school. Poor road safety aspects were the main setback that made walking to school impractical and unreliable. Fear of road accidents, congested roads, and insufficient road facilities are the main reasons walking is not favoured as a mobility mode. These aspects should be highlighted by the related authorities, in ensuring that the safety of children is thoroughly covered. Table 5 shows the correlation result.

Table 5: Correlation result for mobility mode and distance factor

		Distance	**Mobility Mode**
Mobility Mode	Pearson Correlation	1	-0.05
	Sig. (2-tailed)		0.25
	N	553	553
Distance	Pearson Correlation	-0.05	1
	Sig. (2-tailed)	0.25	
	N	553	553

CONCLUSION

Accepting students to school is normally based on the school coverage area that involves two or three neighbouring residential districts. A new residential development project might add demands to the existing school's capacity not only to the increased number of children per classroom, but to the road traffic around the school as well. This research has presented that the choices of mobility mode are overwhelmed by parents' motorised vehicle albeit the house is within walking distance. Active mobility seems to be ignored by the public as the fear of crime on the road are still the main concern and made walking, and cycling were less popular among school children. The correlation coefficient analysis also proved that the result showed a negative relationship between mobility and proximity distance to school. Insufficient road safety aspects made the routes to school risky to road accidents. This has led to parents reckons that walking to school is dangerous and willing to send their children with own vehicle or use the school bus. The research has provided evidence to the practices of mobility, proximity distance and coverage of daily school operations and all these aspects have also been highlighted in the school planning guidelines. What is lacking here is the public confidence on the safety measures of the routes to school, thus contributed to the heavy traffic flow around the school.

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