Mode Choice Analysis of Commuters in Intramuros, Manila

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Abstract: Mode choice is a very important process in travel demand forecasting. It provides management or direction on the choices and behavior of the commuters based on the mode of transport available in a specific area like intramuros¸ Manila. This study analyzed the mode choice of the commuters in Intramuros, Manila with the use of nlogit model. At first, the data were gathered through interviews of the commuters who are randomly selected in the 5 entrance of Intramuros. Then the data were processed and used in the formulation of utility equation. Based on the result of the study, it was found out that variables which are significant to influence the choices of the commuters are the total time of travel, highest educational attainment, family gross monthly income, and waiting time. These variables would serve as a basis in planning and designing of the right transportation system in Intramuros, Manila.

Keywords: Mode Choice, Travel behavior, Travel time, Utility Function

1. INTRODUCTION

One of the most significant models in transport planning is mode choice. It deals very closely with the human choice behaviour and it has a direct impact on the policy making and decision making. The choices of modes may be determined by the costs, destinations, capacities, and frequencies of the modes together with the nature of the carried goods and their destinations.

Model choice involves separating the predicted trips from each zone to each destination zone into distinct travel modes such as walking, bicycle, driving, train, and bus. It is influenced by the characteristics of the trip maker, characteristics of the journey, and characteristics of the transport facility.

Intramuros, an ancient Spanish district located in the heart of Manila. It is known for its moss-covered Muralla and outstanding architectures of its cathedrals, churches, palaces from the Spanish Era. Although the place is abundant on Spanish-era influences, it is now a home of different government and educational institutions, public establishments and other organizations that occupy the area.

The population of Intramuros has been growing over the years. Recently, it has been recorded that the district has a total population of 10,384 people. With this kind of environment, a lot of people would come and go using various kinds of transport. The need to study the trip characteristics of the people and the mode of transport they are using is very important to determine the travel behavior in the area for proper transport planning and decision making.

The main objective of the study is to analyze the mode choice of commuters in Intramuros, Manila. Specifically, it aims to know the characteristics of the commuters, determine their travel behavior, and establish the utility function of the transport mode they

are using. The study provides information about the characteristics and travel behavior of the commuters that would serve as a basis of the Intramuros Administration for their transport planning and policy making. The study focus is the analysis of the mode choice of the commuters in Intramuros, Manila and it is limited to the mode choice of the transport mode available inside Intramuros. It does not include the commuters' mode choice outside Intramuros, Manila. Moreover, the study only considered 3 main modes of transport in Intramuros which are the walking, pedicabs, and e-trike.

2. METHODOLOGY

There were 100 respondents of the study, which comprise of students, teachers, and employees. They were randomly selected and interviewed in the five gates of Intramuros shown in figure 1.

Figure 1. Location of the survey

The study used a survey questionnaire to gather information which composed of the profile of the respondents and their travel information. Then, these data were processed and converted into NLOGIT format.

In this study, NLOGIT software was used to analyze and determine the utility function of the three transport mode, which are the walking, pedicabs and e-trike. NLOGIT provides programs for estimation, simulation and analysis of multinomial choice data, such as transportation mode data in which commuters choose among a set of different alternatives. It has become the primary statistical package for approximation and simulation of multinomial logit models including willingness to pay.

3. RESULTS

3.1 Characteristics of the commuters

In this study, most of the respondents belong to the age group of 15-19 (28%), 20-24 (25%), and 25-29 (16%) with the youngest is 14 years old and the oldest is 82 years old shown in figure 1.

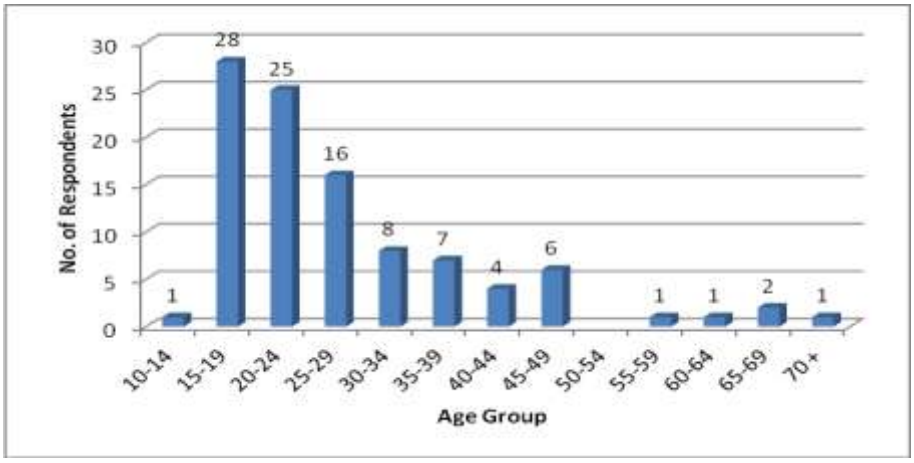

Figure1. Age distribution of the respondents

For the gender of the respondents, 51% are male and 49% are female shown in figure 2. On the other hand, 65% of the respondents are single, 30% are married and 5% are widowed and separated shown in figure 3.

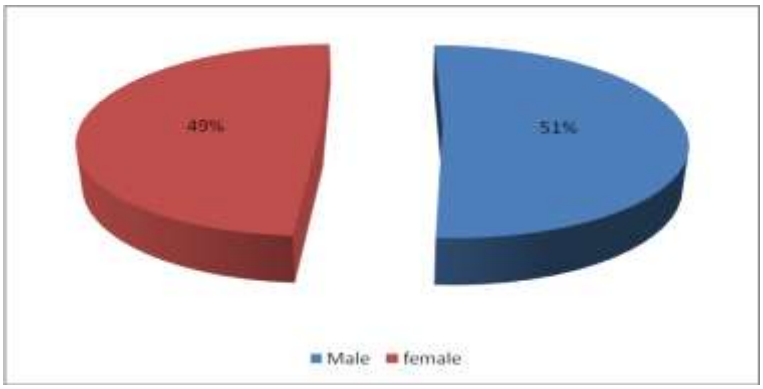

Figure 2. Distribution of the respondent by gender

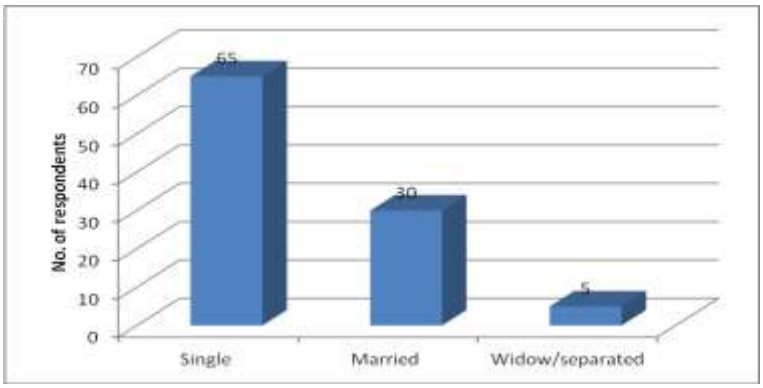

Figure 3. Distribution of the respondents by civil status

With regards to the highest educational attainment of the respondents , Figure 4 shows that most of the respondents are high school graduate which comprise of 46%, then, followed by college graduate which is 42% of the total sample.

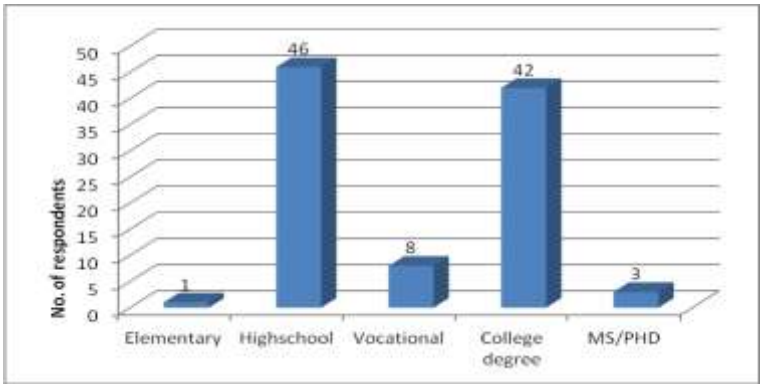

Figure 4. Highest educational attainment of the respondents

Since most of the respondents are students, the individual gross monthly income range with the highest percentage (45%) is below PhP 3000.00, followed by income range of PhP 15,000 - PhP 19,999 (15%), and PhP 10,000 - PhP 14,999 (12%) respectively shown in figure 5. For family gross monthly income, most of the respondents belong to the income group of PhP 40,000 - PhP 59,999 (20%), then followed by PhP 20,000 - PhP 29,999 (13%), PhP 60,000 - PhP 99,999 (12%) shown in 6.

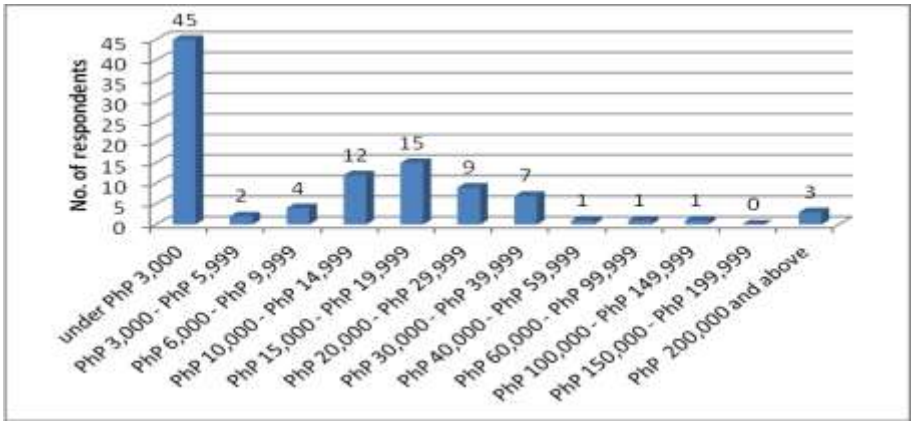

Figure 5. Individual gross monthly income

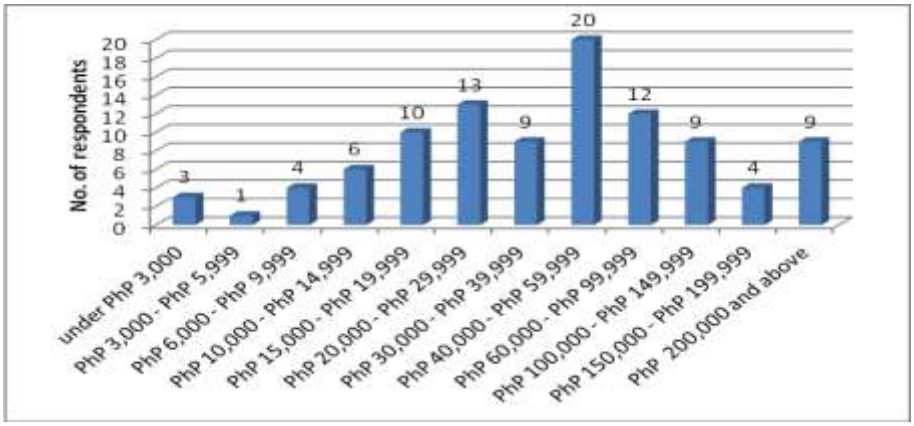

Figure 6. Family gross monthly income

For the trip purpose, most of the respondents are going to school and going to the workplace which is comprised of 46% and 45 %, respectively shown in figure 7. On the frequency of travel to intramuros, the majority of the respondents travel 5 days in a week the mean of 4.46,

standard deviation of 4.43, and standard error of 2.10 shown in table 1 and figure 8.

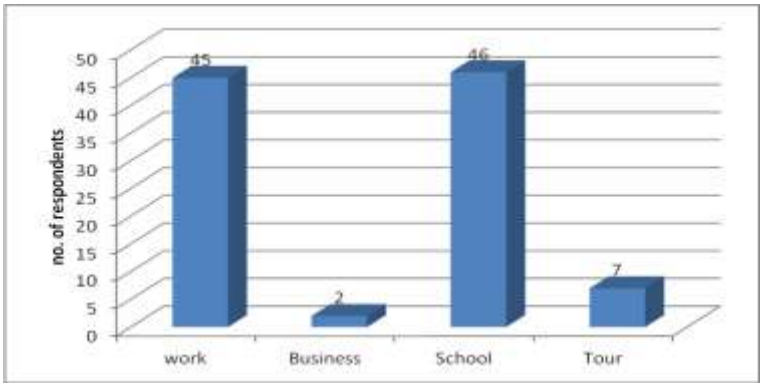

Figure 7. Trip purpose

Table 1. Frequency of Travel

Frequency of Travel (in days)	Number of respondents
1	16
2	7
3	4
4	2
5	45
6	11
7	15
Total	100
Mean	4.46
SD	4.43
SE	2.10

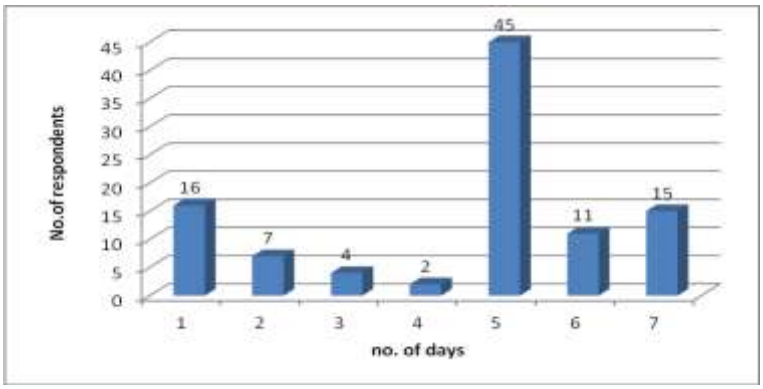

Figure 8. Frequency of travel

3.2 Mode choice of the commuters

Based on the results of the study, table 2 and figure 9 shows that most of the commuters belong to the age group of 15-19, 20-24, and 25-29 year of age chose walking as a mode of

transport inside Intramuros, manila with the following percentages, 16%, 15%, and 10 % respectively.

Table 2. Mode choice by age group

Age	Walking	e-trike	Pedicab	Total
10-14			1	1
15-19	16	5	7	28
20-24	15	5	5	25
25-29	10	2	4	16
30-34	5		3	8
35-39	6		1	7
40-44	3		1	4
45-49	3	2	1	6
50-54				0
55-59			1	1
60-64			1	1
65-69	1		1	2
70 +	1			1
Total	60	14	26	100

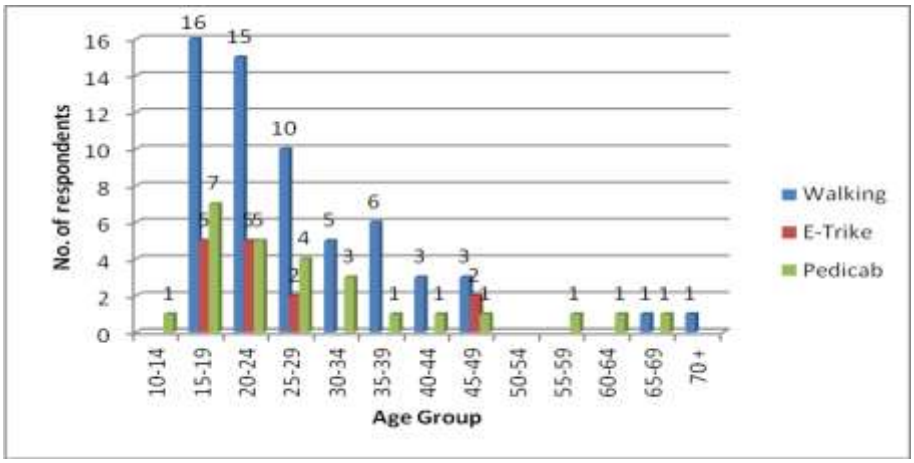

Figure 9. Mode choice by age group

Table 3 and Figure 10 shows the modal split of the commuter by gender. The majority of the female (31%) and male (29%) commuters chose to walk, next to walking is they prefer pedicab than e-trike.

For civil status, most single commuters preferred walking compared to pedicab and e-trike shown in Table4 and figure 10. It is also shown in the figure that besides walking, commuters more like to choose pedicab than e-trike.

Table 3. Mode choice by gender

Gender	Walking	e-trike	Pedicab	Total
Male	29	6	16	51
female	31	8	10	49
Total	60	14	26	100

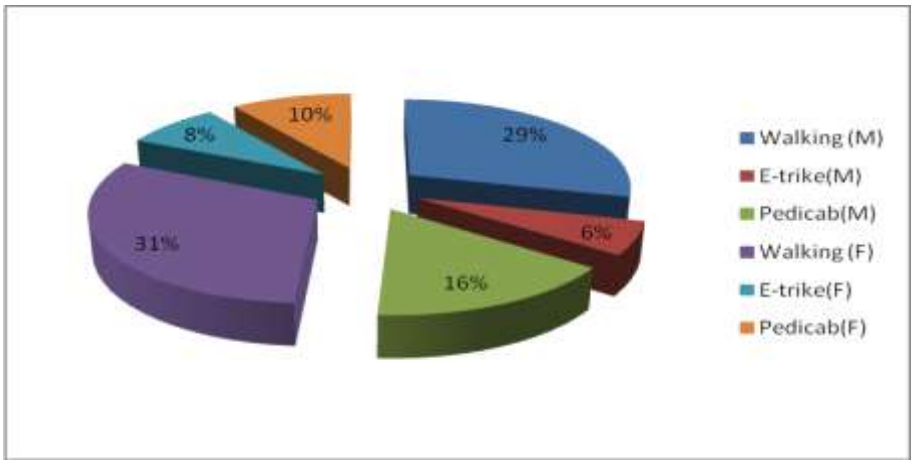

Figure 10. Mode choice by gender

Table 4. Mode choice by civil status

Civil Status	Walking	e-trike	Pedicab	Total
Single	39	12	14	65
Married	19	2	9	30
Widow/separated	2		3	5
Total	60	14	26	100

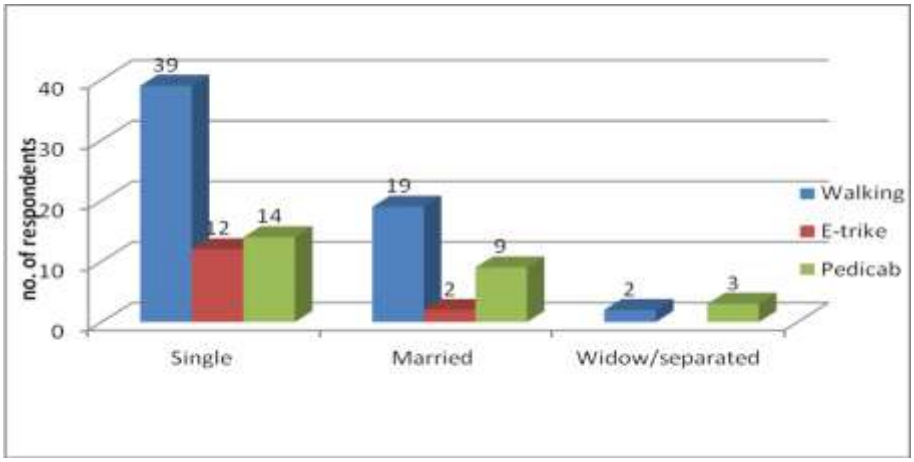

Figure 11. Mode choice by civil status

For highest educational attainment, walking is a dominant mode for high school and college graduate followed by pedicab shown in table 5 and figure 12.

For Individual gross monthly income, most commuters belong to the income under Php 3000.00 range preferred walking compared to other modes shown in Table 6 and figure 13 respectively. It is also shown in the figure that commuters are more like to choose the pedicab than e-trike.

Table 5. Mode choice by highest Educational Attainment

Educational Attainment	Walking	E-trike	Pedicab	Total
Elementary			1	1
Highschool	26	9	11	46
Vocational	4	1	3	8
College degree	28	4	10	42
MS/PHD	2		1	3
Total	60	14	26	100

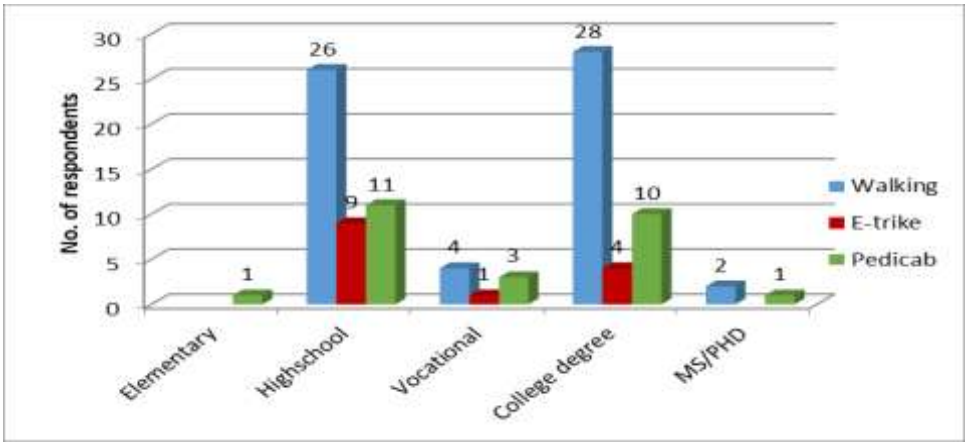

Figure 12. Mode choice by highest Educational Attainment

Table 6. Mode choice by individual gross monthly income

Individual Monthly Income	Walking	E-trike	Pedicab	Total
under PhP 3,000	29	7	9	45
PhP 3,000 - PhP 5,999	1		1	2
PhP 6,000 - PhP 9,999	2		2	4
PhP 10,000 - PhP 14,999	6		6	12
PhP 15,000 - PhP 19,999	11	1	3	15
PhP 20,000 - PhP 29,999	7	2		9
PhP 30,000 - PhP 39,999	3	1	3	7
PhP 40,000 - PhP 59,999		1		1
PhP 60,000 - PhP 99,999			1	1
PhP 100,000 - PhP 149,999	1			1
PhP 150,000 - PhP 199,999				0
PhP 200,000 and above		2	1	3
Total	60	14	26	100

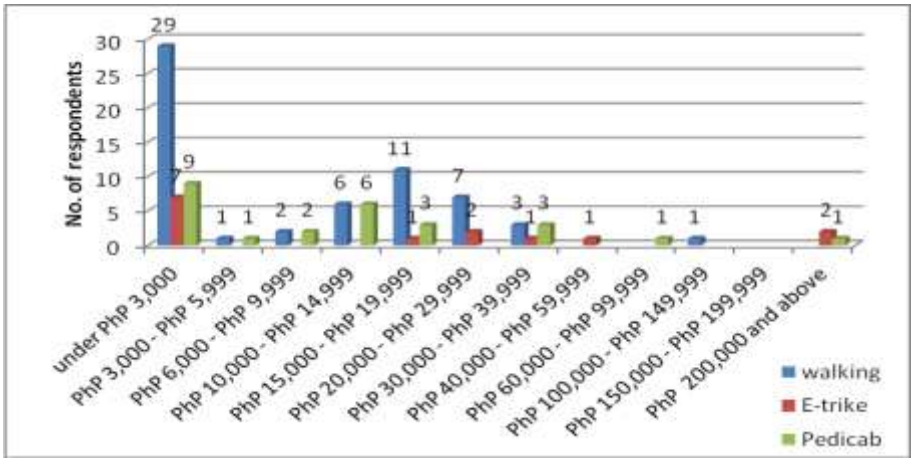

Figure 13. Mode choice by individual gross monthly income

For family gross monthly income, most commuters belong to the family income group PhP 20,000 - PhP 29,999; 40,000 - PhP 59,999; and PhP 15,000 - PhP 19,999 preferred walking as their mode of transport. While PhP 60,000 - PhP 99,999 income group commuters have equal percentages of choosing both walking and pedicab.

Table 7. Mode choice by family gross monthly income

Family Monthly Income	walking	E-trike	Pedicab	Total
under PhP 3,000	2		1	3
PhP 3,000 - PhP 5,999	1			1
PhP 6,000 - PhP 9,999	2		2	4
PhP 10,000 - PhP 14,999	1	1	4	6
PhP 15,000 - PhP 19,999	9		1	10
PhP 20,000 - PhP 29,999	12		1	13
PhP 30,000 - PhP 39,999	7	1	1	9
PhP 40,000 - PhP 59,999	11	3	6	20
PhP 60,000 - PhP 99,999	6		6	12
PhP 100,000 - PhP 149,999	4	3	2	9
PhP 150,000 - PhP 199,999	2	2		4
PhP 200,000 and above	3	4	2	9
Total	60	14	26	100

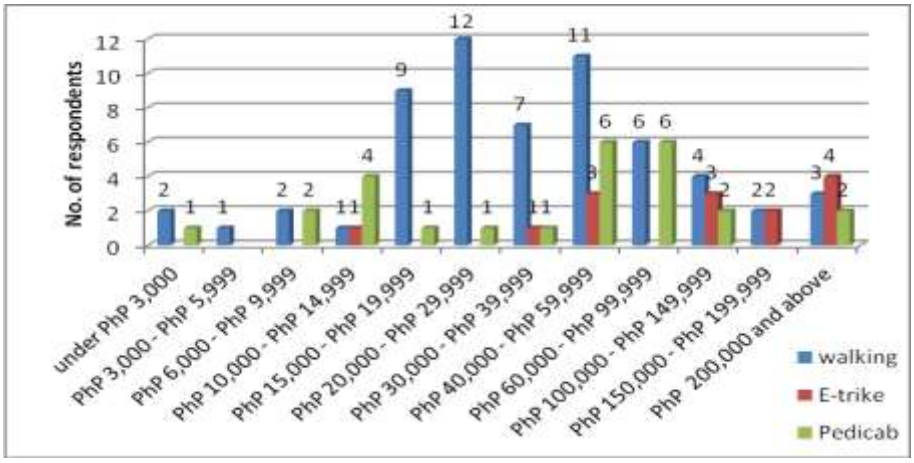

Figure 14. Mode choice by family gross monthly income

In trip purpose, most commuters who are going to school and work preferred walking as their mode of transport. Then, followed by pedicab and e-trike respectively shown in table 8 and figure 15. While on the frequency of travel shown in table 9 and figure 16, still, walking is the most dominant mode of transport in Intramuros, Manila.

Table 8. Mode choice by trip purpose

Trip Purpose	Walking	E-trike	Pedicab	Total
work	27	5	13	45
Business		1	1	2
School	30	7	9	46
Tour	3	1	3	7
Total	60	14	26	100

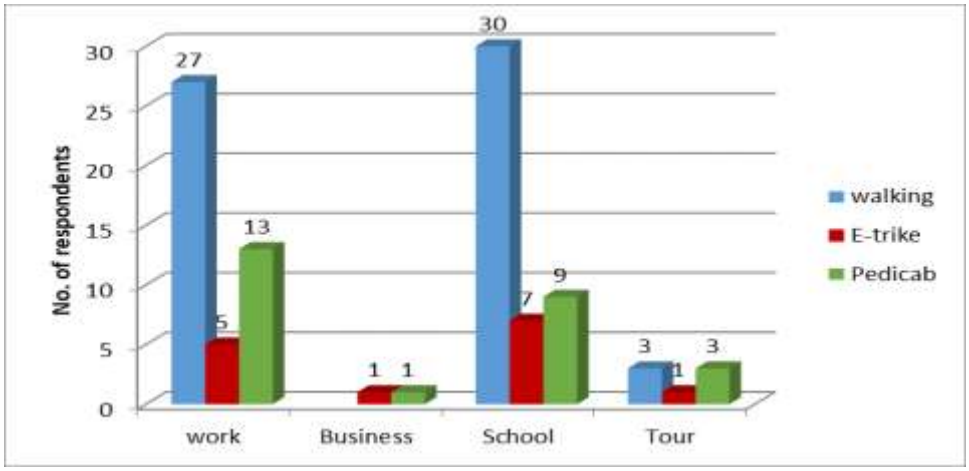

Figure 15. Mode choice by trip purpose

Table 9. Mode choice by frequency of travel

Frequency of Travel (in days)	Walking	E-trike	Pedicab	Total
1	5	6	5	16
2	5	2		7
3	2	2		4
4	1	1		2
5	32	3	10	45
6	7	1	3	11
7	8	2	5	15
Total	60	17	23	100

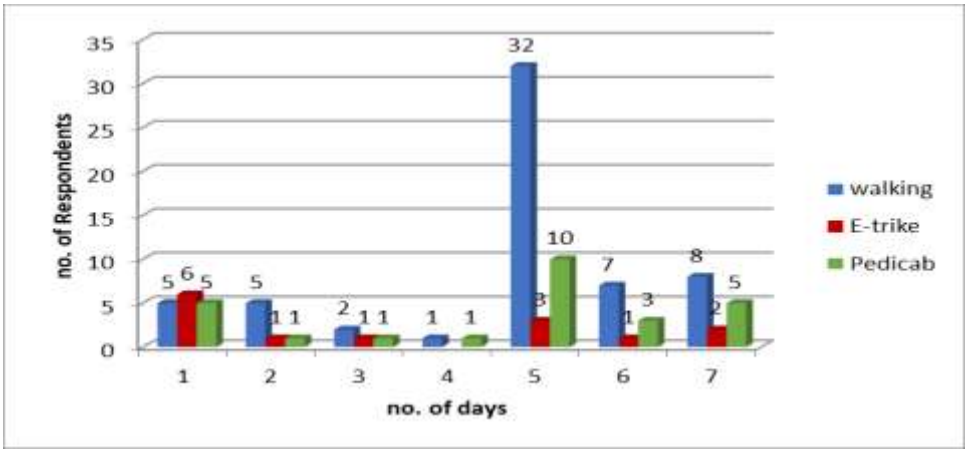

Figure 16. Mode choice by frequency of travel

Over all, out of the 100 respondent, majority preferred walking as their mode of transport. It is interesting to note that in this study, a pedicab is more chosen than e-trike.

3.3 Utility Function

In the formulation of the utility function of the walking, e-trike, pedicab mode, the following variables were considered. These are the cost of travel (fare), total time of travel, trip purpose, highest educational attainment, family gross monthly income, frequency of travel, waiting time, age, and civil status. These variables were used as an input in NLOGIT model to formulate a utility equation. The coefficient and statistics of the variables are shown in Table 1.

Table 1. Coefcient and statistics of the variables

Variable	Coefficient	Standard Error	b/St.Er.|	P[|Z|>z]
ASCA	0.27578852	1.09668437	.251	0.8014
COST	-0.01865641	003057285	-0.610	0.5417
TOTTME	-0.11969044	0.05153801	-2.322	0.0202
PURSCHL	0.86052128	0.55122299	1.561	0.1185
H_ED_ATT	0.43033827	0.20761856	2.073	0.0382
FAM_INCM	-0102925D-04	0.411101D-05	-2.504	0.0123
ASCB	-1.22161384	1.45843110	-0.838	0.4022
FRQNCY	-0.25200807	0.15047389	-1.675	0.0940
WT_TME	0.35807118	0.13668518	2.620	0.0088
AGE	-0.00318096	0. 03003525	-0.106	0.9157
SINGLE	0.95488887	0.88292681	1.082	0.2795

Based on the results of P-value, the following variables are very significant which is lower than 0.05. These are the total time of travel, highest educational attainment, family gross monthly income, and waiting time.

Based on the results of the study, the following utility equation of the 3 modes of transport in Intramuros, Manila was created. The utility equations are shown below.

$$U_w = 0.2758 - 0.01866c - 0.1197t + 0.8605r + 0.4303e - 0.1029i \quad (1)$$

$$U_E = -1.2216 - 0.01866c - 0.1197t - 0.252f + 0.3581v - 0.003181a + 0.9549s \quad (2)$$

$$U_P = -0.01866c - 0.1197t + 0.3581v \quad (3)$$

Where:

W = Walking
E = E-trike
P = Pedicab
c = Travel cost, in pesos
t = total travel time, in minutes
r = trip purpose going to school
e = highest educational attainment
i = family gross monthly income, in pesos
f = frequency of travel
v = waiting time
a = age
s = civil status

4. CONCLUSION AND RECOMENDATION

Based on the results of the study, the following conclusions are drawn. Most of the commuters in Intramuros, Manila are in the teens and twenties age group. Mostly, they are single with the highest educational attainment of high school and college degree. They belong to the middle class family gross monthly income. They usually travel in Intramuros to school or work with the frequency of 5 days in a week.

The mode of transport which is very dominant in all the characteristics of the commuters is walking. Also, it found in the study that e-trike is the least mode of transport to be chosen compared to pedicab and walking.

Based on the result on the NLOGIT model, the most significant variables in the utility function of the mode of transport in Intramuros are the total time of travel, highest educational attainment, family gross monthly income, and waiting time. These variables would influence or affect the choices of the commuters in Intramuros, Manila. These are important indicators to predict the share of trips attracted to available mode of transport in Intramuros Manila. The formulated model will be used as a basis for planning for efficient mode of transport to be implemented in the area and for the improvement of existing mode transport which is least to be chosen.

Also, it is recommended to increase the sample of the study for higher accuracy and precision of the model.

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