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Sustainable Transport in Campus Area: E-Bike

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Abstract

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The increased awareness of the impact of CO₂ emissions and consumption of fossil fuels on the environment has led to world-wide research focused on electric vehicle solutions. University campuses are one of the affected environments involved in this issue as a high dependency on private vehicles causes traffic congestion in the campus area particularly during peak hours leading to concerns about parking especially for the established universities. Therefore, alternative transport solutions should be considered in minimizing the environmental consequences specifically within the campus area. With an adapted technological means, at minimal cost that best suits student capacity, a feasible mode of transport for use within the campus area was visually developed. The emphasis of this new mode of transport is on short journeys around the campus area as well as short commutes from home to campus. The electric bike (E-Bike) will provide an eco-friendly and cost-effective alternative to getting around campus. The objectives of this research are to study the relevance of E-Bike usage within the campus area and to examine the factors that might encourage students to use the E-Bike. A set of questionnaire with the visually developed E-Bike was randomly distributed to 100 students in Universiti Teknologi MARA(UiTM), Alor Gajah, Malaysia campus and data analysis was conducted by using SPSS version 20. The findings revealed that the proposed E-Bike was relevant with the expected benefits perceived by the students. This feasible commuting mode can get people out of their cars, reduce the number of vehicles on campus with lower carbon emissions, promote a healthy lifestyle among students and staff, reduce travel costs and fuel consumption as well as save parking space in campus area to avoid traffic congestion.

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Keywords: Electric-Bike; Electric vehicle; Campus vehicle.

1. Introduction

The increased awareness of the impact of CO₂ emissions and consumption of fossil fuels on the environment has led to world-wide research focused on electric vehicle solutions (McLoughlin et al. 2012) with the university campus being one of the affected environments involved. Apart from that, a high dependency on private vehicles cause traffic congestion within the campus area particularly during peak hours leading to concerns about parking. Therefore, alternative transport solutions should be considered in helping to minimize environmental consequences specifically in the campus area. Previous research focuses primarily on electric vehicles as a solution; however, in the context of the campus environment, a matter of concern is the affordability of the electric vehicle which tend to be expensive (McLoughlin et al. 2012).

For this study, a feasible mode of transport for campus area was developed with an adapted technological means at minimal cost to suit student financial capacity. The emphasis of this new mode of transport is on short journeys taken around the campus area as well as short commutes from home to campus. McLoughlin et al. (2012) mentioned that short journeys by petrol-engined cars are far more polluting till the catalytic converter reaches full operating temperature, making this a good reason to find another mode of campus transport. Supported by literature review in this area, the researchers proposed to develop a new commuting mode feasible in campus which can be more practical with student capacity (in term of cost and physical ability. This is the electric bicycle (the E-Bike) with the new improved sophisticated specifications. The E-bike will allow for a convenient way to get around campus while reducing emissions and, in the end, saving costs and the environment. Not only does the use of electric bikes have a positive environmental impact, the universities benefit from cost savings on gas and vehicle maintenance if it is used by the staff, campus police, mail services officer, and facilities and maintenance personnel. Electric bikes will provide an eco-friendly and cost-effective way to get around campus.

The proposed E-Bike is in line with the six industry sub-sectors identified in the Strategic Reform Initiatives (SRI) Lab for standards development, one of which is green technology based on competitive advantage and the potential to be a global leader in exports. In August 2011, the Malaysian cabinet approved the National Eco Labelling Scheme with the aim of increasing awareness and encouraging the widespread use of environmentally-preferred or eco-products and services among Malaysians (Economic Transformation Program (ETP) Annual Report, 2011). The four main sectors in the National Green Technology Principal include i) Energy Sector, ii) Building Sector, iii) Water and Waste Management sector and iv) Transportation Sector. This study focuses on the transportation sector which comprises adapting green technology elements in transportation facilities and transport (Official portal KeTTHA- Kementerian Tenaga, Teknologi Hijau dan Air, 2015). The objectives of this research are to study the significance of E-Bike usage in the campus area and examine the factors that might encourage students to use the E-Bike. The proposed commuting mode is expected to get people out of their cars, reduce the number of vehicles on campus hence reducing carbon emissions, promote a

healthy lifestyle among students and staff, reduce travelling costs and fuel consumption, as well as save parking space in the campus area to prevent traffic congestion.

2. Problem Statement

The high dependence of motorcycles and private cars (71.5%) have several negative repercussions such as traffic congestion, air pollution and inadequate parking. Other than traffic congestion, parking is one of the current main problems in the University of Malaya. Shoup (1997) and Dober (2000) argued that the major problem with using automobiles is the amount of parking required. In college campuses, parking is a common problem with different slants (Balsas, 2003). Keniry (1995) also state that a university is a group of administrators, faculty and students held together by a common grievance over parking. According to Shannon et al.(2006) when there is a decline in the number of motorized vehicles used especially cars, there will be a decrease in the need for parking areas, enabling such areas to be reused for other facilities that are more beneficial for the environment. Thus, the bicycle is one of the most sustainable forms of transport with no fuel consumption (Gatersleben et al, 2007).

The other concern related to the high dependence of motorcycles and private cars is global warming which endangers health, jeopardizes national security, and threatens other basic human needs. The environmental impact such as high temperatures, rising sea levels, and severe flooding and droughts are already increasingly common. Personal vehicles are a major cause of global warming. Collectively, cars and trucks account for nearly one-fifth of all U.S. emissions, emitting around 24 pounds of carbon dioxide and other global-warming gases for every gallon of gas. About 5 pounds comes from the extraction, production, and delivery of the fuel, while the great bulk of heat-trapping emissions which is more than 19 pounds per gallon come right out of a car's tailpipe. In total, the U.S. transportation sector which includes planes, trains, ships, and freight produces around thirty percent of all U.S. global warming emissions. As oil becomes more difficult to extract, burning gasoline will only become dirtier and using less oil is the real solution. Therefore, this study focuses on exploring the other feasible mode of transport specifically in the campus area.

3. Purpose of the Study

The objective of this research is to study the significance of E-Bike usage in the campus area and to examine the factors that might encourage students to use the E-Bike. The final goal in future research is to propose and develop a new technology-assisted E-Bike which can be used by students as a sustainable mode of transport on campus, thus minimizing the issues of traffic congestion and fossil-fuel emissions and its environmental effects.

4. E-Bike in the campus area

In the early 1980s, electric bicycles or E-bikes originated in Japan with limited market attractiveness until 2000 due to technological and cost factors (Rose, 2012). However with the advancement of technology, the E-Bike has become one of the fastest transportation demands in the transport market with 31 million purchasing power in 2012 (Elliot & Christopher, 2015). Moreover, the E-Bike has been found to have the potential to displace conventional motorized vehicles as it is beneficial in terms of health improvement and safety while being an efficient and convenient form of transportation with zero local air pollution. According to Elliot and Christopher (2015) with wide varieties of cosmetic design, performances and technologies available such as Bicycle-Style E-Bikes (BSEB) and Scooter-Style E-Bikes (SSEB), function and performance (speed) have become a major distinction. As stated by Weinert, Ma & Yang (2006) E-bikes are classified as a “semi”-motorized vehicle as it can be run on either by human power or electricity with an average energy consumption of 1.2-1.5 kWh/100km. However, the most problematic environmental issue concerning electric bikes is the use of lead acid batteries that consists of high lead loss rates during the production, manufacturing and recycling processes.

While the university bus is free of charge, the infrequency causes students to have to wait for a longer time to take the bus. Such factors, among other, cause students to use private vehicles, especially those who live in residential colleges. A high dependence on private vehicles has impacted negatively on the traffic and environment in the University of Malaya campus, causing traffic congestion, air pollution and accidents (Balsas, 2003).

5. Research Methods

Data collection was conducted by distributing 100 questionnaires to the students. Respondents were randomly selected Diploma students from Universiti Teknologi MARA (UiTM), Alor Gajah Campus, Melaka, Malaysia. UiTM Melaka was chosen as a case study to represent the survey of E-Bike usage in campus area. The completed data was analyzed by using SPSS version 20.

6. Findings

Table 1 describes the demographic profile of the respondents with females accounting for 60% and males 40%. The majority of the respondents are in the 18-20 years age group (90%) and all respondents are single in terms of marital status. About half of the respondents are from the Faculty of Business and Management (47%), followed by Communication and Media Studies (20%), Hotel Management and Tourism (19%) and Art and Design (14%). In terms of semester, 34% are in Semester 5 of their studies, followed by 19% in Semester 4, 25% in Semester 3, 2% in Semester 2, and 20% in Semester 1. Out of the total number of respondents, only 8% reported having ailments such as asthma, migraine and scoliosis (abnormal curvature of the spine).

Table 1. Description of the respondent's profile (n=100)

Characteristics		Percentage (%)
Gender	Male	40
	Female	60
Age	18-20 Years	90
	21-23 Years	10
Marital Status	Single	100
	Married	0
Faculty	Business and Management	47
	Communication and Media Studies	20
	Hotel Management and Tourism	19
	Art and Design	14
Semester	Semester 1	20
	Semester 2	2
	Semester 3	25
	Semester 4	19
	Semester 5	34
Have Disease	Yes	8
	No	92

Currently, most of the students in UiTM Alor Gajah Campus (61%) walk from their residential colleges to class. About 21% use public transport as their mode of transport. Public transport in UiTM Alor Gajah refers to shuttle vans and students have to pay about RM1 (0.25 USD) per trip to use the shuttle van service. Some students have their own transport like motorcycles and cars, with about 14% using motorcycles and another 3% using cars. Only 1% currently use the bicycle as a mode of transport from their residential college to classes.

Table 2. Current transport mode from residential college to classes

Mode of Transport	Percentage (%)
Motorcycle	14
Car	3
Walking	61
Public Transport	21
Cycling	1

Table 3 represents the respondents' experience in cycling with 95% reporting having experience and only 5% having no cycling experience. Of those who have experience cycling, 37% reported that they used a bicycle a few years ago while another 35% had cycled a few months ago.

Table 3. Cycling experience

Cycling Experience	Percentage (%)	Last Time Cycled	Percentage (%)
Yes	95	Yesterday	1
		Few days ago	10
		Few weeks ago	17
		Few months ago	35
		Few years ago	37
No	5		

The finding indicates that 85% of the respondents are willing to cycle using the conventional bicycle (Table 4). Most of the respondents reported that saving costs is the reason for their willingness to use the conventional bicycle with 65% saying it was speedier, while 52% and 47% said it was too hot for walking, health reasons and that cycling is fun respectively (Table 5). Other reasons given by the respondents' to indicate their willingness to cycle are to build up leg muscles, save time and as a training session (workout). Among the 15% who are not willing to cycle, they claimed the weather was unsuitable (40%) as Malaysia is a tropical country with rainy and dry seasons, which is sometimes too hot to cycle. The other reasons for unwillingness to cycle mentioned by the respondents are the condition of the terrain which is hilly (33%), followed by limited carrying capacity of bicycle, 24%.

Table 4. Willingness to cycle in campus area with conventional bicycle

Willingness to cycle	Percentage (%)
Yes	85
No	15

Table 5. Reasons of willingness to cycle conventional bicycle (respondents are allowed to choose more than one reasons)

Reasons	Percentage (%)
Too hot for walking	47
Health reason	47
Environment	24
Save cost	65
Fun	47
Faster (Short paths)	52
Limitation of bus route	13
Parking availability	20
Accessibility	17
Other reasons	3

The willingness to used E-Bike in Table 6 marginally increased (96%) as compared to willingness to use the conventional bicycle which is 85%. The proposed E-Bike was found to be relevant with the expected benefits perceived by the students showing the mean score is above 3 for all items (Table 7). This score using 4 scales are 1= Definitely Untrue, 2= Partly Untrue, 3= Partially True and 4= Very True.

Table 6. Willingness to use E-Bike on campus

Willingness to use E-Bike	Percentage (%)
Yes	96
No	4

Table 7. Benefits perceived of E-Bike usage on campus

Reasons	Mean	Sd
Environmental Friendly	3.53	.594
It is convenient	3.26	.564
It is safe	3.10	.692

It is fun	3.46	.673
It is quicker than walking (on campus)	3.63	.562
It is quicker than driving on campus (short path, easy parking)	3.13	.804
It looks “cool”	3.07	.795
It is cheap form of transport	3.29	.729
It makes me feel good	3.28	.700

The finding shows that cost of fuel with less maintenance and speed are found to be significant factors which might encourage students to use the E-Bike, meaning that those who perceive that using the E-Bike can reduce the cost of fuel and incur less maintenance cost are more willing to use E-Bike. Those who believe the E-Bike is faster in terms of short paths as compared to the car are also more willing to use the E-Bike on campus.

Table 8. Factors encouraging willingness to use the E-Bike on campus

Variables	Willingness to use E-Bike		χ^2	p value
	Yes (%)	No (%)		
Cost of Fuel and Less Maintenance				
Reduced cost	95 (97.9)	2 (2.1)	31.629	0.004*
No cost reduced	1(33.3)	2 (66.7)		
Save Environment				
No fuel consumption	94 (95.9)	4 (4.1)	0.085	0.445
Fuel consumption	2 (100.0)	0 (0.0)		
Speed				
Faster	80 (98.8)	1 (1.2)	8.49	0.021*
Slow	16 (84.2)	3 (15.8)		
Parking Area				
Available	85 (97.7)	2 (2.3)	5.043	0.081
Unavailable	11 (84.6)	2 (15.4)		
Technology Assisted				
Additional special features	95 (96)	4 (4.0)	0.042	1.000
No additional features	1 (100)	0 (0.0)		

7. Discussion

Research among University Malaya students on their preference towards cycling in campus indicated that 86.9% of the students are willing to use a bicycle as a mode of transport if they are provided with bicycle facilities in the campus. This concurs with the findings of this study which indicates 85% of the students are willing to cycle on campus. Even though the main transportation mode among the students was motorcycle with 42.5%, 94% of the respondents said that they did have experience cycling (Raja Abdul Aziz, Roza, Adji & Karim, 2011). Moreover, students staying in campus use their private vehicles more to move around in campus compared to public transport. The public transport costs RM 1 (0.25USD) with average frequency of one in every 30. Same goes to UiTM where the students have to spend about RM1 for the shuttle van on campus.

8. Conclusion

In this case study of UiTM, the researchers can conclude that the majority of students are willing to cycle in the campus area. Their willingness showed a slight increase when the researchers proposed the E-Bike usage on campus due to the benefits perceived of using E-Bike as a new mode of transport in the campus area. Therefore, there is a need for the university management to come up with new policies to institute a culture of cycling within campus to encourage students (and staff) to get out off their cars or motorcycles. This can also be done by innovating the conventional bicycle with the technology assisted E-Bike to create a more environmental-friendly campus.

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