Jurnal Teknologi

Full paper

En Route to a Sustainable Campus–An Analysis of University Students' Travel Patterns Via 7 day Travel Diary

Nur Sabahiah Abdul Sukor[a*], Sitti Asmah Hassan[b]

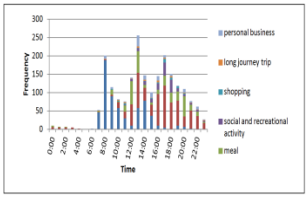
[a]School of Civil Engineering, Universiti Sains Malaysia (Engineering Campus), 14300, Nibong Tebal, Pulau Pinang, Malaysia
[b]Faculty of Civil Engineering, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia

*Corresponding author: sabahiah@eng.usm.my, sabahiah@gmail.com

Article history

Received :26 May 2014
Received in revised form :
25 July 2014
Accepted :6 August 2014

Graphical abstract



Abstract

The objective of this study is to analyse the travel pattern of students in the Engineering Campus of Universiti Sains Malaysia, by using a 7-day travel diary survey. After screening the data obtained, 98 of the 100 responses received were processed and analysed. The results show that there were major differences in travel patterns between weekdays and weekends in terms of activities, trip generation, modal split, travel distance, travel time and cost. These differences were found to be contributed by the factors such as gender and motorized vehicle ownership. In conclusion, the travel demand behaviour of the students was better understood through the study of travel patterns, as well as the intra and interpersonal variability of the students. This information is particularly important for the establishment of better infrastructures, transport planning strategies, and policies for the sustainability of the campus.

Keywords: Sustainable campus; travel diary; travel pattern; mobility

1.0 INTRODUCTION

The current use of private motorized transport is an inevitable condition. This is mainly attributed to the imbalanced supply and demand for public transportation. Factors that could contribute to this imbalance include several attributes such as remote areas with less trip production or attraction, less accessibility, traveller's trip purposes, socio-demographic factors, and other factors that would subsequently affect ones travel patterns and behaviour [1-3]. Hence, a proper transportation study with detailed analysis of the community's travel pattern is necessary in order to gain a better understanding of traveller's preferences and expectations of a transportation system.

Travel pattern is served as the key element in transportation studies to understand and identify transportation needs. Therefore, in order to program feasible and sustainable transport system plans the travel pattern studies were usually performed to discover the factors that encourage a sustainable transportation system [4-5]. A common method used to study travel patterns is a travel diary survey. The travel diary technique has been used widely in household survey in several countries in order to understand the particular purpose of human trips and activities [6-7]. A travel diary is a logbook consisting of particulars to be completed, such as time of departure and arrival at a destination, distance of travel, purpose of travel, mode of transport, and other necessary travel pattern variables. The sample size and sampling method for the travel diary have great variability and are dependent on the study's nature itself. Hence, the sample size could be varied considerably from less than one hundred to more than one thousand. For instance, the American Housing Survey 2001 studied travel behaviours by accessing data from 106,000 households [8]. Meanwhile, there were other studies that involving only 46 participants in their research of car use reduction strategies in Sydney and Adelaide [9].

In addition, the number of days that recorded in each travel diary study was varied significantly. The various types of travel ranged from short periods, such as one or two-day travel diaries to six week travel diaries [10-11]. In some cases, the participants had to repeat their travel diary throughout the project, such as completing a seven-day travel diary three times within a six month period [12].

Travel diary is also able to figure out the intrapersonal and interpersonal variability of travel patterns. The intrapersonal variability was determined as different travel behaviour of an individual, while interpersonal variability was determined as a dissimilarity of behaviour from different individuals [13-14]. Both types of variability were identified as important in transport planning. In addition, through the analysis of the raw data collected from the travel diary survey, a general idea of the community's travel patterns in a certain area is able to be obtained. Therefore, any future transportation plan for that area should be far more realistic.

This study is focusing on the students at School of Civil Engineering, Universiti Sains Malaysia (USM), Penang. The location of branch campus is 45 km from the main campus. It has a student population of up to 4000 peoples and located

strategically between two small towns (as shown in Figure 1). However, limited public transportation systems create difficulties for students to travel to these towns; particularly for those who do not own a motorized vehicle. Such conditions create a necessity for students to own a motorized vehicle for their convenience, not only to travel across town, but also to nearby activity centres, or to other states. Besides, the lack of infrastructures and leisure facilities in the campus discourages the use of passive travel modes.

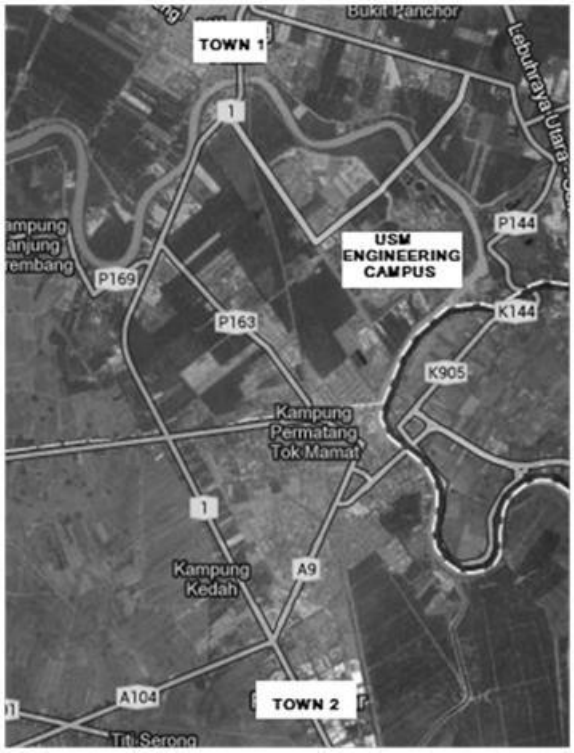


Figure 1 USM Engineering Campus location (Google Maps)

These problems need to be solved in order to improve students' mobility without overusing or being excessively dependent on other motorized vehicles. Therefore, the students' travel preferences need to be identified as a platform for the university's management to plan better transport facilities accordingly. In this study, travel patterns of the students at the Engineering Campus of Universiti Sains Malaysia were determined through a 7-day travel diary survey. The survey's data was used to examine hourly trip generation, trip distribution, mode split, travel distance, and the activity patterns of students at the Engineering Campus.

2.0 METHODOLOGY

The main goal of the study is to obtain the travel patterns of students only, i.e., excluding staff and visitors to the Engineering Campus, Universiti Sains Malaysia (USM). The respondents for this study were included the undergraduate and postgraduate students that residing both inside and outside of the campus. However, the respondents for this study were limited to the School of Civil Engineering.

Prior to the survey, a travel diary of an appropriate size and content was designed for data collection purposes. The travel diary was designed for seven days, according to the required information, such as socio-demographic factors, vehicle ownership, travel patterns, travel purpose, origin, and destination of travel activity, mode choice, travel fare, and travel distance for a particular trip.

The travel diary survey was done towards 100 respondents comprising of first to fourth year undergraduates, and postgraduates students. Respondents were asked to complete their personal information, which was essential to evaluate and analyse the relationship between individual's backgrounds and their travel patterns. The prepared questions were designed to be precise, relevant, and simple; without confusion to respondents, following detailed checking and reference to previous similar studies. Help from relevant management offices, such as the hostel administration department, campus administration department, hostel representative, and others, was also required to obtain reliable and creditable data for analysis. A token of appreciation was given to the respondents that successfully completed their travel diaries according to the guidelines given. After the survey, all data from the travel diaries were processed and analysed by using the SPSS software.

3.0 RESULTS AND DISCUSSION

Table 1 shows the descriptive analysis of the data obtained in this study. The respondents recruited were aged between 19 and 33 years old with the ratio of genders approximately the same. Most of the respondents were Malay and Chinese, with a minimal number of other races. In general, 85% of the respondents lived in the hostels on campus, with the remainder staying outside. For vehicle ownership, around 49% had motorized vehicles and 51% did not. In addition, "at least 1 motorized vehicle" category is created for the respondents that either owned more than one motorized vehicle (i.e. motorcycle and car) or the respondents that owned a motorized vehicle together with non- motorized vehicle (e.g motorcycle and bicycle). Meanwhile, postgraduates made up to 20% of all respondents. However, after screening and filtration of the data collected, two respondents were excluded from further analyses because they failed to provide sufficient information in their travel diary.

Figure 2 illustrates the distribution of hourly activity on weekdays. Between 8.00 am and 11.00 am, travel patterns were dominated by trips to attend academic activities in lecture rooms or halls. The highest frequency of trips during the day occurred at 1 pm, where the majority of trips were for travelling back to hostels/homes and going for lunch. There was also a small frequency of trips for long journeys, shopping, and personal business. Trips for socializing and recreational activities were mostly reported to occur between 5 pm and 6 pm for sports or gathering activities with friends. In addition, the trend shows that students tended to have dinner or supper between 5 pm and 10 pm.

The distribution of hourly activities on weekends is shown in Figure 3. Compared to weekdays, the number of trips to academic halls or classes was less during the weekend. The activity pattern illustrated in Figure 2 shows that the majority of trips in the morning involved meals for either late breakfast or lunch. These were followed by trips travelling back from the places where they had their meals. A small frequency of trips for shopping, personal business, and long trips during the weekends were also reported by the respondents. Most of the trips for socializing and sport occurred at 6 pm in the evening. In addition, a higher frequency of trips involving dinner or supper occurred until midnight during the weekend, compared to weekdays. Students also tended to end their activities quite late during the weekend.

Table 1 Descriptive statistic of the respondents

Variable	Percentage (%) (N)	Mean/ Standard deviation
Age	-	23.08/ 2.849
Gender		
Male	51 (50)	1.49/ 0.502
Female	49 (48)	
Race		
Malay	64.3 (63)	1.43/ 0.674
Chinese	31.6 (31)	
Indian	1.0 (1)	
Others	3.1 (3)	
Residence		
Hostels	86.7 (85)	2.01/ 1.396
Outsiders	13.3 (15)	
Vehicle ownership		
Motorcycle	8.2 (8)	
Car	36.7 (36)	
Bicycle	17.3 (17)	2.91/ 1.122
No vehicle	31.6 (31)	
At least 1 motorized-vehicle	6.1 (6)	
Study level		
Undergraduate	79.6 (78)	1.20/ 0.405
Postgraduate	20.4 (20)	

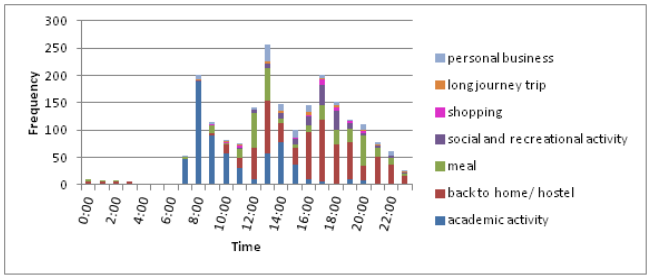


Figure 2 Distribution of hourly activities on weekdays

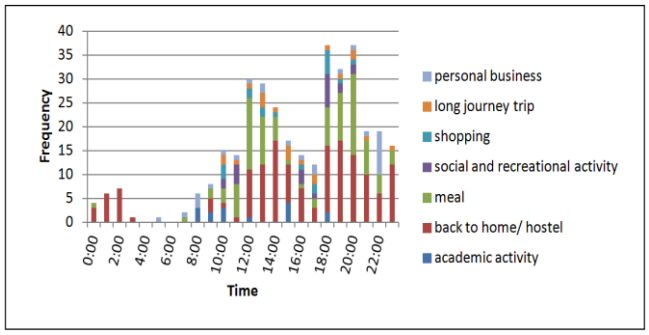


Figure 3 Distribution of hourly activities on weekends

The daily distribution of hourly trip rates is illustrated in Figures 4 and 5, for average weekdays and weekends, respectively. For weekdays, the trip patterns of students had three peaks at 8.00 am, 1 pm in the afternoon, and 5 pm in the evening. The morning peak (with an average rate of 1.6trips/h) reflected trips to attend formal academic activities, such as lectures. The afternoon peak was the highest due to trips for lunch and returning to hostels or homes, with an average rate of 2.1trips/h. Meanwhile, the evening peak, which had the same hourly average rate as the morning peak, reflected trips for travelling back to hostels or homes after classes ended, and the beginning of socializing activities. For weekends, trip generation rates were found to be lower than weekday. This is probably because some students intended to be less involved with trips that were more than 500 m distance. However, on weekends, trip patterns show two peaks between 12 pm and 1 pm, and 6 pm and 8 pm. In the afternoon, the average trip rate was 0.60 trips/h, while the average trip rate in the evening was more than 0.70 trips/h. No peak in the morning was found, which might reflect students' intention to begin their daily activities a little bit later on weekends.

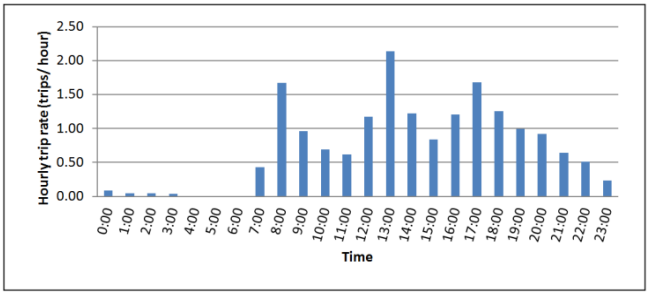


Figure 4 Distribution of hourly trip rates on weekdays

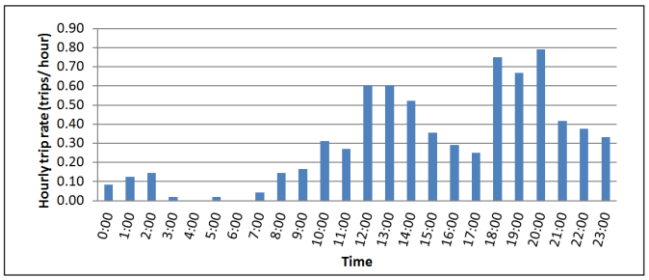


Figure 5 Distribution of hourly trip rates on weekdays

Table 2 shows the daily trip generation rate of respondents according to gender for weekdays. The trip generation rate for students averaged approximately 4.3 trips/day on weekdays and 2.16 trips/day on weekends. Meanwhile Table 3 shows that on the weekdays, male students who owned motorized vehicles achieved the highest trip generation rate (5.08 trips/day) followed by female students who owned a motor vehicle (4.39 trips/day). In addition, the groups of respondents who had no motorized vehicle undoubtedly generated fewer trips; with an average rate of 3.7 trips/day compared to respondents who had motorized vehicles, with an average rate of 4.8 trips/day. Males with non-motorized vehicles generated 3.86 trips/day, while females with non-motorized vehicles generated the lowest trip rate of all four respondent groups, with 3.63 trips/day. For an overall gender comparison, male students generated more trips (4.56 trips/day) than female students (3.96 trips/day) on weekdays.

Table 2 Average daily trip generation rates based on gender and motorized vehicle ownership on weekdays

	Male	Female	Average
Motorized vehicle owners	5.08	4.39	4.79
Motorized vehicle non-owners	3.86	3.63	3.73
Average	4.56	3.96	4.27

Table 3 Average daily trip generation rates based on gender and motorized vehicle ownership on weekends

	Male	Female	Average
Motorized vehicle owners	2.73	2.16	2.49
Motorized vehicle non-owners	1.74	1.76	1.75
Average	2.37	1.95	2.16

Figure 6 presents the percentages of mode split for male and female students on weekdays in a graphical format. The analysis divided respondents according to motorized vehicle owners and the non-owners. The results show that cars were chosen as the primary mode for all groups; except for male students that did not possess a motorized vehicle. This group was found to have more intention to walk, constituting 37.78% of the modal split.

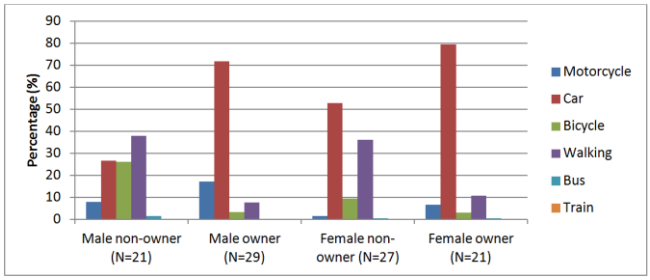


Figure 6 Mode split of university students on weekdays

The findings also show that 52% of the mode split from female students that did not possess a motorized vehicle involved car trips. This shows that even though they did not own a car, they still intended to share a ride with their friends that did own a car. In addition, cars were the only significant travel mode used by students that already possessed a car, with 70% males and 80% females. In fact, it is quite normal for both male and female students with motorized vehicles to choose their own private motorized vehicle; thus giving them a better, faster, and higher freedom of mobility, since this mode was readily available for them.

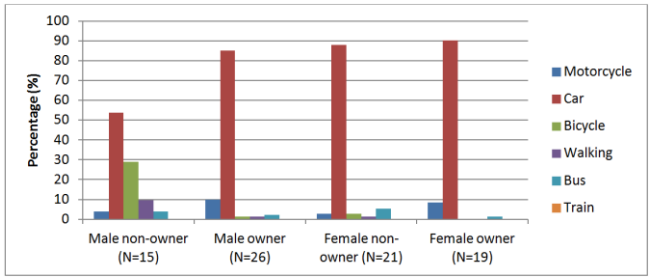


Figure 7 Mode split of university students on weekends

Figure 7 illustrates the mode split of students on weekends. Some of students were not involved with travel activities beyond 500 m distance during weekends. This number of respondents was therefore different from those reported for weekdays. Briefly, all male and female categories used cars as their primary mode during the weekend, with percentages of around 54%, 85%, 88%, and 90%, respectively for males without motorized vehicles, males with motorized vehicles, females without motorized vehicles, and females with motorized vehicles. This is not surprising, because student activities on weekends were mainly non-academic. They may have had an intention to travel further on weekends for shopping, leisure, social, recreational, personal business, or visiting families. Therefore, this caused students to become highly dependent on cars during the weekends. However, male students with no motorized vehicles contributed to bicycle trips of 28.8%; thus showing their willingness to use bicycles for short trips during the weekend. Furthermore, walking trips generated by females with non-motorized vehicles dropped drastically, whilst the car trips for this group were increased. This may have been because of their tendency to travel with friends who had cars or be involved with long distance travel that needed a car.

Tables 4 and 5 summarize the mode split for male and female students on weekdays and weekends, respectively. On weekdays, the male students that owned a motorized vehicle were reported to be more likely to use a car with 3.64 trips/day followed by motorcycles with 0.85 trips/day, and fewer modes of travel adapted were 0.39 trips/day for walking and 0.16 trips/day for bicycles. However, the female students that owned a motorized vehicle also showed a high rate for using cars at 3.49 trips/day, followed by walking at 0.47 trips/day, motorcycles at 0.29 trips/day, and bicycles at 0.13 trips/day. Meanwhile, male students that did not own a motorized vehicle tended to walk (1.46 trips/day) followed by using a car (1.03 trips/ day), bicycle (1.01 trips/day), or motorcycle (0.30 trips/day). Interestingly, female students without a non-motorized vehicle reported a high trip rate of using cars at 1.91 trips/day. The second highest travel mode for the non-motorized vehicle female group was walking, with an average rate of 1.31 trips/day. This was followed by bicycles at 0.34 trips/ day and motorcycles at 0.05 trips/day.

Meanwhile, at weekends, both of male and female students that did not possess a motorized vehicle also tended to use cars for travel, with 0.93 trips/day and 1.55 trips/day, respectively. Male students generated bicycle trips of 0.50 trips/day and walking at 0.17 trips/day. In addition, the female students with non-motorized vehicle produced an average of 0.10 trips/day using buses. Of the students that owned motorize vehicles, male students were involved with car trips at 2.33 trips/day and 0.27 trips/day using motorcycles. Meanwhile, female students averaged 1.95 trips/day by car and 0.18 trips/day by motorcycle. There were 0.10 trips/day reported by a female student using a shuttle bus to travel between campus and town for shopping or meals.

Table 4 Average daily trip generation by modes of travel on weekdays

Mode of travel	Male		Female	
	Non-motorized vehicle owners	Motorized vehicle owners	Non-motorized vehicle owners	Motorized vehicle owners
Motorcycle	0.30	0.86	0.05	0.29
Car	1.03	3.64	1.91	3.49
Bicycle	1.01	0.16	0.34	0.13
Walking	1.46	0.39	1.31	0.47
Bus	0.06	0.01	0.01	0.02
Train	0.00	0.01	0.00	0.00
TOTAL	3.86	5.08	3.63	4.39

Table 5 Average daily trip generation by modes of travel on weekends

Mode of travel	Male		Female	
	Non-motorized vehicle owners	Motorized vehicle owners	Non-motorized vehicle owners	Motorized vehicle owners
Motorcycle	0.07	0.27	0.05	0.18
Car	0.93	2.33	1.55	1.95
Bicycle	0.50	0.04	0.05	0.00
Walking	0.17	0.04	0.02	0.00
Bus	0.07	0.06	0.10	0.03
Train	0.00	0.00	0.00	0.00
TOTAL	1.74	2.73	1.76	2.16

Figure 8 depicts the distribution of kilometres travelled hourly by all modes over 24 hour periods during weekdays. As shown, there are several hourly peaks for kilometres travelled at 8 am, 11 am, 1 pm, 2 pm, 4 pm, 6 pm, 9 pm, and 11 pm. The highest peak was found at 6 pm, with an average hourly distance travelled of 14 km/h. This was because students were involved with leisure trips i.e., socializing and sports. This also included trip-chaining behaviour that may have occurred on the way back to hostels or homes. The morning peak at 8 am was the lowest, with an average hourly distanced travelled of 7 km/h. However, this was not surprising because the peak hours of 8 am, 10 am, and 11 am, were simply the beginning of student's academic and breakfast activities. Meanwhile, at 1 pm, most students were travelling for lunch; thus resulting in average hourly distances of 11 km/h.

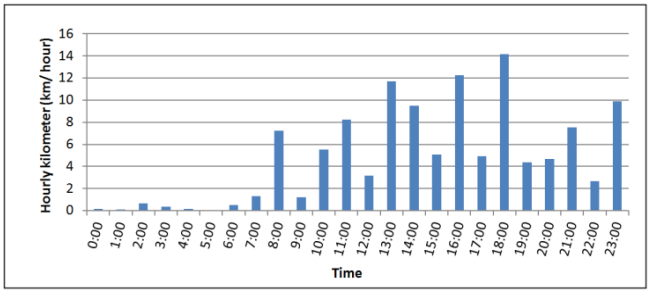


Figure 8 Distribution of hourly kilometers travelled on weekdays

The distribution of average hourly kilometres travelled on weekends is shown in Figure 9. Peaks are shown at 10 am, 2 pm, 4 pm, 6 pm, 8 pm, 9 pm, and 11 pm. The highest peak was found at 9 pm, an average hourly distance travelled of 17 km/h. This represents student's leisure trips (i.e., dinner or socializing) at night, during the weekend. Because students were free from academic activities, they tended to return late from their respective activity locations, which were generally further away from their residences.

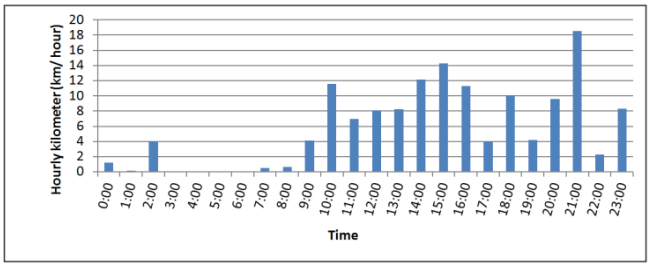


Figure 9 Distribution of hourly kilometers travelled on weekends

Table 6 summarizes the average daily distance travelled on weekdays according to gender and vehicle ownership. Generally, motorized vehicle owners had a higher average daily distance travelled of 34.13 km, compared to non-motorized vehicle owners, who only generated 22.14 km on weekdays. Male students with motorized vehicles travelled 35.22 km compared to female students with motorized vehicle, who only travelled 32.63 km. Conversely, female students that did not own a non-motorized vehicle travelled 25.10 km compared to male students in the same category, who only travelled 18.33 km during weekdays. However, the average daily distance travelled on weekdays for both male and female groups were comparable at 28.13 km and 28.40 km, respectively. The overall average daily distance travelled was 28.26 km during weekdays.

Meanwhile, Table 7 shows the average daily distance travelled by students on weekends. Male students with motorized vehicles produced the highest average daily distance travelled of 52.48 km, while female students in the same category travelled 41.27 km during weekends. Male students that did not own a motorized vehicle accounted for the lowest average distance travelled of 14.15 km. This is significantly dissimilar to female students without a motorized vehicle, who accounted for an average distance travelled of 47.89 km; which was even higher than the average distance travelled by females that owned a motorized vehicle. In general, male students travelled 38.46 km, which was lower than female students, who travelled an average 44.74 km daily distance on weekends. In terms of vehicle ownership, motorized vehicle owners generated 47.75 km and

non-motorized vehicle owners produced an average 33.83 km daily distance travelled. Overall, the average distance travelled on weekends was 41.56 km. The distance travelled on weekends was apparently greater than that of weekdays. This was very likely contributed to by long journeys due to respondents' intention to travel further from their residences for social and recreational purposes.

Table 8 illustrates the average daily travel time on weekdays. The result shows that male students with motorized vehicles contributed the highest value of 73.65 minutes for travel, followed by female students with motorized vehicles with an average of 72.42 minutes. Meanwhile, male students that did not own a motorized vehicle averaged 55.47 minutes, compared to female students in the same category, who averaged 61 minutes for travel. In summary, male and female students allocated similar times for travel during weekdays, at 66.02 and 66 minutes, respectively. Meanwhile, motorized vehicle owners averaged 73.14 minutes travelling, which was higher than non-motorized vehicle owners, who averaged only 58.58 minutes. Overall, the average daily travel time on weekdays was 66.01 minutes.

The average daily travel time on weekends is shown in Table 9. According to the table, male students with motorized vehicles spent the longest time travel on weekends (67.30 minutes). Meanwhile, female students with motorized vehicles averaged 57.47 minutes travelling. Male students without motorized vehicles accounted for the least time travelling (42.07 minutes), while female students in the same category averaged 65.57 minutes travelling. Overall, male students averaged 58.07 minutes travelling on weekdays, which was less than the female students (61.73 minutes). In addition, motorized vehicle owners took 63.16 minutes travelling compared to 55.78 minutes by non-motorized vehicle owners. In total, weekends accounted for an average 59.88 minutes daily travel time.

The average daily travel cost on weekdays is summarized in Table 10. Travel costs were evenly divided between drivers and passengers for every trip. Therefore, costs were split, even if they were for carpooling or as passengers of a vehicle. In the category of motorized vehicle owners, male respondents spent RM 7 and female respondents spent RM 5.33. Therefore, the average travel cost for this category was RM 6.30. Normally, male students with non-motorized vehicles spent only RM 2.21 and female students with non-motorized vehicles spent RM 3.94. Overall, non-motorized vehicle owners spent an average RM 3.18. In terms of gender, male and female students spent similar amounts for travel, giving an average cost for weekdays of RM 4.77.

Table 11 illustrates the average daily travel cost on weekends. The trend shows that male students had the highest average daily travel cost at weekends (RM 11.63), followed by female students without motorized vehicles (RM 8.06). This shows that female students that did not own a motorized vehicle tended to spent more for travel during weekends than female students that owned a motorize vehicle. However, the average daily travel cost, according to gender and vehicle ownership, showed a similar trend.

Table 6 Average daily distance travelled on weekdays (km)

	Male	Female	Average
Motorized vehicle owners	35.22	32.63	34.13
Non-motorized vehicle owners	18.33	25.10	22.14
Average	28.13	28.40	28.26

Table 7 Average daily distance travelled on weekends (km)

	Male	Female	Average
Motorized vehicle owners	52.48	41.27	47.75
Non-motorized vehicle owners	14.15	47.89	33.83
Average	38.46	44.74	41.56

Table 8 Average daily travel time on weekdays (min)

	Male	Female	Average
Motorized vehicle owners	73.65	72.42	73.14
Non-motorized vehicle owners	55.47	61.00	58.58
Average	66.02	66.00	66.01

Table 9 Average daily travel time on weekends (min)

	Male	Female	Average
Motorized vehicle owners	67.30	57.47	63.16
Non-motorized vehicle owners	42.07	65.57	55.78
Average	58.07	61.73	59.88

Table 10 Average daily travel cost on weekdays (RM)

	Male	Female	Average
Motorized vehicle owners	7.00	5.33	6.30
Non-motorized vehicle owners	2.21	3.94	3.18
Average	4.99	4.55	4.77

Table 11 Average daily travel cost on weekends (RM)

	Male	Female	Average
Motorized vehicle owners	11.63	7.45	9.87
Non-motorized vehicle owners	2.29	8.06	5.66
Average	8.22	7.77	7.99

In addition, Table 12 summarizes the t-values and p-values of various dependent variables for different t-test groups on weekdays and weekends. The independent-samples t-test was conducted to compare travel time, travel cost, travel distance, and trip rate, in the categories of gender and motorized vehicle ownership, respectively, for weekdays and weekends. There was a significant difference between males (M = 4.56, SD = 1.53) and females (M = 3.96, SD = 1.23) in terms of weekday trip generation rate; t(96) = 2.138, p-value = 0.035.

Furthermore, there was a significant effect on motorized vehicle ownership, t(96) = - 2.702, p-value = 0.008 where motorized vehicle owners (M = 1.22, SD = 0.50) spent a longer time travelling than non-motorized vehicle owners (M = 0.97, SD = 0.37) on weekdays. Motorized vehicle owners spent more on travel fares (M = 6.30, SD = 6.74) than those that did not own a motorized vehicle (M = 3.18, SD = 4.60). This difference was significant, t(86.73) = - 2.685, p = 0.009. The group who owned a motorized vehicle generated significantly more trips (M = 4.79, SD = 1.55) than the group that did not own a motorized vehicle (M = 3.73, SD = 1.02), t(85.19) = - 4.000, p = 0.000. Comparison of motorized vehicle owners (M = 2.49, SD = 1.56) and non-motorized vehicle owners (M = 1.75, SD = 1.23) revealed significant differences between weekend trip rates; t(79) = - 2.326, p = 0.023.

Table 14 T-test results according to gender and vehicle ownership for weekdays and weekends

Day	Test variable	Gender		Motorized vehicle ownership	
		t-value	p-value	t-value	p-value
Weekdays	Time travelled	0.004	0.997	- 2.702	0.008
	Travel cost	0.367	0.715	- 2.685	0.009
	Distance travelled	- 0.042	0.967	- 1.888	0.062
	Trip rate	2.138	0.035	- 4.000	0.000
Weekends	Time travelled	- 0.361	0.719	- 0.726	0.470
	Travel cost	0.148	0.883	-1.397	0.166
	Distance travelled	- 0.563	0.575	-1.249	0.215
	Trip rate	1.287	0.202	-2.326	0.023

4.0 CONCLUSIONS

This study is focusing on the area that could be considered as remote and without much activity. The branch campus in this study has less attraction compared to urban areas. This alone probably affects trip generation; and subsequently, the results of this study may differ from those conducted in urban areas.

The travel patterns and activities of university students in this study were successfully obtained through the 7-days travel diary survey. In addition, the travel preferences of the students were better understood via the analysis of the travel patterns obtained. Subsequently, an understanding of the travel demand behaviours of the students in this study is useful for transport planning strategies as well as enhancing the necessary infrastructures or facilities on campus. In addition, this study has revealed that students at this study area had to travel a little bit further for meals and leisure activities. This is because the campus is located in a less developed area, with limited local facilities and infrastructures. Therefore, the students' options were either to travel less or to travel longer distances to fulfil their needs. Due to a lack of public transportation, their choice was further limited to only using their own motorized vehicle (i.e., car or motorcycle).

In addition, this study also found that the travel patterns of students on the Engineering Campus were totally different for weekdays and weekends. The differences are listed below:

a) Activity patterns on weekdays were formal, organized, and rigid; whereas on weekends, they tended to be more flexible with greater variability of trips.
b) Trip generation rates on weekdays were more consistent; while trip generation rates on weekends were slightly more scattered.
c) Mode splits on weekdays were combined with a significant number of non-motorized and motorized travel modes; while the mode split on weekends was majorly dominated by motorized vehicles.
d) Distances travelled on weekends were much longer than on weekdays. This might be due to the students' intention to travel to the attraction places outside or further from the campus areas.
e) Time used for travel on weekends was shorter than that of weekdays. This was probably because students tended to use cars or motorcycles to travel during weekends. The travel time of using the motorized vehicle is expected to be shorter than using public transportation.
f) Travel fares spent on weekends were relatively higher than on weekdays; because of the longer distances travelled and the might includes the need for toll and fuel.

Interestingly, this study also revealed that female students that did not own a private car tended to have more car trips and travelled further than female students that owned a private car. This was comparable to male students that did not own a car or a motorcycle. The might be due to the female students' intention to share a ride with the friends that owned a motor-vehicles. Therefore, this shows that car ownership is not the main factor for students to choose car as their priority mode of transport on campus.

Actually, many factors are able to influence travel patterns and behaviours; especially physical factors of urban form, socio-demographics, infrastructures provided, and psycho-social elements. However, this study revealed that students that live in less developed areas have the potential to travel further to spend their leisure time. This finding is important for university management, in order to facilitate a campus with more areas for leisure, recreation, sports, shops, and restaurants. Therefore, the students would be less dependent towards motorized vehicles: especially if the facilities were located within walking distance from their hostels or lecture rooms.

Several weaknesses in this study could be improved upon in future studies. From the aspect of the travel diary survey, the survey period could be extended to obtain more reliable data of the students' travel patterns. An online travel diary survey might be an option, as it would be far more convenient for the students. The applicable of online based travel diary research are also

discussed in several previous studies [15-16]. Obstacles, like poor internet connection faced only a few years ago, are solved with Wi-Fi connections that are widely available on campus. In order to obtain more accurate travel patterns, it is suggested to involve more students (or respondents) in future survey.

Acknowledgement

Fund provided by APEX Delivering Excellence Research Grant USM (1002/PAWAM/910346) is gratefully acknowledged. The help from Mr Thoo Hon Kent who assisted in the data collection and analysis in this study is also very much appreciated.

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