IJIE

INTERNATIONAL JOURNAL OF INTEGRATED ENGINEERING
ISSN: 2229-838X e-ISSN: 2600-7916

Vol. 18 No. 5 (2026) 69-85
https://publisher.uthm.edu.my/ojs/index.php/ijie

The Effect of Housing Locations Towards Off-Campus Students' Travel Behaviour

Muhammad Amir Hafiz Aziz[1], Nur Sabahiah Abdul Sukor[1]*

[1] *School of Civil Engineering, USM Engineering Campus, Universiti Sains Malaysia, Nibong Tebal, Pulau Pinang, 14300, MALAYSIA*

*Corresponding Author: cesabahiah@usm.my
DOI: https://doi.org/10.30880/ijie.2026.18.05.007

Article Info

Received: 28 August 2025
Accepted: 15 June 2026
Available online: 7 July 2026

Keywords

Off-campus housing, travel behaviour, mode choice, spatial mapping, student well-being

Abstract

University students exhibit distinctive travel characteristics. Lately, the residential trends among university students in Malaysia, particularly those who live off-campus undergone a significant transformation. This study aims to analyse the effect of student housing location on students' daily commutes. The methodology employs statistical analyses and spatial mapping techniques. Multiple variables were explored, including sociodemographic characteristics, residential locations, transport mode preferences, commuting patterns, and attitudinal tendencies of off-campus students at the Engineering Campus, USM. Data were obtained through an online questionnaire involving 190 participants and analysed using descriptive statistics and Pearson correlations to identify potential interrelationships among the variables. Additionally, QGIS-based spatial mapping techniques were used to visualise the spatial distribution of housing locations and corresponding mobility flows. Findings suggest that proximity and accessibility of accommodation relative to the campus may play a central role in shaping students' commuting choices. Interestingly, students residing nearer to the campus appeared more inclined towards active travel modes, such as walking and cycling, whereas those living further away displayed a stronger reliance on motorised transportation.

1. Introduction

Understanding the travel behaviour of university students is essential in transportation studies. It offers critical insights into the factors shaping on-campus mobility while supporting the development of more sustainable transport systems. However, students' travel patterns have evolved considerably in recent years, largely due to the growing proportion of students living off campus. Over the last decade, global university enrolments have risen steadily, contributing to shifting housing and mobility dynamics. According to data from the UNESCO Institute for Statistics, the worldwide tertiary enrolment rate increased by 21% between 2000 and 2020, resulting in more than 200 million students at the tertiary level [1]. This unprecedented growth has intensified demand for both on- and off-campus accommodation, as institutions face growing challenges in providing sufficient housing capacity.

With more students now living off-campus, exploring the influence of residential location on commuting decisions and travel preferences has become a critical research focus [2]. Off-campus housing has gained popularity due to several factors, including limited availability of on-campus facilities, students' desire for independence and flexibility, and comparatively lower rental costs. In certain contexts, such as China, students

prefer off-campus housing to gain greater autonomy over their schedules, as on-campus students are often restricted by curfew regulations [3]. Conversely, in the United Kingdom (UK), institutional policies frequently place students in off-campus housing due to limited on-campus capacity [4]. In both cases, national housing policies have been formulated to emphasise the importance of suitable and well-planned accommodation in maintaining student welfare and academic success.

Similarly, in Malaysia, the Ministry of Higher Education has reported steady growth in higher education enrolment, with over 280,000 graduates annually between 2010 and 2019 [5]. However, the expansion of student housing infrastructure has not kept pace with rising enrolment, particularly over the last decade, resulting in a growing population of off-campus students. This imbalance between housing provision and enrolment growth has broader implications for students' quality of life, influencing comfort, convenience, perceived safety, and, in some cases, academic performance and attitudes towards learning [6]. However, there is limited research specifically highlighting the effects of housing location on off-campus students.

For example, the Engineering Campus of USM highlights the challenges posed by a growing off-campus student population with diverse travel behaviours. In 2024, 652 students lived off-campus: 305 at Desasiswa Utama (near campus and housing mostly postgraduates and international students) and 347 classified as *Pelajar Tanpa Asrama* (PETAS), who live in scattered rental housing. PETAS students often face longer, riskier, and more expensive commutes, which may negatively affect their well-being. Factors such as distance from campus, access to public transit, and parking availability influence their travel choices [7]. Additionally, housing location affects both environmental and social aspects of commuting. Students living farther away contribute to greater energy use and emissions due to longer travel times [8]. Therefore, this study aims to examine how housing location influences the travel behaviour of off-campus students at USM's Engineering Campus. By analysing patterns based on where students live, the research seeks to support future housing and transport planning at the university.

2. Literature Review

A study of postsecondary students at four Toronto universities found that travel distance, time, and access to transportation significantly affect mode choice and car use, with shorter distances encouraging walking or cycling [9]. Travel diary data showed that students in older, bike-friendly areas were more likely to walk, bike, or use multiple modes of transportation. Similarly, Das et al. [10] found major differences between on-campus and off-campus students at Vellore Institute of Technology, with off-campus students facing longer travel times that affected their punctuality and well-being due to higher commuting costs and longer distances. Longer commutes were also associated with poorer physical health, lower psychological adjustment, and adverse effects on job performance and relationships [11]. Students with longer travel times reported lower emotional well-being. In Kochi City, India, residential location also shaped transport behaviour, as students in areas with good walking and cycling infrastructure and mixed land use were more likely to walk or bike [12]. These students showed better academic performance, linked to more physical activity, reduced stress, and better attendance.

Housing decisions are influenced by several factors. At Boise State University, a survey found that affordability was the top priority, followed by location, amenities, and space [13]. Still, living close to campus remained important—56.6% lived within 1 mile and 28.3% within 1–5 miles, highlighting proximity as a key preference when affordable. Housing location is closely tied to transport costs, moving expenses, and time spent on daily routines [14]. Due to limited finances, students often prioritise rent, location, and commute time. At UCLA, 59% of students chose housing primarily for affordability [15]. Mode choice is also linked to housing preferences [16].

Meanwhile, gender influences preferences as well: female students prioritise safety, while males focus more on amenities [17]. Family and race also matter. Students who are married or have dependents tend to rent larger off-campus homes, and those with nearby family members prefer to live with them. International students often choose to live with peers of the same nationality [18]. In summary, off-campus housing choices are shaped by a mix of affordability, location, gender, family situation, and culture. These factors interact and influence how students weigh their options, showing the need for flexible and inclusive housing solutions.

2.1 Travel Behaviour Characteristics

A study examined the impact of mode choice on travel behaviour at McMaster University in Canada and found a direct correlation between mode choice and students' travel behaviour [7]. Various factors, including financial considerations, personal attitudes, and environmental awareness, have been shown to shape individuals' transportation mode choices. A comprehensive study conducted in Danang, Vietnam [19] identified several significant determinants of mode selection, including travel duration, gender, school location, and commuting distance. Their findings further revealed that students in developing nations tend to prioritise speed over cost, indicating that travel time remains one of the most dominant factors affecting their commuting decisions.

Zhou et al. [20] examined transportation mode preferences at Iowa State University and reported that off-campus students in college-town settings were more likely to adopt alternative modes of travel, with walking emerging as the most preferred option. Hamad et al. [21] found gender differences in transportation mode choice

at Sharjah University City, UAE, with females less receptive to non-motorised transportation. On the other hand, Zhou [15] identified commute distance, trip time, and infrastructure density as significant factors influencing commuting behaviour. Students living close to campus preferred walking and cycling due to shorter distances and reduced travel expenses. Sisiopiku [22] also found that students without vehicles recorded the highest travel times due to reliance on active mobility or public transport.

Furthermore, Handy & Thigpen [11] examined perceived commute quality at the University of California, Davis, finding that bicycles offered the highest travel quality, followed by walking and driving. Motorised vehicle commuters experienced higher stress and wasted travel time. Nash & Mitra [9] found that built-in infrastructure and separate lanes increased active mobility by enhancing safety perceptions. Muslim et al. [23] studied student satisfaction with housing areas at UiTM Shah Alam, finding that transportation systems and amenities influenced comfort, while public transportation issues reduced satisfaction.

2.2 Spatial Mapping and Analysis

Spatial analysis is widely used to detect spatial patterns and develop predictive models. Kamruzzaman et al. [16] applied GIS to visualise student activity spaces in Northern Ireland using a two-day travel–activity diary. They assessed demand-responsive transport (DRT) performance using three indicators: the number of unique locations visited, the average daily distance travelled, and the activity duration. Joseph [2] used GIS tools for nearest-neighbour, hotspot, and network analyses to examine spatial patterns of student mode choice. The study mapped student residences, campus destinations, and transport facilities to identify location clusters. Some non-Austin addresses had to be excluded due to the shapefile boundaries. Similarly, Yunus et al. [24] investigated the spatial distribution of off-campus housing around Bayero University's New Campus in Nigeria. GPS was used to collect residence coordinates, and GIS was used to map distribution patterns, neighbourhood relationships, and student hotspots based on enrolment data, hostel capacity, and housing availability.

3. Methodology

A structured online questionnaire was administered via Google Forms to off-campus students at the Engineering Campus, Universiti Sains Malaysia (USM), focusing on four areas: sociodemographic, transport mode, travel behaviour, and attitudinal preferences. The study targeted students categorised as Pelajar Tanpa Asrama (PETAS), who live in various off-campus rental accommodations, and Desasiswa Utama residents, who live in off-campus hostels. Out of 347 off-campus undergraduates (12.3% of the total students at Engineering Campus), 190 valid responses (54.8%) were collected after excluding incomplete entries, exceeding 10% of the population threshold required for further analysis. A pilot study involving 12 respondents was first conducted to test the questionnaire's clarity and relevance. Based on their feedback, questions were refined and expanded to include rental rates, effects of off-campus living, and preferred study locations. The final survey was distributed through Telegram, WhatsApp groups, and personal outreach. Data analysis combined statistical and spatial approaches.

4. Results and Discussion

4.1 Sociodemographic

Among the 190 respondents, 58.9% were male and 41.1% female, reflecting the slightly male-dominated population at USM's Engineering Campus. The average age was 22.42 years (SD = 0.922), consistent with a primarily undergraduate cohort. Respondents were mostly from the School of Mechanical Engineering (30%), followed by Electrical and Electronic (19.7%), Biological Systems (14.3%), Aerospace and Chemical (both 12.3%), and Materials Engineering (11.3%). By academic year, Year 2 students made up the largest group (35.5%), followed by Year 3 and Year 4 students (31.1% each), with no Year 1 participants due to on-campus residency requirements. Regarding housing type, 76.3% lived in terrace houses, which are common in Nibong Tebal, while 10% lived in bungalows, 8.4% in semi-detached houses, and 5.3% in detached houses. Household size averaged 8 members (SD = 2.128), ranging from small (2 people) to large groups (up to 10 co-renters). Nearly all respondents (95.8%) paid rent, with 47.4% paying RM 101 to 150, 29.5% paying RM 151 to 200, and the rest paying other amounts, reflecting typical low-income student budgets. The statistical details are shown in Table 1.

4.2 Transportation Mode and Travel Behaviour Characteristics

Part B of the questionnaire survey gathered data on the modal choice for commuting to campus. Table 2 provides the descriptive and frequency analysis of the respondents' transportation modes. A significant majority (90.5%) possessed a driver's license, and 74.7% owned at least one vehicle, indicating a high level of vehicle ownership among the respondents. The analysis of vehicle types showed that 32.8% owned cars, 29.9% owned motorcycles, and 14.2% owned bicycles. However, 22.5% did not own any vehicle.

On average, households had 2 cars and 2 motorcycles, highlighting the reliance on private motorised transport. The primary mode of transportation to campus was the car, with 55.3% of respondents using it, either by driving (31.1%) or carpooling (24.2%). Motorcycles were used by 24.7% of respondents, while active mobility options such as bicycling (12.1%) and walking (5.8%) were less common. E-hailing services and other modes were chosen by 3% and 0.5% of respondents, respectively. This data suggests that most of the sample population relies on motorised private vehicle transport to access the university campus.

Table 1 *Descriptive statistics (frequency, mean, and standard deviation) for the sociodemographic characteristics of respondents (N = 190)*

Item	Variables	Frequency (%)	Mean	Standard Deviation
Gender	(0) Male	58.9	0.41	0.493
	(1) Female	41.1		
Age	-	100.0	22	0.891
School	(0) PPKA	27.4	1.98	1.741
	(1) PPKEE	20.5		
	(2) PPKBSM	15.3		
	(3) PPKM	12.1		
	(4) PPKAe	12.6		
	(5) PPKK	12.1		
Year of Study	(1) Year 1	0.0	2.93	0.830
	(2) Year 2	37.9		
	(3) Year 3	31.1		
	(4) Year 4	31.1		
Type of House	(0) Terrance	76.3	0.49	0.980
	(1) Semi-detached	8.4		
	(2) Detached	5.3		
	(3) Bungalow	10.0		
Number of Household	-	100.0	8	2.128
Renting Status	(0) Not Paying the Rent	4.2	0.96	0.201
	(1) Paying the Rent Monthly	95.8		
Rental Rate per Individual	(0) RM 0	4.2	2.23	0.901
	(1) RM 1 to RM 100	12.1		
	(2) RM 101 to RM 150	47.4		
	(3) RM 151 to RM 200	29.5		
	(4) RM 201 to RM 400	6.8		

Int. Journal of Integrated Engineering Vol. 18 No. 5 (2026) p. 69-85

Table 2 *Descriptive statistics (frequency, mean, and standard deviation) of transportation mode of respondents (N = 190)*

Item	Variables	Frequency (%)	Mean	Standard Deviation
Possession of Driver License	(0) No	9.5	0.91	0.294
	(1) Yes	90.5		
Vehicle Ownership	(0) No	25.3	0.75	0.436
	(1) Yes	74.7		
Type of Vehicle Own	(0) Does Not Own	22.5	-	-
	(1) Bicycle	14.2		
	(2) Motorcycle	29.9		
	(3) Car	32.8		
	(4) Others (Beam)	0.5		
Total Number of Cars Available in the Household	(0) None	1.1	2.67	1.107
	(1) 1 Car	10.0		
	(2) 2 Cars	34.2		
	(3) 3 Cars	40.0		
	(4) 4 Cars	6.8		
	(5) 5 Cars	5.8		
	(6) > 5 Cars	2.1		
Total Number of Motorcycles Available in the Household	(0) None	25.3	2.59	2.244
	(1) 1 Motorcycle	14.7		
	(2) 2 Motorcycles	14.2		
	(3) 3 Motorcycles	14.2		
	(4) 4 Motorcycles	7.1		
	(5) 5 Motorcycles	1.6		
	(6) > 5 Motorcycles	22.6		
Total Number of Bicycles Available in the Household	(0) None	62.6	1.17	1.958
	(1) 1 Bicycle	11.1		
	(2) 2 Bicycles	8.9		
	(3) 3 Bicycles	3.2		
	(4) 4 Bicycles	3.2		
	(5) 5 Bicycles	0.5		
	(6) > 5 Bicycles	10.5		
Main Travel Mode to Campus	(0) Walking	5.8	2.63	1.214
	(1) Bicycle	12.1		
	(2) Motorcycle	24.7		
	(3) Car (Driving)	31.1		
	(4) Carpooling (Non-driving)	24.2		
	(5) E-hailing	3.0		
	(6) Others (Beam)	0.5		

Part C of the questionnaire collected data on respondents' travel behaviour characteristics. Table 3 presents the descriptive analysis of these characteristics. Over half of the respondents (51.6%) travelled between 2 km and 5 km to campus daily, with 40% travelling less than 2 km. The travel time for most respondents (51.1%) was between 5 and 10 minutes, while 30% took less than 5 minutes. Regarding travel costs, 38.9% of respondents reported spending between RM 5 and RM 10, while 25.3% spent less than RM 5. The preferred route choice revealed that 62.1% of respondents preferred using the main route, while 37.9% chose alternative routes.

Table 3 *Descriptive statistics (frequency, mean, and standard deviation) of travel characteristics of respondents (N = 190)*

Item	Variables	Frequency (%)	Mean	Standard Deviation
Travel Distance	(0) < 2 km	40.0	0.70	0.674
	(1) 2 km to 5 km	51.6		
	(2) 5 km to 10 km	7.4		
	(3) 10 km to 20 km	0.5		
	(4) > 20 km	0.5		
Total Travel Time	(0) < 5 minutes	30.0	0.90	0.717
	(1) 5 to 10 minutes	51.1		
	(2) 10 to 30 minutes	17.9		
	(3) > 30 minutes	1.1		
Total Travel Cost	(0) > RM 5	25.3	1.29	1.111
	(1) RM 5 to RMM 10	38.9		
	(2) RM 10 to RM 15	23.7		
	(3) RM 15 to RM 20	5.3		
	(4) RM 20 to RM 30	6.8		
Preferred Route Choice	(0) Preferred Alternative Route	37.9	0.62	0.486
	(1) Preferred Main Route	62.1		

Fig. 1 illustrates the travel-time distribution for off-campus student trips, showing peak arrival times between 7 am and 9 am, coinciding with the start of morning classes. The departure times peaked between 1 pm and 3 pm, likely due to the end of morning classes and the lunch break. These patterns highlight the concentrated traffic volumes during these periods, indicating potential areas for transportation planning and infrastructure improvements.

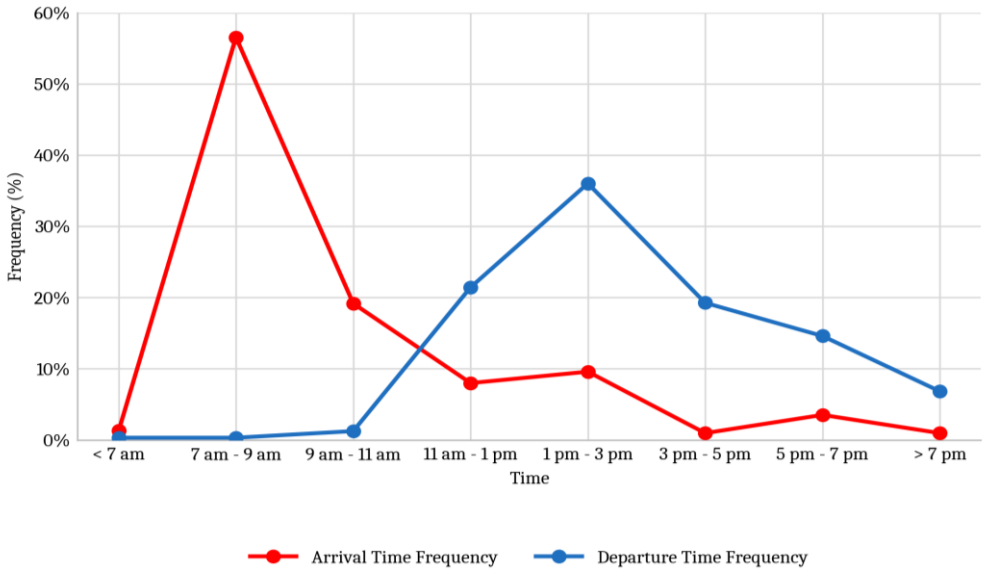


Fig. 1 *Arrival and departure time of respondents (N = 190)*

Fig. 2 shows the average daily time off-campus students spent on campus. The majority (44%) stayed between 4 and 6 hours, likely aligning with standard class schedules. Another 27% spent 6 to 8 hours, suggesting involvement in activities beyond lectures, such as studying or extracurriculars. Only 14% spent more than 8 hours, indicating extended campus use is less common. Meanwhile, 14% spent just 2 to 4 hours, and a small fraction (1% each) stayed less than an hour or between 1 and 2 hours daily.

Int. Journal of Integrated Engineering Vol. 18 No. 5 (2026) p. 69-85

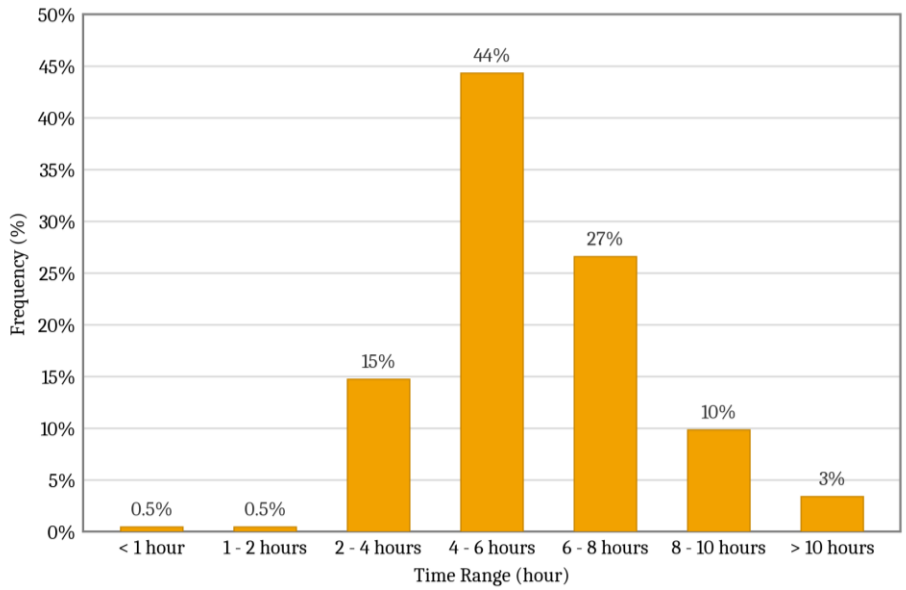


Fig. 2 *The average time spent on campus by the respondents (N = 190)*

4.3 Safety Perception of Respondents

Respondents' safety perceptions were rated on a 5-point Likert scale, as shown in Table 4. For accident risk, 63.2% (41.1% agreed, 22.1% strongly agreed) felt their route was safe, while 17.9% disagreed, 4.7% strongly disagreed, and 14.2% were undecided. Regarding peak-hour vehicle volume, 34.2% disagreed, 16.3% strongly disagreed, 20.5% were undecided, and only 17.4% and 11.6% agreed and strongly agreed. On route liveliness, 31.6% agreed, 18.6% strongly agreed, 24.2% were undecided, while 15.3% disagreed and 10% strongly disagreed. For lane width, 43.7% agreed, 25.8% strongly agreed, with 16.3% undecided, 11.6% disagreeing, and 2.6% strongly disagreeing. Overall safety was rated positively by 40.5% agreeing and 12.6% strongly agreeing, while 28.9% were undecided, 14.7% disagreed, and 3.2% strongly disagreed.

Table 4 *Descriptive analysis for the level of safety of the respondents' trips to campus (N = 190)*

Statement	Variables	Frequency (%)	Mean	Standard Deviation
The route I travel to campus has a lower risk of accidents	(1) Strongly Disagree	4.7		
	(2) Disagree	17.9		
	(3) Undecided	14.2	3.58	1.155
	(4) Agree	41.1		
	(5) Strongly Agree	22.1		
The route I travel to campus has lower vehicle volume, including during the peak hours	(1) Strongly Disagree	16.3		
	(2) Disagree	34.2		
	(3) Undecided	20.5	2.74	1.253
	(4) Agree	17.4		
	(5) Strongly Agree	11.6		
The route I travel to campus is lively and dynamic all the time	(1) Strongly Disagree	10.0		
	(2) Disagree	15.3		
	(3) Undecided	24.2	3.34	1.232
	(4) Agree	31.6		
	(5) Strongly Agree	18.6		
The route I travel to campus has sufficient lane width	(1) Strongly Disagree	2.6		
	(2) Disagree	11.6		
	(3) Undecided	16.3	3.78	1.039
	(4) Agree	43.7		
	(5) Strongly Agree	25.8		

Statement	Variables	Frequency (%)	Mean	Standard Deviation
Overall, I am satisfied with the safety of the route I travel to campus	(1) Strongly Disagree	3.2		
	(2) Disagree	14.7		
	(3) Undecided	28.9	3.45	0.995
	(4) Agree	40.5		
	(5) Strongly Agree	12.6		

4.4 Altitudinal Preferences

Attitudinal preferences from Part D of the questionnaire reflect students' views on housing and commuting, rated on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree), as shown in Table 5. For housing satisfaction, 80.6% (53.2% strongly agreed, 27.4% agreed) were satisfied, while 12.6% disagreed and 6.8% were undecided. Rent satisfaction was more evenly split: 27.4% strongly agreed, 18.9% agreed, 17.4% were undecided, and 36.3% disagreed. Satisfaction with the transport system was generally low, with 27.4% undecided, 26.8% disagreeing, and only 27.4% expressing agreement. Regarding road geometry, 51.5% were satisfied (38.9% agreed, 12.6% strongly agreed), while 27.4% were undecided. For travel mode, 53.2% were satisfied (40% agreed, 13.2% strongly agreed), 25.8% disagreed, and 21.1% were undecided.

Table 5 *Descriptive analysis (frequency, mean and standard deviation) for the level of satisfaction of respondents (N = 190)*

Statement	Variables	Frequency (%)	Mean	Standard Deviation
I am very satisfied with my current housing location	(1) Strongly Disagree	2.1		
	(2) Disagree	10.5		
	(3) Undecided	6.8	4.19	1.087
	(4) Agree	27.4		
	(5) Strongly Agree	53.2		
I am very satisfied with the rent I paid	(1) Strongly Disagree	17.9		
	(2) Disagree	18.4		
	(3) Undecided	17.4	3.19	1.469
	(4) Agree	18.9		
	(5) Strongly Agree	27.4		
I am very satisfied with the management of off-campus students in the Engineering Campus	(1) Strongly Disagree	22.1		
	(2) Disagree	38.4		
	(3) Undecided	21.6	2.39	1.102
	(4) Agree	13.7		
	(5) Strongly Agree	4.2		
I am very satisfied with the transportation system to the campus	(1) Strongly Disagree	18.4		
	(2) Disagree	26.8		
	(3) Undecided	27.4	2.69	1.161
	(4) Agree	22.1		
	(5) Strongly Agree	5.3		
I am very satisfied with the current road geometry along the route to the campus	(1) Strongly Disagree	7.4		
	(2) Disagree	13.7		
	(3) Undecided	27.4	3.36	1.098
	(4) Agree	38.9		
	(5) Strongly Agree	12.6		
I am very satisfied with my travel mode to the campus	(1) Strongly Disagree	5.8		
	(2) Disagree	20.0		
	(3) Undecided	21.1	3.35	1.115
	(4) Agree	40.0		
	(5) Strongly Agree	13.2		

Int. Journal of Integrated Engineering Vol. 18 No. 5 (2026) p. 69-85

Respondents were asked to indicate both their usual study location and their preferred study location, along with the reasons for their choices. As illustrated in Fig. 3, the data show the distribution of respondents across three main study settings: rented houses, on-campus facilities, and other locations. A total of 55% reported that they typically studied at their rented accommodation, while 44% identified the campus as their regular study space, and 1.1% selected alternative locations. In contrast, when asked about their preferences, 58% preferred studying on campus, 41% favoured their rented houses, and 1.6% preferred other places.

Furthermore, respondents justified their preferred study locations in open-ended responses, which were categorised into six common themes (see Fig. 4). Most respondents preferred studying at their rented house for convenience, accessibility, and privacy. Eight per cent cited convenience and accessibility, as studying at home allows for a customised schedule and eliminates transportation issues. 9% valued the privacy of a less-crowded environment conducive to focused, uninterrupted work. Conversely, 6% and 4% preferred on-campus study for better study spaces and access to academic resources. A significant portion preferred on-campus study for several reasons: 14% found the campus environment more comfortable, 13% appreciated adequate study facilities, 12% valued opportunities for group discussion, and 8% cited better internet connectivity. Only small percentages (3% and 4%) preferred their rented house for group discussions and internet connectivity. Some respondents preferred alternative locations, such as coffee shops or friends' homes, valuing their comfort and suitability for prolonged study sessions.

To explore the impact of housing location on academic performance, respondents were asked about off-campus living. As shown in Fig. 5, 63% agreed it influenced their performance, while 37% disagreed. The most reported challenges were poor time management and loss of focus (16% each), followed by difficulty attending study groups (12%) and lack of study facilities (11%). Smaller percentages cited poor mental health and other commitments (4% each). These findings suggest that off-campus living at greater distances can create time, focus, and resource constraints that affect students' academic and personal well-being.

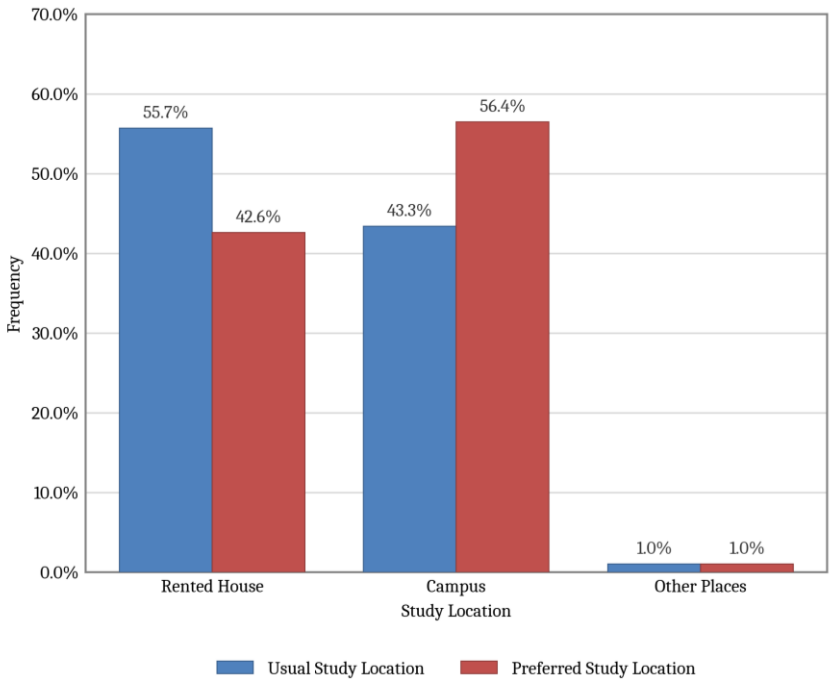


Fig. 3 *Percentage of respondents' usual and preferred study locations*

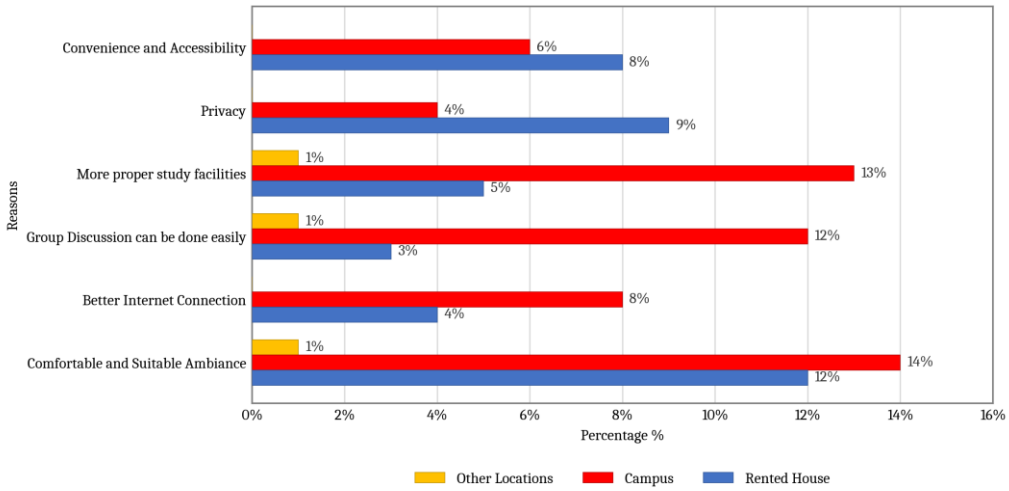


Fig. 4 *Respondents' justification for their preferred study location (N = 190)*

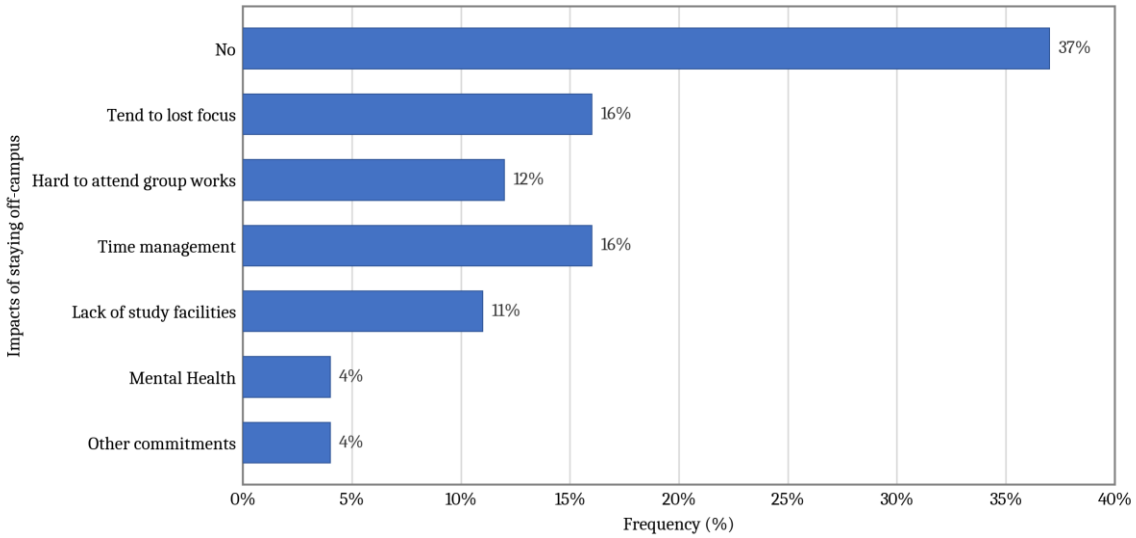


Fig. 5 *The impact of staying off-campus towards the respondents' academic achievement (N = 190)*

4.5 Correlation Between Travel Behaviour Characteristics

Table 6 shows a strong positive correlation between travel distance and average commute time (r = 0.714***), indicating that students living farther from campus have longer commute times, consistent with Danaf et al. [25]. Distance also correlates moderately with travel cost (r = 0.343***), as greater distances often involve higher fuel use or pricier transport options, as supported by Whalen et al. [7], though Nguyen-Phuoc et al. [19] found cost had a smaller impact. No significant link was found between distance and route choice, suggesting decisions may depend more on safety or convenience [26]. Travel time also correlates moderately with cost (r = 0.366***), reflecting the time and stress burden noted by Mouratidis [27]. Finally, a weak negative correlation between cost and route choice (r = -0.178**) suggests students facing higher costs tend to opt for cheaper, alternative routes.

4.5.1 Correlation between Sociodemographics, Types of Housing and Travel Behaviour

Table 7 presents correlations between sociodemographic factors and travel behaviour. Gender is positively correlated with travel time (r = 0.124*) and cost (r = 0.149**), suggesting female students tend to have longer and more costly commutes, likely due to safety or comfort preferences [28]. Age is negatively correlated with travel time (r = -0.161**), indicating older students generally live closer or have more efficient commutes. Housing type also shows a negative correlation with travel distance (r = -0.142**), implying those in larger homes (e.g., bungalows) travel farther—possibly because they live with family.

Renting status is strongly negatively correlated with both travel distance (r = -0.354***) and time (r = -0.319***), showing that students who rent tend to live closer to campus. Similarly, higher rental rates are associated with shorter distances (r = -0.302***), shorter travel times (r = -0.268***), and lower travel costs (r = -0.206***), likely due to higher housing costs near the university.

Int. Journal of Integrated Engineering Vol. 18 No. 5 (2026) p. 69-85

Table 6 *Pearson correlation between travel characteristics*

Parameters		Travel distance	Average total travel time	Average total cost per trip	Preferred route choice to campus
Travel distance	Pearson Correlation	1	0.714***	0.343***	-0.029
	Sig. (2-tailed)		<0.001	<0.001	0.681
	N	190	190	190	190
Average total travel time	Pearson Correlation	0.714***	1	0.366***	-0.064
	Sig. (2-tailed)	<0.001		<0.001	0.367
	N	190	190	190	190
Average total cost per trip	Pearson Correlation	0.343***	0.366***	1	-0.178**
	Sig. (2-tailed)	<0.001	<0.001		0.011
	N	190	190	190	190
Preferred route choice to campus.	Pearson Correlation	-0.029	-0.064	-0.178**	1
	Sig. (2-tailed)	0.681	0.367	0.011	
	N	190	190	190	190

Table 7 *Pearson correlation between sociodemographic, types of housing and travel behaviour characteristics*

Parameters		Gender	Age	Year of study	Type of house	Household member	Renting status	Rental rate per individual
Travel distance	Pearson Correlation	-0.014	-0.113	-0.077	-0.142**	0.034	-0.354***	-0.302***
	Sig. (2-tailed)	0.842	0.107	0.275	0.044	0.631	<0.001	<0.001
	N	190	190	190	190	190	190	190
Average total travel time	Pearson Correlation	0.124*	-0.161**	-0.105	-0.047	0.014	-0.319***	-0.268***
	Sig. (2-tailed)	0.079	0.022	0.137	0.505	0.848	<0.001	<0.001
	N	190	190	190	190	190	190	190
Average total cost per trip	Pearson Correlation	0.149**	-0.002	-0.006	0.025	-0.051	-0.026	-0.206***
	Sig. (2-tailed)	0.033	0.982	0.932	0.720	0.473	0.712	<0.001
	N	190	190	190	190	190	190	190

4.5.2 Correlation between Transport Ownership and Travel Behaviour

Table 8 highlights key links between transport mode and travel behaviour. Possession of a driver's licence is positively correlated with travel distance (r = 0.186***) and time (r = 0.192***), indicating students living farther are more likely to drive [21]. Vehicle ownership reduces travel time (r = -0.123*), while travel mode choice increases with both travel distance (r = 0.195***) and time (r = 0.141***), suggesting that longer commutes encourage driving [20]. The number of household cars and motorcycles also correlates positively with travel distance and time, especially for motorcycles [19]. In contrast, bicycle ownership is negatively correlated with distance (r = -0.186***) and time (r = -0.305***), showing that students who live closer to campus tend to cycle, consistent with Davison et al. [29].

Table 8 *Pearson correlation between transport ownership and travel behaviour characteristics*

Parameters		Possession of driver's license	Vehicle ownership	Main travel mode	Number of cars	Number of motorcycles	Number of bicycles
Travel distance	Pearson Correlation	0.186***	0.028	0.195***	0.244***	0.200***	-0.186***
	Sig. (2-tailed)	0.008	0.691	0.005	<0.001	0.004	0.008
	N	190	190	190	190	190	190
Average total travel time	Pearson Correlation	0.192***	-0.123*	0.141**	0.125*	0.137**	-0.305***
	Sig. (2-tailed)	0.006	0.081	0.044	0.076	0.05	<0.001
	N	190	190	190	190	190	190
Average total cost per trip	Pearson Correlation	0.031	-0.102	-0.087	0.020	-0.073	0.112
	Sig. (2-tailed)	0.664	0.150	0.217	0.775	0.303	0.113
	N	190	190	190	190	190	190

4.6 Spatial Analysis

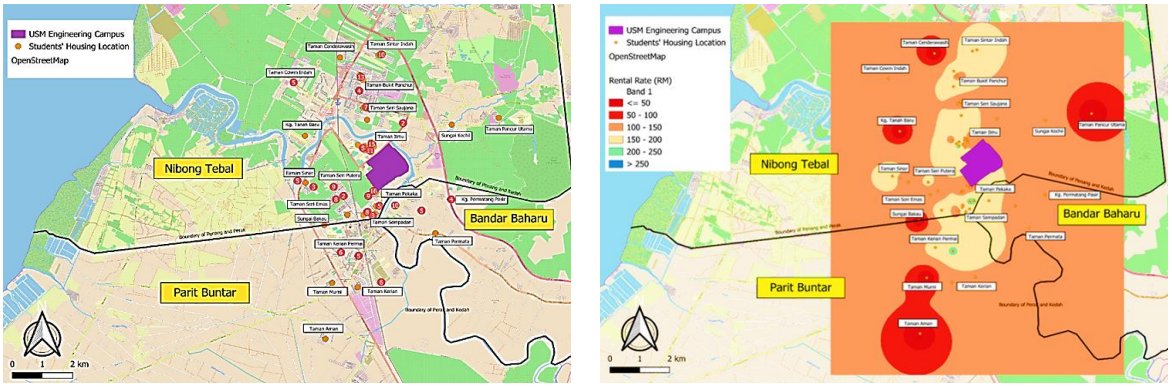
Spatial analysis examines how housing location affects off-campus students' travel behaviour, with reference to the Engineering Campus (purple area). It visualises travel modes, time, and routes through maps. By examining spatial links between housing, distance, cost, time, and safety, spatial analysis can highlight ideal housing areas that reduce commute time, promote sustainable transport, and enhance the student experience.

4.6.1 Housing Location and Rental Rates

The respondents' housing locations were mapped to illustrate the spatial distribution, as shown in Fig. 6(a). The orange markers represent the residential locations of individual respondents. The mapping reveals that most housing locations are both scattered and clustered around the campus vicinity. Several residential areas exhibit highly concentrated clusters, including Taman Ilmu (11 points), Taman Pekaka (6 points), Taman Sempadan (6 points), Taman Seri Saujana (4 points), Taman Bukit Panchur (3 points), and Taman Sinar (3 points). In contrast, some neighbourhoods show lower-density clusters, recording 2 points each, such as Taman Sintar Indah, Taman Seri Emas, Taman Seri Putera, and Taman Kerian. Additionally, several locations are represented by discrete single points, including Kg. Tanah Baru, Taman Murni, Taman Aman, and Sungai Bakau exhibit more dispersed housing patterns.

Fig. 6(b) shows the distribution of housing rental rates, with red areas indicating the highest rates. The spatial pattern indicates that the highest rental rates (RM 200 to RM 250) are in Taman Kerian Permai, Taman Pekaka, and Taman Ilmu. Lower rental rates are found further from these clustered regions, in areas like Kg. Tanah Baru, Taman Kerian Permai, and Taman Aman. Most housing areas fall within RM 100 to RM 150 and RM 150 to RM 200, suggesting that students are dispersing to seek more affordable options, despite longer commutes, higher travel costs, and increased travel distances

Int. Journal of Integrated Engineering Vol. 18 No. 5 (2026) p. 69-85



(a) **(b)**

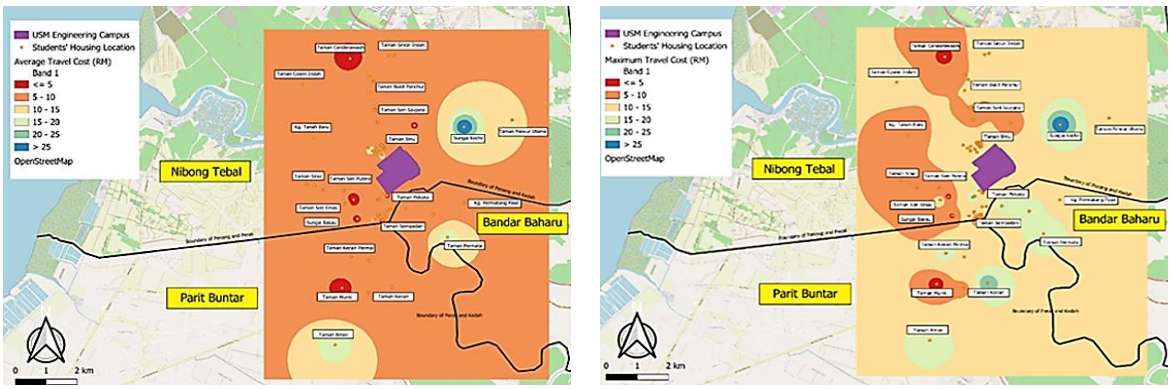
Fig. 6 *Spatial Mapping (a)Housing locations distribution; and (b) Housing rental rate per month*

4.6.2 Travel Cost between Housing Locations to Engineering Campus

Spatial analysis of travel costs shown in Fig. 7(a) highlights disparities in housing affordability and accessibility. Red areas represent lower travel costs. Students living near campus, such as in Taman Seri Putera and Taman Pekaka, report lower travel costs (below RM 5 to 10), while those in Taman Ilmu and Taman Sempadan face moderate costs (RM 10 to 15) represented by yellow colours. Locations like Taman Aman, Sungai Kechil, and Taman Permata show higher costs (RM 15 to 25+), reflecting greater distances and fuel use. However, average costs may understate the burden for some students. Fig. 7(b) shows that maximum travel costs are often significantly higher, particularly for active travellers (walkers or cyclists) who invest more time and energy. These findings underscore the financial strain on students in distant housing, especially those with fewer transport options or lower incomes.

4.6.3 Travel Time and Safety Risk Perception

Spatial mapping of travel time, as shown in Fig. 8(a), reveals significant differences in accessibility across housing areas. Travel times were grouped into four categories: <5 mins (0), 5 to 10 mins (1), 10 to 30 mins (2), and >30 mins (3), represented by blue, red, orange, and green colours. No locations fell under < 5-minute range. Most nearby housing areas, including Bandar Baharu, had commute times under 10 minutes, while Taman Ilmu and Taman Sempadan showed some variation. The longest travel time was recorded at Taman Aman. Notably, some distant areas had shorter travel times due to lighter traffic, highlighting that commute duration depends on more than just distance, as factors such as road conditions and congestion also play a role.



(a) **(b)**

Fig. 7 Spatial Mapping *(a) Average travel cost of commuting journey to campus; and (b) Maximum travel cost of commuting journey to campus*

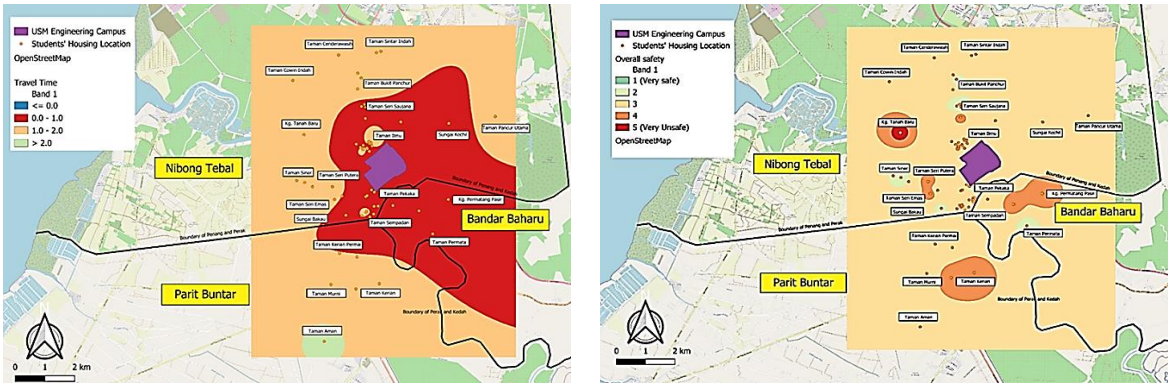


Fig. 8 *Spatial Mapping (a) Travel time distribution of the commuting journey from housing locations to the campus; and (b) Level of overall perceived safety*

Meanwhile, spatial mapping of safety perception (see Fig. 8(b)) reveals how students rate the safety of their daily commutes, based on five factors: accident risk, vehicle volume, traffic conditions, lane width, and overall route safety. Using a 1 (very safe) to 5 (very unsafe) scale, represented by blue, green, yellow, orange and red in colours, only Kg. Tanah Baru was clearly perceived as unsafe (in red areas), likely due to traffic or environmental issues. Most areas were rated "fair" (yellow). Other areas with perceived safety concerns include Taman Kerian, Kg. Permatang Pasir and Taman Seri Putera.

5. Conclusion

This comprehensive study has provided valuable insights into the intricate relationship between the residential locations of off-campus students at the Engineering Campus, USM, and their corresponding travel behaviours. The outcomes of this research, guided by three primary objectives, have significant implications for the development of effective policies and strategic interventions to enhance the overall well-being, academic performance, and quality of life of the student population.

Firstly, an in-depth analysis of the respondents' sociodemographic characteristics, residential locations, and travel behaviours revealed a diverse range of profiles among off-campus students, based on data from a questionnaire survey with a 54.8% response rate. Analysis using SPSS revealed significant differences across factors such as age, gender, housing type, rental rates, proximity to campus, and travel modes. This diversity highlights the need for tailored approaches from management and policymakers to address the unique housing, mobility, and support needs of off-campus students, as a one-size-fits-all solution is unlikely to be effective.

Secondly, spatial mapping using QGIS illustrated the distribution of housing locations across three districts, Nibong Tebal, Bandar Baharu, and Parit Buntar, revealing that Nibong Tebal has the highest student concentration. The mapping also identified students who may have been staying with family in Sungai Bakap and Bagan Serai, and most off-campus students stayed with friends in Taman Ilmu, Taman Pekaka, and Taman Sempadan near the campus. These insights are valuable for guiding future housing and transportation planning to enhance accessibility and connectivity.

Lastly, the study assessed the impact of housing locations on students' well-being, finding that factors such as long commute times, high transportation costs, and perceived safety significantly influence students' overall quality of life. Those living farther from campus faced greater challenges, affecting their academic performance and social engagement. This underscores the importance of considering housing locations in strategies to support off-campus students. Collaboration among policymakers, university administrators, and urban planners is essential to develop effective solutions that address the interconnected needs of this student group and prevent inequities that could hinder their success and well-being. For example, it is suggested to provide demand-responsive transport (DRT) services that link off-campus student residential areas to the engineering campus

5.1 Limitations of Study

A key methodological challenge encountered during this research was the difficulty in administering the questionnaire survey and securing an adequate response rate among the off-campus student population. The data collection process spanned approximately one month, resulting in 203 completed survey responses that were incorporated into the final dataset. This limitation primarily stemmed from consistently low levels of student engagement and participation, which posed a persistent obstacle throughout the data-gathering phase. Off-campus students, who often manage demanding schedules with both academic and non-academic commitments, frequently struggle to allocate sufficient time to provide comprehensive, well-considered responses. Furthermore,

because participation was voluntary, there is a possibility of self-selection bias, whereby the sample may disproportionately represent students who were more motivated or invested in the research topic. Consequently, this may limit the generalizability of the findings to the broader off-campus student population.

Another notable limitation is the study's restricted geographical scope, as it focuses exclusively on the Engineering Campus at USM. While this targeted approach facilitated a detailed exploration of student housing patterns and travel behaviours within a specific academic context, the findings may not be directly transferable to other university environments. Institutions with distinct spatial layouts, diverse student demographics, or different regional transportation infrastructures may exhibit substantially different dynamics. Moreover, the socioeconomic and cultural factors influencing student residential choices and mobility patterns in Malaysia may not align with those observed in international higher education contexts, thereby constraining the broader applicability of the results.

A third limitation concerns the reliance on self-reported data obtained through the questionnaire survey. Although this approach was appropriate for capturing respondents' subjective perceptions and lived experiences, it is inherently vulnerable to potential biases, recall inaccuracies, and incomplete disclosures. For example, some respondents may have underestimated or overestimated their actual commuting time and travel expenses, while others might have withheld candid descriptions of the challenges they face in managing off-campus housing and transportation arrangements. Such issues introduce possible measurement errors, which should be considered when interpreting the study's outcomes and their policy implications.

5.2 Recommendations for Future Work

This study examines how housing locations affect the travel behaviour of off-campus students at the USM Engineering Campus. Accordingly, several suggestions are proposed to improve study quality and data collection methods, enabling more robust future analyses. Future research would benefit from incorporating additional empirical data to complement the self-reported survey responses used in this study. While the questionnaire provided valuable insights into students' personal experiences and perceptions, including more quantitative indicators could enhance the reliability and precision of the findings. For instance, using GPS to track students' travel patterns, maintaining detailed records of transport use, and developing spatial maps of commuting routes and durations could yield a clearer understanding of actual mobility behaviour. Furthermore, incorporating objective indicators such as academic results, attendance records, and extracurricular participation would allow for a more comprehensive evaluation of how housing location and commuting experiences influence student well-being and success. These metrics could serve as benchmarks to assess the academic and personal outcomes of off-campus students. Finally, future studies should extend beyond the specific case of USM's Engineering Campus. Analysing off-campus student housing and travel behaviour at other universities and campuses could broaden the applicability of the findings. Comparative studies across different institutional and regional contexts in Malaysia would help determine whether the dynamics observed here are universally relevant or influenced by local socioeconomic, cultural, and infrastructural conditions.

Acknowledgement

This work was supported by the Universiti Sains Malaysia under the Research Universiti Grant (RUI 1001/ PAWAM/ 8016122).

Conflict of Interest

There is no conflict of interest regarding the publication of the paper.

Author Contribution

Study conception and design: *Nur Sabahiah Abdul Sukor;* ***Data collection:*** *Muhammad Amir Hafiz Aziz;* ***Analysis and interpretation of results:*** *Muhammad Amir Hafiz Aziz;* ***Draft manuscript preparation:*** *Nur Sabahiah Abdul Sukor, Muhammad Amir Hafiz Aziz. All authors reviewed the results and approved the final version of the manuscript.*

References

[1] UNESCO (2021). Global education monitoring report 2021/2: Non-state actors in education: Who chooses? Who loses? https://unesdoc.unesco.org/ark:/48223/pf0000379875,

[2] Joseph, L. E.-W. (2014). Student travel mode choice: A case study of students attending the University of Texas at Austin [Master's thesis, The University of Texas at Austin]. Texas ScholarWorks. http://hdl.handle.net/2152/26281

[3] Zhu, X. (2020). Chinese-style off-campus Education: Research on the popularity of after-school training institutions. International Journal of Learning, 6, 247–251. https://doi.org/10.18178/IJLT.6.4.247-251

[4] Wilkinson, C., & Greenhalgh, P. (2022). Exploring student housing demand, supply side and planning policy responses in a small university city: Studentification in Durham, UK. Housing Policy Debate, 34, 746–768 https://doi.org/10.1080/10511482.2022.2137379

[5] Ghani, Z. A., & Sulaiman, N. (2021). Drivers for off-campus students housing demand in Malaysia. Traektoriâ Nauki = Path of Science, 7, 6001–6013. https://doi.org/10.22178/pos.66-8

[6] Ghani, Z. A., Sulaiman, N., & Mohammed, M. I. (2020). Challenges of students housing provision in Malaysia. Traektoriâ Nauki = Path of Science, 6, 2001–2012. https://doi.org/10.22178/pos.64-3

[7] Whalen, K. E., Páez, A., & Carrasco, J. A. (2013). Mode choice of university students commuting to school and the role of active travel. Journal of Transport Geography, 31, 132–142. https://doi.org/10.1016/j.jtrangeo.2013.06.008

[8] Sundram, V. P. K., Hashim, N., Shariff, S. H., Pujiati, A., & Ardiansari, A. (2021). Sustainable transportation on university campus: A case at UiTM Selangor, Puncak Alam Campus, Malaysia and Universitas Negeri Semarang, Indonesia. Asian Journal of University Education, 17, 262–272. https://doi.org/10.24191/AJUE.V17I2.13407

[9] Nash, S., & Mitra, R. (2019). University students' transportation patterns, and the role of neighbourhood types and attitudes. Journal of Transport Geography, 76, 200–211. https://doi.org/10.1016/j.jtrangeo.2019.03.013

[10] Das, R., Vishal Kumar, S., Prakash, B., Dharmik, & Subbarao, S. S. V. (2016). Analysis of university students travel behaviour: En route to sustainable campus. Indian Journal of Science and Technology, 9, 1–11. https://doi.org/10.17485/ijst/2016/v9i30/99246

[11] Handy, S., & Thigpen, C. (2019). Commute quality and its implications for commute satisfaction: Exploring the role of mode, location, and other factors. Travel Behaviour and Society, 16, 241–248. https://doi.org/10.1016/j.tbs.2018.03.001

[12] Krishnapriya, M. G., & Soosan George, T. (2020). Mode choice behaviour of students, integrating residential location characteristics: A study from Kochi City, India. European Transport / Trasporti Europei, 79, 1–17. https://doi.org/10.48295/ET.2020.79.5

[13] Wigington, A., Johnson, J., Schaefers, M., Grinwis, J., & Troyer, K. (2021). Student housing availability: How low supply is creating barriers to higher education. In the 2021 Undergraduate Research Showcase, Boise State University. https://scholarworks.boisestate.edu/under_showcase_2021/115

[14] .Kamal, N. A. M. S., Mohd, T., & Baharun, N. (2020). Examining off-campus students' housing preferences between public and private university students. Charting a Sustainable Future of ASEAN in Business and Social Sciences. Springer. https://doi.org/10.1007/978-981-15-3859-9_13

[15] Zhou, J. (2014). From better understandings to proactive actions: Housing location and commuting mode choices among university students. Transport Policy, 33, 166–175. https://doi.org/10.1016/j.tranpol.2014.03.004

[16] Kamruzzaman, M., Hine, J., Gunay, B., & Blair, N. (2011). Using GIS to visualise and evaluate student travel behaviour. Journal of Transport Geography, 19, 13–32. https://doi.org/10.1016/j.jtrangeo.2009.09.004

[17] Johari, N., Mohd, T., Abdullah, L., Ahmad Mohamed, N., & Sani, S. I. A. (2017). Evaluating off-campus student housing preferences: A pilot survey. AIP Conference Proceedings, 1891, 020068. https://doi.org/10.1063/1.5005401

[18] Razak, F. A., Shariffuddin, N., Padil, H. M., & Hanafi, N. H. (2017). Phenomenon living in off-campus accommodation among UiTM students. International Journal of Academic Research in Business and Social Sciences, 7, 786–796. https://doi.org/10.6007/ijarbss/v7-i6/3038

[19] Nguyen-Phuoc, D. Q., Amoh-Gyimah, R., Tran, A. T. P., & Phan, C. T. (2018). Mode choice among university students to school in Danang, Vietnam. Travel Behaviour and Society, 13, 1–10. https://doi.org/10.1016/j.tbs.2018.05.003

[20] Zhou, J., Wang, Y., & Wu, J. (2018). Mode choice of commuter students in a college town: An exploratory study from the United States. Sustainability, 10, 3316. https://doi.org/10.3390/su10093316

[21] Hamad, K., Htun, P. T. T., & Obaid, L. (2021). Characterization of travel behaviour at a university campus: A case study of Sharjah University City, UAE. Transportation Research Interdisciplinary Perspectives, 12, 100193. https://doi.org/10.1016/j.trip.2021.100488

[22] Sisiopiku, V. (2018). Travel patterns and preferences of urban university students. Athens Journal of Technology and Engineering, 5, 19-31.

[23] Muslim, M. H., Karim, H. A., & Abdullah, I. C. (2012). Challenges of off-campus living environment for non-resident students' well-being in UiTM Shah Alam. Procedia - Social and Behavioural Sciences, 50, 875–883. https://doi.org/10.1016/j.sbspro.2012.08.089

[24] Yunus, S., Ahmed Yusuf, Y., Kamilullah, S., Sulaiman Yunus, N., Ahme Yusuf, Y., Kamil Ilah, S., & Dauda Yakubu, M. (2018). Spatial analysis of off-campus student housing around the new campus of Bayero University. Journal of the Environmental and Social Sciences, 24, 358-371.

[25] Danaf, M., Abou-Zeid, M., & Kaysi, I. (2014). Modeling travel choices of students at a private, urban university: Insights and policy implications. Case Studies on Transport Policy, 2, 142–152. https://doi.org/10.1016/ j.cstp.2014.08.006

[26] Anthonia, U. (2019). Influence of home environment on the academic performance of the students in some selected schools in Dekina local government area in Kogi State, Nigeria. International Journal of Contemporary Research and Review, 10, 21430–21444. https://doi.org/10.15520/ijcrr.v10i03.682

[27] Mouratidis, K. (2020). Commute satisfaction, neighborhood satisfaction, and housing satisfaction as predictors of subjective well-being and indicators of urban livability. Travel Behaviour and Society, 21, 265–278. https://doi.org/10.1016/j.tbs.2020.07.006

[28] Haryadi, B., Narendra, A., Purnomo, M., & Purnomo, A. (2022). Modelling student travel mode choice: A case study in Semarang, Indonesia. IOP Conference Series: Earth and Environmental Science, 969, 012077. https://doi.org/10.1088/1755-1315/969/1/012077

[29] Davison, L., Ahern, A., & Hine, J. (2015). Travel, transport and energy implications of university-related student travel: A case study approach. Transportation Research Part D: Transport and Environment, 38, 27–40. https://doi.org/10.1016/j.trd.2015.04.028