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ANALYSIS OF STUDENT PERCEPTION ON INFRASTRUCTURE AND WILLINGNESS TO CYCLE

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ABSTRACT

Understanding the role of the built environment in decisions to bicycle may lead to positive infrastructure policy. Several studies support the notion that providing bicycle infrastructure, particularly lanes and paths, can increase bicycle use. Many of these studies, however, rely on aggregate data, making it difficult to examine the direct relationship between infrastructure and behavior.

The aim of this paper is to identify the arrangements of bicycle infrastructure at Universitas Indonesia (UI) Campus Depok, and to provide recommendations to fulfill the needs of cyclists so as to encourage cycling on campus.

Bicycle infrastructure at the Universitas Indonesia Campus receives good ratings. The findings indicate that the quality of facilities strongly influences respondents' assessment, followed by perceptions of reliability, convenience, accessibility, and security. The willingness to use a bicycle as a mode of transport on campus is influenced by reliability and accessibility.

This paper concludes that UI has the opportunity to become a more bicycle-friendly campus, and that greater cycle ability can be achieved by planning, investment of funds for infrastructure development, and programs aimed at improving safety and enhancing convenience.

Keywords: Cycling; Green transport; Student perception; University campus

1. INTRODUCTION

Cycling, also called bicycling or biking (Oxford English Dictionary, 1989) is the use of bicycles for transport, recreation, or for sport. Persons engaged in cycling are referred to as cyclists, bikers, or less commonly, as bicyclists.

Various assessments of the impacts of bicycling on levels of physical activity, obesity rates, cardiovascular health, and morbidity have concluded that cycling is a healthy activity (anderson et al., 2000; Bassett et al., 2008; Bauman et al., 2008; Cavill et al., 2006; Dora & Phillips, 2000; Gordon et al., 2009; Hamer & Chida, 2008; Huy et al., 2008; Matthews et al., 2007; Roberts et al., 1996; Shephard, 2008).

An extensive and rapidly growing literature suggests the need to facilitate bicycling through appropriate infrastructure such as bicycle lanes and bicycle parking facilities. Countries and cities with high levels of bicycling and good safety rates tend to have extensive infrastructure in

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conjunction with pro-bicycle policies and programs, whereas those with low bicycling rates and poor safety records have generally done much less to promote cycling (Pucher & Dijkstra, 2003; Fietsberaad, 2006; Pucher & Buehler, 2005).

University areas or campuses are unique places where people from different backgrounds, socioeconomic backgrounds, and attitudes gather for studying, working, and relaxing (Ojeda & Yudell, 1997; Balsas, 2003). In terms of planning, campuses include a mixed use of educational, recreational, residential, and commercial areas that facilitate trips over short distances (Toor & Havlick, 2004), particularly in the movement from routine areas to gathering places such as libraries, places of worship, sports complexes, and student activity centers.

Bicycle infrastructure has been developed previously in several campuses showed that increasing supporting infrastructure such as special bicycle lanes was associated with increased number of bicycle users.

Moreover, Akar and Clifton (2009) at the University of Maryland concluded that the provision of bicycle lanes, bicycle parking near actual buildings, and bicycle signage encouraged both regular and non-regular cyclists to use bicycles on campus.

The Universitas Indonesia (UI) campus is generally characterized by higher density and motorcycle oriented. However, the campus environment provide opportunities to observe cycling behavior within a relatively small area that has high variance of transport services. Enrollment at UI as shown rapid increase in recent years (currently in excess of 40,000 students), resulting in higher demand for cycling facilities.

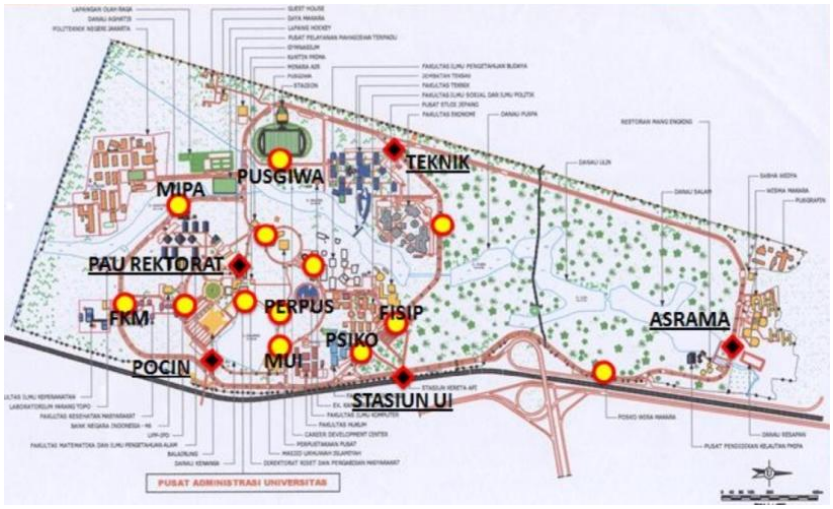

Figure 1 Locations of bicycle lanes and parking facilities at Universitas Indonesia campus, Depok

Bicycle infrastructure at UI campus Depok, inaugurated since 2007, bicycle has become an alternative mode of transport for the campus's academic community. A bike-sharing scheme enables students to borrow a bicycle from one of 18 shelters (shown in Figure 1), typically located next to faculty buildings and the campus entrance of campus (see Figure 2).

Universitas Indonesia provides supporting facilities, such as bicycles that are available from shelters, and bicycle lanes parallel to the main road. The cycle network covers a total distance of approximately 9,000 m; the lanes are 2.1 m wide and surfaced with square, textured paving-blocks as shown in Figure 3, and there are some intersections with the main road and pedestrian facilities, as shown in Figure 4.

Figure 2 Bike-pool parking and shelter, Universitas Indonesia

Figure 3 Bicycle lanes

Figure 4 Crossing facilities

Given the growing consensus on the benefits of bicycling, the question is how to increase the modal share of cycling at Universitas Indonesia, and to encourage students towards the benefits of using a bicycle as the healthiest and most environmentally friendly way of getting around the campus. A quantitative survey was conducted to evaluate the current situation and the potential for increasing the modal share cycling. The purpose of this research was to investigate infrastructure condition and the potentials of growth in cycling habits of students.

2. METHODOLOGY

Many factors encourage or support the use of bicycles, but a number of factors also represent obstacles or challenges for cyclists (Moritz, 1997; Skinner & Rosen, 2007).

Similarly to the concept of walkability, which is characterized by features ranging from safety to attractiveness, bikeability can also be evaluated using these concepts. It is suggested that both walking and cycling modes can serve multiple but similar purposes, including leisure, recreation, exercise, commuting, and shopping (Saelens, 2003).

Shay et al. (2003) generalize five infrastructure factors for cycle ability: Facility; Accessibility and convenience, such as proximity to multiple destinations; Connectivity, intersections and efficiency to destinations; Aesthetic aspects, involving pleasant environment, attractive architecture, landscaping and street trees in the majority of streetscapes; the final factor is traffic calming or road safety, which can be operationalized as tree canopies, street lighting, and design approaches that limit vehicular speeds.

So after summarized from various sources as for factors that can affect a person's decision in choosing a bicycle as a mode of transport either supportive or obstruction five standards namely safety, convenience, accessibility, reliability, and facility were reviewed (Skinner & Rosen, 2007; British Medical Association, 1992; Goldsmith, 1992; Jensen et al., 2000; Jones, 2005, Komanoff & Pucher, 2003; Stinson& Bhat, 2004), and combined strategically to fit the context of a campus-setting.

A randomized quantitative questionnaire was conducted in 2014 among student cyclists at Depok campus, Universitas Indonesia, in order to understand students' decisions on whether or not to use a bicycle to reach destinations around the campus. Survey participants were questioned on their current situation, the potentials and challenges of cycling while on campus and whether or not they have experience of cycling to their classes. All the questions were assessed via a six-point Likert scale. The responses were analyzed via descriptive statistical and non-parametrical methods to determine the correlation with linear regression.

3. RESULTS

In total, a total of 204 questionnaires were completed by students who use a bicycle for their activities around campus. Of the students whose ride bicycle, 47% travel to university by public transport and 42% student walked to university, most of the student cycling more than 3 times a week. As shown in Table 1, 68% of participants use the segregated bicycle lanes (those separated from the highway) for trip distances of less than 800 m.

Table 1 Respondents' travel behaviors

Transport mode to UI Campus	
Walking	42%
Public Transport	47%
Car	9%
Motorcycle	2%
Frequency	
More than 3 times a week	40%
1 – 3 times a week	37%
Less than 4 times a month	23%
Trip Distance	
< 500 m	36%
500 – 800 m	32%
800 – 1500 m	23%
> 1500 meter	9%

As shown in Table 2, the average response to each factor (20 questions; six-point Likert scale) with greater than 3, indicating that the respondents expressed a tendency to agree on some aspects of the statement about bicycle infrastructure at the Universitas of Indonesia.

The reliability factor has an average value of 4.65 with a modus value of 5 (Agree) on each statement. Conversely, the convenience factor is ranked lowest with average value of 3.88, particularly on statement 7 (that the bike lane is not used by pedestrians), which are part of the convenience factor has the lowest average value of 2.71 modus is 2.

Furthermore, the 20 statements presented to the statement on which bike means Green Campus UI support movement that is part of the facility factor has the highest average value that is equal

to 5.1 the value of the modus 6. It can be stated most of the respondents are very agree on this statement.

Table 2 Respondent statements

Factor	Perceived Importance	Mean		Modus
Safety (X1)	Good signage	3.83	4.15	5
	Free from cars and motorcycles	4.47		5
	Safe lane to ride bicycle and to cross the road	4.34		5
	Component of bicycle are safe (maintain to prevent breakage, etc.)	3.94		4
Convenience (X2)	Suitable topography	4.38	3.88	5
	She did bicycle path	4.62		5
	Convenient to ride bicycle (no pedestrian conflict)	2.71		4
	Convenient bicycle lane	3.82		5
Accessibility (X3)	Availability and accessibility of shelter	4.35	4.31	5
	Proximity to trip origin and destination	4,47		5
	Suitable service time	3.84		5
	Continuity and connectivity of bicycle lanes	4.60		5
Reliability (X4)	The easiest and quickest way	4,04	4.65	5
	Reliable of bicycle facilities	4,37		5
Facility (X5)	Good condition of bicycle shelters	4.09	4.31	5
	Good surface condition of bicycle lane	4.12		5
	Good condition of bicycle	3.92		4
	Encouraging green campus	5.10		5
Infrastructure	Availability of good condition infrastructure	4.25		4
Mode choice	Willingness to ride bicycle	4,61		5

Moreover, analyzing of F-test to investigate the influence of the independent variables with the dependent, with Hypotheses of the test F are:

H_0: The various factors describing the available infrastructure (safety, convenience, accessibility, reliability, and facilities) have no significant effect on willingness to use a bicycle for on-campus trips.

H_1: There is significant simultaneous influence of several factors (safety, convenience, accessibility, reliability, and facilities) to the availability of infrastructure and the willingness to use a bicycle for on-campus trips.

The data were analyzed using analysis of variance (ANOVA), and the findings are presented in Table 3.

- The sample size was 204, so that the obtained value of F table is used as the basis of determining the hypothesis was 2.41
- For the first ANOVA of the availability of infrastructure, the calculated F-value obtained for all factors (safety, convenience, accessibility, reliability, facilities) is greater than the critical value for 204 samples, so that H_0 is rejected: the factors have a significant

combined influence (safety, convenience, accessibility, reliability, and facilities) to the condition of infrastructure and willingness to use a bicycle for on-campus trips.

Table 3.ANOVA of factors (safety, convenience, accessibility, reliability, and facilities)

	Model	Y1 (Infrastructure)					Y2 (Willingness)				
		Sum of squares	df	Mean square	F	Sig.	Sum of squares	df	Mean square	F	Sig.
X1	Regression	57.605	17	3.389	3.435	.000	32.018	17	1.883	1.589	.071
	Residual	183.469	186	0.98			183,47	186	1.185		
	Total	241.074	203				252.510	203			
X2	Regression	69.995	15	4.666	5.128	.000	34.665	15	2.311	1.994	.018
	Residual	171.079	188	0.910			217.845	188	1.159		
	Total	241.074	203				252.510	203			
X3	Regression	67.700	17	4.952	4.793	.000	67.586	17	3.976	3.999	.000
	Residual	173.373	186	1.033			184.924	186	0.994		
	Total	241.074	203				252.510	203			
X4	Regression	39.613	8	4.952	4.793	.000	47.259	8	5.907	5.612	.000
	Residual	201.461	195	1.033			205.251	195	1.053		
	Total	241.074	203				252.510	203			
X5	Regression	126.274	16	7.892	12.856	.000	59.496	16	3.719	3.603	.000
	Residual	114.800	187	0.614			193.014	187	1.032		
	Total	241.074	203				252.510	203			

- For the accessibility (X3), reliability (X4), and facilities (X5) factors, H_0 is rejected: there is a significant simultaneous effect on the willingness to use a bicycle for on-campus transport
- For the safety and convenience factor, for ANOVA of Y1, H_0 is accepted: there is no significant effect simultaneously against the willingness to use a bicycle for on-campus transport.

Regression analysis (Table 4) shows that the principal factor influencing infrastructure (Y1) is facility (X5) (regression coefficient 0.84). The reliability factor (X4) also strongly influences the willingness to ride a bicycle (Y2).

Table 4 Relationship of the respondent to the variable

Variable	**Regression model**	**R**	**R square**
Infrastructure	Y1= -0.02+ 0.023 (X1) +0.03 (X2) + 0.14 (X3) - 0.04 (X4) + 0.84 (X5)	0.70	0.49
Willingness	Y2= 1.19 - 0.04 (X1) +0.15 (X2) + 0.19 (X3) + 0.2 (X4) + 0.19 (X5)	0.47	0.22

Cycling has multiple health, environmental, transport, economic and social benefits (Bauman et al., 2008; Byrnes et al., 1999; Garrard et al., 2006). In order to encourage more people into cycling, especially for women, special attention needs to be paid to addressing perceptions of risk associated with road safety (Bauman et al., 2008; Krizek et al., 2005; Garrard, et al., 2008; Garrard et al., 2012).

Table 5 shows categorical regression by gender, showing that male cyclists perceives the facility (X5) and accessibility (X3) factors as the most powerful influences on infrastructure, and facility (X5) as influencing the willingness to ride a bicycle. On the other hand, female

cyclists perceive facility (X5) as the greatest influence on infrastructure and reliability (X4), and accessibility (X3) as influencing willingness to ride a bicycle.

Table 5 Influence of gender and perceptions (M: Male; F: Female)

Variable	Regression model	R	R square
Infrastructure (M)	Y= 0.55- 0.06 (X1) +0.003 (X2) + 0.25 (X3) - 0.04 (X4) + 0.7 (X5)	0.66	0.43
Willingness (M)	Y= 0.733- 0.07 (X1) +0.1 (X2) + 0.09 (X3) - 0.24 (X4) + 0.51 (X5)	0.52	0.27
Infrastructure (F)	Y= -0.84 + 0.21 (X1) +0.05 (X2) - 0.02 (X3) - 0.03 (X4) + 0.9 (X5)	0.77	0.60
Willingness (F)	Y= 1.64 +0.04 (X1) +0.07 (X2) + 0.23 (X3) - 0.28 (X4) + 0.01 (X5)	0.42	0.18

4. DISCUSSION

Safety features received high Cronbach alpha scores for internal consistency (0.888), suggesting that the bicycle environment at UI is relatively safe for its students. Most bicycle lanes on campus are perceived as having good signage, and are designed is dedicated to routes, free of vehicle or traffic. Nevertheless, convenience received the lowest score, as it seems that pedestrians at UI tend to walk in the bicycle lanes, causing difficulties for cyclists.

The condition of bicycle infrastructure needs to be improved. The continuity of the bicycle network needs to be maintained: wider bicycle lanes are better and more convenient, because this lane can somehow become a meeting place for the students as well. The width of the bicycle lanes should be consistent throughout the network. Pillars/trees should not be placed at the center of the bicycle lanes, thereby ensuring that that there are no obstructions along the route.

For the safety and convenience of cyclists, a proper divider should be applied on the cycling route, in the form a bright color, or zebra divider to alert other road users. Other than that, trees should be planted more frequently along the routes, not to provide more natural shades but also as divider between the bicycle lane and the main road.

The provision of bicycle shelters close to popular trip origins and destinations, especially lecture buildings and train and bus stations; and appropriately designed bicycle facilities and street furniture can help to improve convenience for cyclists and encourage modal shift among students, from cars to bicycles. This can also be encouraged by increasing drinking areas along the route and adding more sitting areas or stops for students to rest before continuing their journey, and by adding public restrooms along the routes.

Although the provision of high-quality bicycle infrastructure can initially be costly, as a global strategy to decrease global warming and reduce greenhouse emissions, campus authorities need to help finance university cycling facilities as a long-term beneficial project.

Creation of a safe, convenient, accessible and reliable bicycle system has the potential to increase the number of student who travel by bicycle and, in turn, reduce dependency on cars and motorcycles as the primary modes of transportation. After reviewing perceptions to bicycling at UI Campus Depok it is understandable why so few students cycle and why the majority of university students living off campus travel by motorcycle or car.

5. CONCLUSION

This study assessed the existing bicycle infrastructure in a campus-setting and evaluated its suitability to attract new cyclist. As a campus with sufficient need for cycling by its patrons,

this study provides an audit tool and recommendations for ways in which to enhance the cycling experience across the university campus.

Bicycle infrastructure at the Universitas Indonesia campus received good scores, and several factors have a strong influence on respondents' assessment of the availability of bicycle infrastructure and their willingness to use a bicycle for on campus trips: facilities have a strong influence on the respondents' assessment of the bicycle infrastructure followed by reliability, convenience, accessibility, and security. Reliability and accessibility influence respondents' willingness to choose a bicycle as a mode of transport on campus.

More bicycle shelters might be necessary in order to enhance attraction and convenience for cyclists. The dedicated, traffic-free bicycle lanes scored higher than routes used by both cyclists and pedestrians, indicating that shed-use facilities can increase potential conflict between pedestrian and cyclists.

The idea of green transport can be embedded, so that cycling becomes the preferred mode of transport on-campus than car or motorcycle. It is also recommended that the University website should encourage green transport initiatives, in order to increase cycling and to reduce car dependency.

6. ACKNOWLEDGEMENT

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