

# Potential to increase active commuting level in university area (Case study: Universitas Gadjah Mada)

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**Abstract.** In order to alleviate the negative impacts of motorized vehicle use as well as create sustainable environment within campus area, it is pivotal to encourage mode shifting among university students. Active transport modes such as walking, cycling, and using public transport can be considered as alternative modes. This paper tried to identify the potential to increase active commuting in UGM by understanding student's travel behavior. ANOVA test was employed to identify the perceptions between students across residential zones toward motivators and barriers to actively commute. The findings were used to propose strategies for increasing active commuting level in UGM, which are: reducing barriers to actively commute, improving public transport services, improving walking and cycling facilities, and introducing programs to discourage motorized vehicle use.

## 1. Introduction

Nowadays, universities all over the world has been increasing their attention on encouraging the usage of environmental friendly transport modes as strategy for implementing sustainable transportation in university environment [1][2]. This idea is emerged since university area has attracted trip with a regional scale. Therefore, transportation problem in university will significantly contribute to a problem in the bigger setting. Implementing sustainable transportation policy for university area will not only create a more livable university area but also contribute to the overall sustainability of the city [3].

One of the oldest university in Indonesia which posited in Yogyakarta, Universitas Gadjah Mada (UGM), has high number of students which increase over time. The increasing number of students enrollment are associated with high number of motorized vehicles in campus area as students tend to choose motorized vehicles for their mobility. University students are a group that tends to use various types of travel mode, including large proportion of active transport used. Active transports can be alternative way for bringing sustainable context in the university. Walking, cycling, and using public transport are considered as active forms of transport since these type of modes involve physical activity

Moreover, according to Gatersleben and Appleton [4], student population were the easier group to target for active commuting since they mostly could not afford their own vehicles and do not like to rely on infrequent bus services. Thus, active modes can provide an excellent form of flexible transport for them.

Most people lived very close to their daily destinations and traveled less by motorized vehicles [5]. University students come from various regions, thus forced them to live in temporary residence. In choosing their residences, distance to the campus becomes student's main consideration [6]. Therefore,



majority of students who comes from other region will live in campus surrounding. Relatively close to campus however does not make high use of non-motorized vehicle. There are also plenty of trips which made by students causing high traffic in UGM area. Student mobility following with their complex travel behavior, indeed become one of contributor for the traffic in the area. The daily travel of people to and from campus in motorized transports is one of the biggest impacts which an academic institution can put on environment [7].

This paper tried to identify the potential for increasing active commuting in UGM by understanding student travel behavior. Student travel behavior are identified through their travel characteristics as well as their perception towards the barriers and motivators to actively commute. Results of what actually motivate and/or hinder students to actively commute will be used to propose several suitable strategies for increasing the levels of active commuting among students in UGM.

## 2. Literature Review

### 2.1 Sustainable Transportation

The University environment tends to have an economical attractiveness, which then resulting on the emergence of various businesses in surrounding area to support university member's activities. The development of university's surrounding area causes mixed activity that triggers complex mobility within university area. In fact, commuting is the single largest impact which a university might have on the environment [8]. Moreover, many university-related activities also contribute significantly on the environment, including transportation [9]. Therefore, implementing sustainable concept in university campuses is needed.

Due to the high number of admitted students each year as well as their number of employee, it is indeed that universities become one of major traffic generators which demand on wide parking areas. Beside of its loss of natural environment and noise disturbance, expropriation of visual environment for parking provision is main environmental impacts of transportation on universities [8]. Based on Velazquez et al. [10], a sustainable university will encourages a less of negative environmental, economic, societal, and health effects in the use of resources for university's activities in order to help community for achieving a sustainable lifestyle. Thus, a university is responsible in managing their university members to commute effectively for creating sustainable campus.

### 2.2 Active Transports

One way to reduce the automobile use can be done by encouraging people to shift into more sustainable travel modes. Active transport is one of the most possible alternative to replace motorized vehicles. Active transport refers to walking, cycling, and the use of other non-motorized vehicles which then being defined as human power based transports [11]. However, trips using public transport were also considered within active transport due to walking on access or egress roads [12].

Active transport offers various advantages both to individuals and even the broader communities. Beside its low emission consumption, some studies found that people who travelling more by active transports possess better physical and mental health [13]. Moreover, improving active transport also have a possibility to achieve social equity since walking and cycling are often being used by physically, economically, and socially disadvantaged communities [11].

### 2.3 Motivators and Barriers to Actively Commute

Many previous studies have been identified several factors influencing active commuting, particularly factors which will motivate and/or deter individual to actively commute. Nkurunziza, Zuidgeest, Brussel, & Maarseveen [14] defined factors which may affect cycling behavior in Dar-es-Salaam into three distinct categories, which are individual factors, socio-environmental factors, and physical environmental factors. Individual factors refer to cultural factors, the social norms of the community, and behaviors considered normal or appropriate. While the physical environment is represented the natural (topography, climate, geography, and others) and built physical environments (land use patterns and transport infrastructure). The findings discovered that low bicycle price, quality of bicycle, and

cycling training were the major influencing perceived motivators on cycling commuting. In the other hand, factors such as weather, lack of safe parking, lack of cycling paths, water showers, social status, social insecurity, and not being comfortable on a bicycle were found as the most negative influence which impeding people to cycling. Moreover, regarding the interventions factors, exemption of bicycle tax, car congestion charges, and guarding bicycles at public places were the most important policy interventions. Meanwhile, in another study conducted by Nkurunziza, Zuidgeest, & Maarseveen [15] who also investigated cycling commuting in Dar-es-Salaam, the availability of bicycle paths and special bicycle infrastructure gave bigger motivation to people to cycling.

Regarding barriers to actively commute, travel time and distance were identified as the most important barrier in an Australian study [2]. Improvement to health, potential to save money, and avoid the need to find parking were reported as motivating factors among university communities. Meanwhile, an introduction of a U-Pass for using public transport was considered as the most likely intervention to influence travel behavior for active commuting. However, regardless its findings, the study also involved several other motivator and barrier items. Infrequent public transport between residential and university, weather, the need to run errands, cheap parking at the university, lack of continuous cycle path, danger from vehicular traffic, lack of secure bike parking at the university, and involvement of physical effort were another example of barrier items included in the study. Whilst a contribution for reducing air pollution, socialize opportunity, and the difficulty in obtaining parking permit were identified as potential motivators included in the study as well.

Moreover, study on university students which examined the association of environmental, social, and personal factors on cycling commuting was conducted by Titze, Stronegger, & Janschitz [16]. This study included traffic safety, bicycle theft, availability of bike lanes, clothes, and mobility as several factors correlates with cycling. Meanwhile, a similar study further explored factors associated with active commuting to the university in Spain. The findings revealed that access to motorized vehicles, walking and cycling facilities, and psychosocial barriers were significant correlated to active commuting [17]

### **3. Research Methodology**

Data was collected by randomly disseminating questionnaires to active students in UGM through social media, personal messages, and electronic mail. The questionnaire consisted of two sections. In the first section, questions related with socio-demographic information were asked. Then, in the further section, respondents were asked to measure several motivator and barrier items for revealing the importance level of those items in encouraging and/or impeding them to use active transport modes in their trips to university.

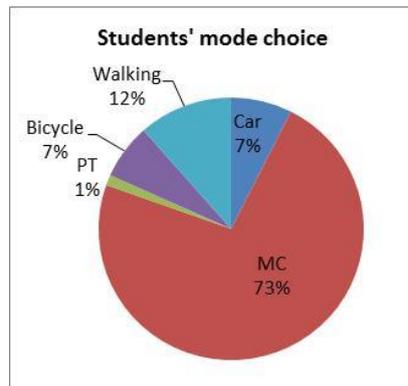
The motivator and barrier items were rated by using a Likert scale of 1-5; 1 being 'not at all important' or 'not at all likely' and 5 'very important' or 'very likely'. In order to understand the possible active transport mode based on students' residential distance, the region was divided into three zones (Zone 1: < 1 km away from UGM, Zone 2: 1-5 km away from UGM, and Zone 3: >5 km away from UGM). Residential distance below one kilometer away from campus was chosen to represent a feasible walking distance which also can be reached by bike. While residential distance within one to five kilometers away from campus represents a feasible cycling distance. Finally, distance of more than five kilometers away from campus will have public transport as travel choice to actively commute.

As the purpose of this paper is to identify the potential for increasing active commuting level based on students current travel behavior, data interpretation become important where some trends and facts will be revealed which may useful for further analysis. To begin the data analysis process, descriptive statistics were calculated to summarize and describe the data obtained. The analysis was executed by using one-way ANOVA test which can be used to identify the different perceptions of motivators and barriers toward active commuting behavior among students. This finding will be used to propose strategies for increasing active commuting level in UGM.

## 4. Results

### 4.1 Travel Characteristics

Most of students reported motorcycle (73%) as their mode choice for university travel. While car only accounted for about 7% of students' travel mode. Accordingly, there were 80% of the students using motorized vehicles for the university trips. In contrast, there were only few students who reported active transport as travel modes. Walking, cycling, and public transport were reported to be used by 12%, 7%, and 1% of the students respectively.



**Figure 1.** Proportion of mode choice among students

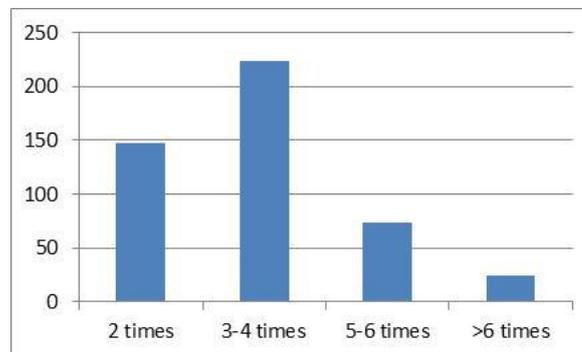
Regarding their residential location, result showed that walking and cycling were quite high for those living in Zone 1 and Zone 2, most likely because this zone is feasible to be reached by this type of travel modes. Meanwhile, it is no doubt that in Zone 3, only less than 2% of students using public transport and bicycle, and none of them walking to campus. In addition, public transport use was generally not popular among students within all zones. It is only reported less than 4% of students in all zones.

**Table 1.** Main mode of transport among students based on residential distance zone (%)

Mode Choice	Distance		
	Zone 1 (<1 km) n = 137	Zone 2 (1-5 km) n = 213	Zone 3 (>5 km) n = 120
Car	3.6	7.0	12.5
Motorcycle	55.5	77	85.8
PT	1.5	1.4	0.8
Bicycle	8.8	8.9	0.8
Walking	30.7	5.6	0

Figure 2 illustrate trip frequencies made by students in a day. The figure show that most students generated an average 3-4 trips/day (47.66%) followed by 31.28% of them generated 2 trips/day. However, there is sizeable proportion of students who generated an average 5-6 trips/day. Students with

high mobility needs tend to avoid in using active transports, hence they will choose motorized transport as their travel mode.



**Figure 2.** Daily trip frequencies of students

#### 4.2 Motivators ad Barriers for Active Commuting

In order to elaborate students' perceptions towards active commuting behavior according to their travel distance to the university, the motivator and barrier items were analyzed toward residential distance zone categories. There were significant differences for several motivator items across three zones. Significant differences were occurred in motorized free vehicle area ( $F(2, 414) = 3.651, p < 0.05$ ); parking restrictions ( $F(2, 414) = 3.483, p < 0.05$ ); and protected lanes from weather ( $F(2, 414) = 3.241, p < 0.05$ ). Those within closer residential distance from the university rated these three items higher than those living far from university. This finding also reveals that students more motivated with pushed measures rather than pull measures.

Table 2. One-way ANOVA results for perceptions of motivators between residential zones

Motivators	Zone 1 (<1 km)		Zone 2 (1-5 km)		Zone 3 (>5 km)		Total		F	p-value
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
Lanes are protected from weather	4.73	0.621	4.55	0.725	4.51	0.743	4.59	0.705	3,241*	0.040
Safe parking area	4.59	0.692	4.54	0.732	4.57	0.673	4.57	0.704	0.170	0.844
Environmental awareness	4.54	0.721	4.41	0.837	4.44	0.753	4.46	0.784	1,016	0.363
Health	4.44	0.828	4.39	0.788	4.41	0.786	4.41	0.798	0.176	0.838
Saving expenses	4.43	0.876	4.32	0.860	4.20	0.945	4.32	0.889	1,769	0.172
Presence other active commuters	4.29	0.844	4.14	0.848	4.22	0.835	4.21	0.844	1,168	0.312
Bike shelters and campus bike	4.18	0.967	4.15	0.994	4.06	0.994	4.13	0.985	0.464	0.629
Car free day	4.12	0.980	4.01	1,037	3.93	0.983	4.02	1,007	1,032	0.357
Motorized vehicle free area	3.88	1,185	3.57	1,163	3.49	1,148	3.64	1,173	3,651*	0.027
Parking restrictions	2.79	1,296	2.59	1,271	2.35	1,186	2.59	1,264	3,483*	0.032
Paid parking	2.28	1,353	2.29	1,319	1.98	1,192	2.21	1,301	2,192	0.113

\*F = ANOVA score,  $p$  = Significance level,  $* \leq 0.05$

For barrier items, there were also significant differences across three zones, including travel distance and travel time. Moreover, the biggest significant differences were also occurred in these two items (travel distance ( $F(4, 414) = 14.085, p < 0.001$ ); travel time ( $F(4, 414) = 8.939, p < 0.001$ )). Furthermore, barrier items associated with public transport services, the coverage area and frequent

service, were also reported with high importance for impeding students to actively commute with statistically significant differences between those in Zone 1 and 3. This reveals that students in Zone 1 and 2 have slight similarity in perceiving barriers for active commuting. The perception toward barriers are incrementally increased in hindering them to actively commute.

Table 3. One-way ANOVA results for perceptions of barriers between residential zones

Barriers	Zone 1 (<1 km)		Zone 2 (1-5 km)		Zone 3 (>5 km)		Total		F	p-value
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
High mobilities and activities	4.34	0.82	4.37	0.83	4.39	0.81	4.36	0.82	0.094	0.910
Travel distance	3.88	1.20	4.17	0.97	4.56	0.80	4.19	1.03	14.085***	0.000
Covered area of PT services	3.98	0.98	4.12	0.84	4.30	0.85	4.12	0.89	3,573*	0.029
Longer travel time	3.95	0.92	3.97	1.01	4.41	0.81	4.08	0.96	8,939**	0.000
Infrequent PT services	3.94	0.97	4.14	0.90	4.25	0.87	4.11	0.92	3,394*	0.035
Clothes	3.53	1.08	3.74	1.11	3.72	1.00	3.67	1.08	1,621	0.199
MT vehicle access	3.44	1.08	3.69	1.02	3.83	1.00	3.66	1.04	4,286*	0.014
Social status	3.12	1.31	2.80	1.36	2.35	1.24	2.78	1.34	9,704**	0.000

<sup>a</sup>F = ANOVA score, *p* = Significance level, \*  $\leq 0.05$ , \*\*  $\leq 0.001$ , <sup>a</sup> = Levene's test for homogeneity of variance has been violated ( $p \leq 0.05$ ) so the Welch test (adjusted F) has been used instead

### 4.3 Strategy Implications

It is clear that a variety of different strategies are needed to be adopted in order to increase active commuting among students in UGM. The potential to shift into active transports among students is not dependent solely on making active transport more attractive but also restricting the use of motorized transports. Moreover, the proposed strategies have to be compiled based on which conditions might motivate or hinder students to perform active commuting behavior. Some strategies which will effectively increase the level of active commuting among students in UGM can be suggested as a result. The strategies that could be employed to increase the level of active commuting among students in UGM as well as some supporting evidences will be discussed in below.

#### 4.3.1 Reducing barriers to actively commute

Results revealed that most of students are currently non-active commuters. Generally, non-active commuters perceive more barriers than active commuters. Therefore, reducing barriers to actively commute is proposed as the first intervention in order to target this large proportion of students. Giving more attention to personal barriers can be more important than providing infrastructure. Some approaches reducing the perceived barriers to actively commute are needed.

The biggest barrier to actively commute for students is having high mobility and activities which then forced them to run errands in several destinations during the day. UGM has sprawl characteristic with a large area which then engender its community to commute from one point to another point within campus area in difficult ways. It is needed some approaches in order to reduce this barrier for active commuting. One of the possible strategy can be through developing the university to be more compact area. Specifically, it is important to integrate the clusters in the university as there are distances between clusters. Building integrated bridge or lanes which connecting inter-faculty buildings within campus may give an easy access for university communities to visit one to another points.

Travel distance and time were also perceived as biggest barriers to actively commute among students. Even though a sizeable proportion of students are already living close to campus, distance and time still play an important role in the their travel mode choice which discouraging them to choose active modes as their travel mode to the university. Therefore, community designs that provide networks for bike and pedestrian lanes connecting campus with residential areas that have a high student population, are highly recommended to reduce the perceived barriers of travel distance and time. It is also indicated

that improving the built environment along walking and cycling network lanes may help to reduce the perceived barriers of time and travel distance.

Meanwhile, it is reported that students living in Zone 3 also perceived travel distance and time as most important factors to deter them for using active transports to the university. This group only has public transport as suitable option for active commuting activities. TransJogja, as the most reliable public transport service in Yogyakarta, has number of shelters in campus area. However, students still have to walk for long distances in accessing the services, particularly for those in east campus (cluster of Sosio-Humaniora and cluster of Agro) as there is no shelter in this area. Therefore, to decrease the perceived barriers of travel distance and time targeting those living in Zone 3, the need to add number of shelters in the campus area is suggested to be considered by the university in collaborating with regional government as public transport authority for TransJogja services.

Furthermore, it is suggested to introduce campus shuttle bus operating in the university and surrounded area. Bus fleets with environmental friendly technology are highly recommended for the operation. This approach can facilitate students who have high mobility and activities during the day for commuting around campus area. Moreover, barrier of travel distance and time can be also reduced through this approach as students will have an easy access to reach all university and surrounded area.

#### *4.3.2 Improving public transport services*

According to its transportation master plan document, it is clear that UGM already realized that it is impossible to prohibit the use of car or motorcycle in the campus area without preparing other alternative modes including its facilities. It is also not feasible to enforce academic communities, especially those who live far from the university, for cycling or using public transport from their residential place since the current urban transportation policy can not guarantee cyclists' safety on the road and public transport services are not reliable in serving urban mobility. Meanwhile, there are a sizeable proportion of students living in Zone 3 who only rely on public transport services.

Therefore, the idea of improving public transport services is needed to be addressed in order to attract more students of UGM to actively commute. Indeed, it is not things which can be done by the university itself. The regional government, as the public transport authority, need to be involved for implementing this strategies. Therefore, it is important to underline that the development of campus transportation can not stand independently since it is always affected by the urban transport policies.

#### *4.3.3 Improving walking and cycling facilities*

The results in this study demonstrate that active commuters are found to be more attracted by the motivator for active commuting rather than non-active commuters since they are already performing active commuting behavior. These student groups live in both Zone 1 and 2. Therefore, it is suggested for UGM to consider improving walking and cycling facilities in campus area as well as collaborate with regional authority for improving cycling facilities in Yogyakarta area.

Firstly, the improvement strategies will be focused on providing walking and cycling lanes which protected from weather conditions. Results showed that the availability of protected lanes from weather can motivate students to actively commute to university. Therefore, presenting protected lanes from weather condition for pedestrians and cyclists can promote active commuting activities in the university. For executing, developing pergolas and vegetation along the lanes are suggested.

Providing safe bicycle parking area becomes the second improvement strategies which can be employed in UGM as it was an important motivator for students to encourage them actively commute. Students concerned about the availability of safe bicycle parking area as an important motive for them to actively commute, particularly cycling to the university. Moreover, providing bike campus to be rented by university communities which already implemented by UGM, can give an access to bicycle among those who do not own a bike which then may promote more bicycling in university environment. Therefore, providing more campus bikes and shelters as well as improving regulation for renting bike campus facilities are suggested in order to increase active commuting, particularly cycling, among students.

Finally, it is important for UGM to collaborate with the regional authority of Yogyakarta to implement several regulations in order to ensure the cyclists' safety in the road. It is known that the existing condition of cycle lanes in Yogyakarta are still mixed up with other motorized vehicles.

However, by developing some alternative lanes in which involving residential areas could reduce the potential for cyclist to combat with motorized vehicle users. Moreover, socialization for prioritizing pedestrians and cyclists in the road are also suggested to be done among the citizens of Yogyakarta.

#### *4.3.4 Introducing programs to discourage motorized vehicle-use*

Implementing strategies to create an active commuting behavior in campus area through reducing the convenience and cost-effectiveness of driving have been introduced in many universities [18]. It also suggested further to employ a comprehensive approach includes both “carrot and stick” strategies, in which encouraging people to consider issues other than travel time, such as the cost of commuting [2]. At the beginning, the schemes are suggested to be implemented by UGM through introducing car free day program and increasing motorized vehicle free area in the university. These two conditions were found to be considered by students as important motives to actively commute and they also feel to be more encouraged for using active modes if the university employed these interventions.

It is also argued to support the cost effectiveness of improving walking and cycling facility schemes by increasing the cost of driving. Paid parking can be a strategy to be considered thereby the cost of driving would be rising up. Therefore, the further schemes that could be implemented by UGM after active transport facilities have been upgraded are implementing several push measures such as parking restrictions and paid parking schemes. By increasing the cost of driving both economically and efficiently through paid parking and parking restrictions, active commuters are expected to be increased..

## **5. Conclusions**

This study was focused on the potential to increase active commuting among students in UGM. Findings revealed that majority of students are using motorized transport as their travel mode to the university. However, there are a potential to increase the level of active commuting since the majority of students are living within walking and cycling distance. Regarding motivator for active commuting, students within closer residential distance from the university rated the items higher than those living far from university. This finding reveals that students more motivated with pushed measures rather than pull measures. While for barrier items, students in Zone 1 and 2 have slight similarity in perceiving barriers to actively commute. However, the perception toward barrier is incrementally increased in hindering them to actively commute.

In order to increase the level of active commuting among students, several strategies are proposed to be implemented by UGM. The proposed interventions are consists of four main strategies. First, it includes strategies in reducing the barriers to actively commute, specifically by developing the university to be a more compact area, improving supporting facilities in the faculty area, building a network for bike and pedestrian lanes connecting campus with residential areas that have a high student population, improving the built environment for walking and cycling, increasing the number of TransJogja shelters in the university area, and introducing campus shuttle bus. Second, it is needed to improve public transport services, particularly increasing the frequency of the bus services and increasing the coverage area of bus services. Third, it is suggested to consider improving walking and cycling facilities, particularly providing walking and cycling lanes which protected from weather conditions, providing safe bike parking area, providing more campus bike and its shelters, developing alternative routes for cyclist in the city, and carrying out socializations among citizens of Yogyakarta for prioritizing cyclists and pedestrians. Finally, it is necessary to introduce programs for discouraging motorized vehicle-use such as introducing car free day program, increasing motorized vehicle free area in the university, implementing parking restrictions and paid parking schemes, and carrying out socializations among students regarding the disadvantages of motorized vehicle use and the benefits of active commuting.

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