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Original Article

Attitude to and Usage Intention of High School Students Toward Electric Two-Wheeled Vehicles in Hanoi City

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Abstract: In recent years, electric two-wheeled vehicles (E2Ws) including electric bicycles and electric motorcycles have been used widely in Vietnam. Currently, the total number of E2Ws used is 3 million and with an average growth rate of 13.33% an estimated 6 million E2Ws will be used in 2024. E2Ws have been used widely among Vietnam's youth. Based on the Theory of Planned Behavior (TPB) of Ajzen (2005, 2016) [1, 2], the main purpose of this research is to identify factors affecting the attitude to and intention of high school students in Hanoi city towards E2W usage and their affected level. The analytical results show that the attitude towards E2W usage is influenced respectively in descending order by (i) perceptions of economic benefit, (ii) usage convenience, (iii) friendly environmental awareness, (iv) stylish design. Usage intention towards E2Ws is determined respectively in descending order by (i) subjective norm, (ii) attitude toward E2W usage, (iii) the attraction of motorcycles. Based on the research results, some proposals for producers, authorities and policy-makers have been recommended.

Keywords: Electric two-wheeled vehicle, intention, attitude high school students.

1. Introduction

1.1. Overview

Vietnam currently has 3.2 million cars and 49 million registered fuel motorcycles. The average growth rate of personal vehicles is 7.3% for fuel motorcycles and 6.3% for cars. Besides fuel motorized vehicles, two-wheel electric vehicles have been increasingly used, especially among the youth and in urban areas. The current total number of E2Ws used is 3 million vehicles [3], which is still a small figure compared to the 49 million fuel motorcycles in the whole country [4]. The average growth rate of E2Ws in recent years is approximately 13.3% [5]. These figures indicate a potential market in Vietnam for E2Ws in the coming time.

Private vehicles, especially fuel motorcycles and E2Ws, play the most important and convenient role for urban residents and account for 85-90% of the total number of trips by all motorized vehicles. Meanwhile, public transportation meets only 10-15% of the total

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travel needs of people. By 2020 and 2030, personal vehicles are estimated to still account for 75-80% and 60-65% of the total travel needs of people, with public transport meeting 20-25% and 35-40% of the total travel needs [6].

The increase in the use of fuel motorized vehicles cause serious environmental pollution and serious traffic congestion in urban areas in Vietnam. Emissions from fuel transport vehicles are a cause of air pollution, and this is one of the biggest factors that exacerbate climate change. Fuel motorized vehicles emit carbon dioxide, which creates the greenhouse effect. Fuel motorcycles are one of the main sources of CO and VOC emissions, which cause air pollution and profoundly affect urban residents' health. Therefore, the reduction of emissions from fuel transport vehicles becomes an urgent issue in Vietnam.

E2Ws run on lead-acid batteries or iron lithium batteries. E2Ws do not use gasoline fuel and save energy. E2Ws do not discharge emissions into the environment and help diminish pollution. In the future, along with the trend of developing and using electric vehicles around the world, E2Ws can be used as a useful alternative to fuel motorcycles in Vietnam. E2Ws have many stylish designs, dimensions, colors, which are suitable for young people's taste. The average price of E2Ws is from 8-15 million VND per unit, which is a competitive price compared to a fuel motorcycle. This study aims to identify factors and their impact on the attitude to, and the intention to use E2Ws of young people in Hanoi, focusing mainly on high school students.

1.2. Study area

Hanoi is the capital, the economic - social and political center of Vietnam. Hanoi is located in the North part of Vietnam, and is the largest city of Vietnam with an area of 3,324 km^2 and a total population of 7.65 million people. Hanoi has 12 districts with a population density of 2,279 people per km^2, four times higher than the average population density of the whole country. The economic growth rate of Hanoi is about 8.5%, higher than the economic growth rate of all Vietnam (6.8%). The average GDP per capita of Hanoi is about 86.04 million VND (approximately 3,740 USD per capita). The estimated population of Hanoi by 2030 is 9.13 million people, by 2040 9.93 million and by 2050 10.73 million people [7]. The average growth rate of fuel motorcycles and cars has been 6.7% and 10.67% respectively from 2011 to 2016 [8].

According to the Register Office, Hanoi had 5,255,245 registered fuel motorcycles and 327,820 cars at the end of 2016. The average growth rate of all motorcycles and cars was 6.7% and 10.67% respectively in the period of 2011-2016. On average, there are 470 fuel motorcycles/1,000 people and 20 cars/1,000 people. The ownership rate of fuel motorcycles in Hanoi is 1.5 times higher than the national average ownership rate and higher than that of other countries in the Asian region [8].

Table 1. Population, vehicles in Hanoi in the period 2010-2016

Year	Population (number of people)	Fuel motorcycles (unit)	Cars (unit)	Total vehicles (unit)	Percentage of total vehicles (%)		
					Fuel motorcycles	Cars	Other vehicles
2010	6,617,900	3,577,041	180,396	3,850,582	93.0	4.7	2.3
2011	6,779,300	3,980,070	218,507	4,301,247	92.5	5.1	2.4
2012	6,957,300	4,444,127	226,810	4,778,526	93.0	4.7	2.3
2013	7,128,300	4,660,761	231,960	5,002,883	93.0	4.6	2.4
2014	7,306,508	4,852,380	255,658	5,228,797	93.0	4.9	2.1
2015	7,489,170	5,045,672	275,938	5,454,385	92.5	5.0	2.5
2016	7,676,399	5,255,245	327,820	5,741,200	91.5	5.7	2.8

Source: Hanoi Department of Transport (2017) [9], Trinh Thu Thuy (2018) [5].

The number of personal vehicles in Hanoi is expected to increase. Besides that, Hanoi has 11,000 E2Ws of which 7,000 are electric bicycles and 4,000 are electric motorcycles. In addition, there are 88 electric cars used for tourist services. On average, there are 11.02 electric motorcycles per 1,000 people and 47.21 electric bicycles per 1,000 people [9].

It is estimated that Hanoi will have 1.4 million E2Ws by the year 2024 if the E2W growth rate reaches 13.5% per year, compared to 6 million E2Ws in the whole country at present [5].

Table 2. Forecast of personal vehicles and transport market share in Hanoi city for the period 2020-2030

Year	Total number (units)			Market share (%)	
	Automobiles	Cars	Fuel motorcycles	Public transport	Personal vehicles
2020	843,042	623,420	6,099,273	20÷25	75÷80
2025	1,404,364	1,091,467	7,002,347	27÷31	69÷73
2030	1,954,738	1,532,195	7,506,430	35÷40	60÷65

Source: Hanoi Department of Transport (2017) [9].

2. Research context

2.1. Usage intention towards E2W

According to the Theory of Planned Behavior (TPB), a behavioral intention is based on an attitude toward the behavior, a subjective norm and perceived behavioral control. A behavioral intention is defined as an important antecedent to future behavior. The strength of intention indicates how much people attempt to conduct the behavior. Therefore, understanding behavioral intention results in a valuable prediction about a given behavior [1, 2]. The application of TPB has been conducted in some studies on travel behavior, focusing on behavioral intentions toward public transportation [10-12]. The theory of planned behavior from intention to action has been applied to study the relationship among beliefs, attitudes, behavioral intention and actual behavior in various fields including transportation mode choices and particular consumer behavior in use of vehicles [10, 13].

2.2. Attitude towards E2W usage

Attitude towards a behavior is the degree to which performance of the behavior is positively or negatively valued. According to the expectancy-value model, attitude towards a behavior is determined by the total set of accessible behavioral beliefs linking the behavior to various outcomes and other attributes [1].

A positive attitude will encourage people to choose, buy, use and stick with the products. On the contrary, a negative attitude will not support or limit the purchase or use of the product [14]. Consumer attitude towards E2W usage is based on the perception of consumers' beliefs about economic benefits, the convenience of using E2Ws, E2Ws' design style, environmental protection, and safety awareness during E2W use, and an awareness of environmental pollution and unsafe conditions when using fuel motorcycles.

2.3. Subjective norm

A Subjective norm is the perceived social pressure to engage or not to engage in a behavior. Drawing an analogy to the expectancy-value model of attitude, it is assumed that the subjective norm is determined by the total set of accessible normative beliefs concerning the expectations of important referents [1]. A subjective norm is an external factor affecting a consumer's decision-making process [7, 15]. A subjective norm is affected by the perception, and thinking of reference groups or influential people such as family members, friends and colleagues [10, 16]. In addition to family and friends, businesses also have a significant and direct impact on consumer behavior such as through sales advice, product policy, promotion policy, customer service and guarantee policies [17].

Influences of both electric and fuel motorcycle brand names as well as customer care policies have a significant impact on consumers' intention to use such fuel motorcycles in Hanoi [16]. Brand name and communication policy of businesses affect the usage intention of bicycles and electric scooters in India [18, 19]. The advertising effectiveness of businesses has affected customers' decisions in buying bicycles in India [19] and the willingness to buy electric cars in China [13].

2.4. Perceived behavioral control

Perceived behavioral control refers to people's perceptions of their ability to perform a given behavior. Drawing an analogy to the expectancy- value model of attitude (see attitude toward the behavior), it is assumed that perceived behavioral control is determined by the total set of accessible control beliefs, i.e., beliefs about the presence of factors that may facilitate or impede performance of the behavior [1, 2]. Perceived behavioral control has a strong impact on the decision making to buy fuel motorcycles in Vietnam [16] and affect the intention to use bicycles in India [19] as well as the intention to use the BRT in Thailand [20]. However, Perceived behavioral control has not affected the intention to use the metro in Ho Chi Minh City [10].

2.5. Perception of economic benefits

The economic benefit is related to the attribute of products that measure in economic terms, the saving of operating cost in comparison with an alternative vehicle such as a motorcycle. Economic benefits are often determined by product attributes, which are internal factors affecting attitudes and behaviors. Awareness of economic benefits is often based on purchasing cost and the operating cost of a vehicle. The purchasing price of electric vehicles depends heavily on the battery cost, which is the biggest obstacle to the widespread dissemination of electric vehicles. As battery costs decrease, the competitiveness of electric vehicles will increase [21].

The lower price of electric motorbikes and lower operating costs in comparison with other vehicles is one of the reasons electric bicycles are used in China [22, 23]. The operating cost of a motorcycle in Vietnam is a factor affecting the purchase of motorcycles [16]. The cost of operating electric motorbikes in Vietnam and India is lower than that of fuel motorcycles, which encourages people to accept electric motorbikes [18, 24].

2.6. Perception of usage convenience

Convenience refers to the comfortable features of products that users have experience in terms of flexibility, mobility, fuel recharge and replacement of components and parts. The speed and travel range of electric scooters affected the popularity of electric scooters in Taiwan in the 1990s [25]. The specifications of electric bicycles such as speed, engine capacity, travel range, comfort, and convenience have increased the use of electric bicycles in China [22, 23]. Efficient technology improvements for electric scooters such as higher engine power, higher speed and faster acceleration have increased the use of electric motorcycles in Hanoi. Conversely, long battery charging times or slow acceleration will decrease the choice of an electric motorcycle [24]. The characteristics of electric bicycles, such as having a longer range and relatively easy hill-climbing are the advantages of electric bikes compared to pedal-powered bicycles, promoted a potential market for electric bicycles in Portland, Oregon, USA [26]. Durability, electric motor power and the availability of spare parts are important factors affecting the buying behavior for electric motorcycles in India [18].

2.7. Perception of style design

Style design (size and weight) refers to apparent features of a vehicle that affect the taste of users. The electric scooter style was widely accepted in Taiwan in the 1990s [25]. The preferred designs and brands of bicycles have created competition in the market and stimulated more bike usage in India [12, 19]. Fuel motorcycles' stylish designs and brand names are images stimulating consumers' minds, being one of the factors that affect the process of buying motorbikes in Vietnam [16].

The design of electric motorbikes has made electric motorbikes more widely accepted in the Indian market recently [18].

In Vietnam, there are about 50-60 different E2W designs in the E2W market. These are relatively diverse and compact, and are suitable for people of various appearances, ages, gender as well as the diversified preferences of users.

2.8. Perception of usage safety

Safety is considered as the result of a user's experience in terms of perception of speed safety and road safety. Electric vehicles have a safer speed than those powered by gasoline engines because of limitations in engine power, speed and acceleration. A safe speed is one of the reasons that electric motorbikes are widely accepted in Taiwan [25] and electric bicycles are used in China [22, 23].

Currently, there are no statistics on accidents caused by two-wheeled electric vehicles in Vietnam. Two-wheeled electric vehicles have been controlled for safe speeds and engine capacity by technical standard regulations issued by state official agencies. According to the National technical standardized regulations for electric bikes by the Ministry of Transport (Circular No.30/2013/TT-BGTVT dated November 1, 2013), electric bicycles have a maximum speed of no more than 25 km/h and motor power is no higher than 250W. Electric motorcycles have a maximum speed of no more than 50 km/h and a motor power of no higher than 400W. This standard regulation ensures safety for E2W users during their operation because E2Ws only reach a maximum speed of 35-60 km/h.

2.9. Perception of environmental friendliness

Environmental concerns have a direct strong impact on people's behavior in specific environmentally related domains like recycling, energy saving, buying environmentally friendly products or travel mode choices. Environmental perception includes the perception of environmental pollution, environmental knowledge and energy saving on a user's behavior.

Environmental and energy efficiency issues have rapidly increased the number of electric motorcycles in Taiwan [25]. Electric bicycles are considered friendly environmental vehicles, attracting more interested people and increasing usage in India. The electric bicycles with outstanding features such as no fuel consumption and no carbon emissions have high potential for the strong development of the electric bicycle market in comparison with gasoline motorcycles in India in the future [18].

Electric vehicles do not use fuel and have no emissions into the environment. Using an E2W results in cost-efficiency, convenience, and are relatively energy-saving compared to other competitive vehicles. However, E2Ws use lead-acid batteries so their impact on the environment needs to be considered. But due to technological improvement, the feasibility of lithium ion batteries will mean the replacement of lead acid batteries, making electric bicycles more energy efficient and will significantly diminish environmental pollution [22].

2.10. Attraction of alternative vehicles

An attractive alternative to E2Ws is fuel motorcycles - one of the most popular vehicles used in Vietnam which users prefer to substitute for E2Ws. Fuel motorcycles have some attributes, which are better than that of E2Ws such as speed, engine power, longer travel distance, and are easy to recharge with fuel, etc.

The attraction of fuel motorcycles as well as the habit of using personal vehicles has had an adverse impact on the intention to use the metro in Ho Chi Minh City [10], where there are more than 7.2 millions motorbikes with a personal ownership rate of 865 vehicles/1,000 people [27], accounting for 92% of the total number of vehicles [4].

2.11. Social and demographic factors

The electric motorcycle market in Taiwan is divided by gender between men and women. Women are more responsive to the design of electric scooters. Age, educational level and many motorcycles in a household are also factors affecting the choice of electric

motorbikes. People with a higher educational level tend to use electric scooters more and pay more attention to the technological improvements of vehicles and environmental pollution caused by traffic [25].

The social - demographic factors such as age, gender, educational level and income indicate the differences in buying electric scooters in India [18, 19]. In India, people with a higher income and a higher educational level tend to buy more electric scooters while young people between 15 and 25 years old will show more interest in electric motorbikes than other age groups [18, 19]. Educational level has a significant impact on the decision to use electric motorbikes in Hanoi city, while gender does not make any difference. People with a higher educational level more easily accept electric motorcycles [25].

3. Objectives, research model and hypothesis

The main objective of this study is to identify factors affecting the attitude and intention to use E2Ws and their influence level in Hanoi city.

By applying TPB theory to a contextual study of Vietnam and adjusting the TPB model in accordance with the actual situation of Vietnam and Hanoi city, a specific research model is proposed to explore factors affecting attitude to, and use intention towards E2Ws in Vietnam. From the fuel motorcycle usage in Hanoi, we adjust the TPB model and construct additional factors of motorcycle attraction to the model and other antecedent factors affecting attitude towards E2W use.

Exploratory Factor Analysis (EFA) has confirmed the research model with 12 factors affecting directly and indirectly use intention towards E2W. Intention to use E2Ws is influenced by five factors: attitude towards E2W usage, subjective norm, perceived behavioral control, business's sale promotion and attraction of fuel motorcycles. Attitude towards E2W usage is influenced by seven factors: perception of economic benefits, usage convenience, convenience in replacing components, size - weight, use safety, environmental friendliness, environmental pollution and unsafety caused by fuel motorcycles.

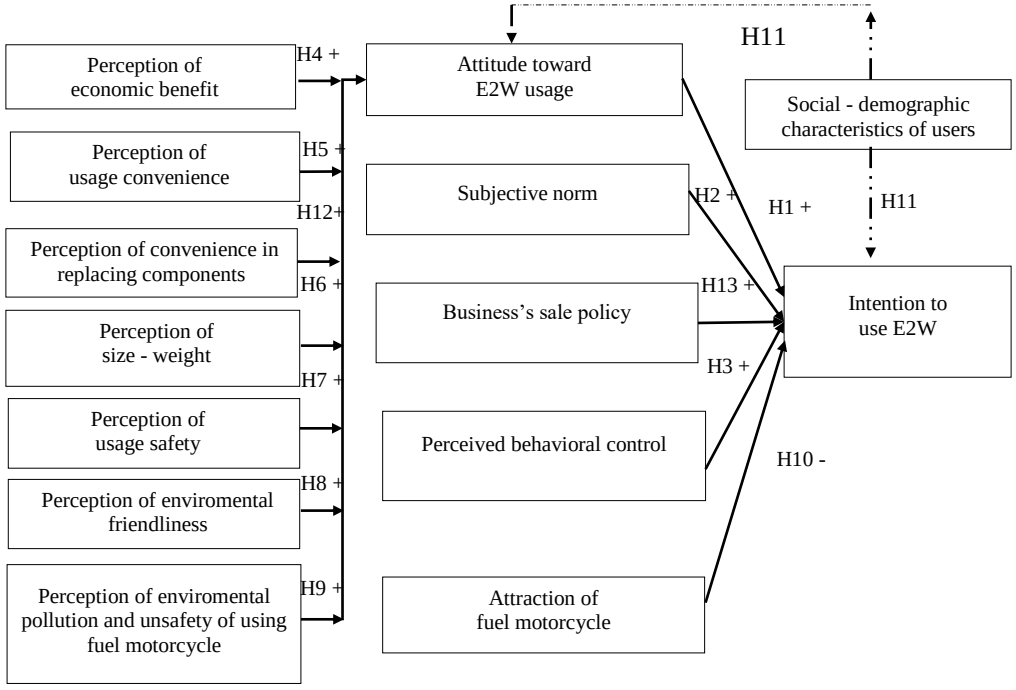

Figure 1. Research model and hypotheses after exploratory factor analysis EFA.

Table 3. Factors and hypotheses

Factors	Expected relations
Attitude towards E2W usage	*Hypothesis H1:* Positive attitude toward E2W usage encourages people's intention to use E2Ws.
Subjective norm	*Hypothesis H2:* Subjective norm positively affects usage intention toward E2Ws.
Perceived behavioral control	*Hypothesis H3:* Perceived behavioral control affects positively usage intention toward E2Ws.
Perception of economic benefit	*Hypothesis H4:* Perception of economic affects positively attitude toward E2W usage.
Perception of convenience	*Hypothesis H5:* Perception of convenience positively affects intention to use E2Ws.
Perception of size - weight	*Hypothesis H6:* Perception of size and weight tastes has significant influence on attitude towards E2W usage.
Perception of safety on E2W usage	*Hypothesis H7:* Perception of safety on E2W usage affects positively intention to use E2Ws.
Perception of environmental friendliness	*Hypothesis H8:* The better perception of environmental awareness, the better attitude towards the usage intention of E2Ws.
Perception of environmental pollution and unsafety of gasoline motorcycle	*Hypothesis H9:* The better perception of environmental pollution and unsafety of using fuel motorcycle, the better attitude towards the usage intention of E2Ws.
The attraction of fuel motorcycle	*Hypothesis H10:* The attraction of fuel motorcycle has negative affect to usage intention of E2Ws.
Social - demographic characteristic of users	*Hypothesis H11:* Social - demographic characteristics of users has differential affect to attitude to and intention toward E2W usage.
Perception of convenience in replacing components	*Hypothesis H12:* Perception of convenience in replacing components has positively affect attitude of E2W usage.
Business's sale policy	Hypothesis H13: Business's sale policy affects positively attitude towards E2W usage.

4. Methodology

4.1. Research design

In order to develop the research model and testing, the research was conducted by two-step methodology. The first step was primary research, which applied a desk research method and the second step was exploratory research, which applied a qualitative and quantitative research method.

Exploratory research: Exploratory research was implemented using a qualitative research method. Data collection was gathered by in-depth interviews and focused on group interview techniques. Exploratory research was conducted initially to collect fundamental information known as the qualitative research method to identify the factors most relevant to the study context and to have a better understanding of the potential influence of these factors on attitude and usage intention towards electrical two-wheeled vehicles. In addition, this exploratory research helped confirm the use intention as the key responsive variable to be researched in the second survey stage.

In-depth interviews: The psychological characteristics of E2W users may internally drive users' responses to electric two-wheeled vehicles. These interviews were conducted with key knowledgeable people such as directors, technical managers, sales' managers, marketing managers, etc. in E2W manufacturer, who have been directly responsible for collecting and analyzing information regarding the electric vehicle market, consumers' taste and needs, brand names of various E2Ws, government policies and regulations relevant to electric vehicles.

Focus group interviews: The interviews were conducted before a large-scale interview. Data was gathered from groups of E2W users in Hanoi city. The group interviews are useful to have a better understanding of the perception, attitude and the usage of consumers, which has assisted in identifying more accurate research issues.

Table 4. In-depth interviews and Focus group interviews

No.	Interviewees	Number of interviewees (persons)
1	Directors, technical managers, sale managers, production managers in the E2W manufacturers	14
2	Sale staffs, customer care staffs, technical staff at the E2W stores and agents	10
3	E2W users in Hanoi	20
	Total	44

Source: Trinh Thu Thuy (2018) [5].

In-depth interviews and focus target group interviews helped us to construct a scale of variables for each factor. The interviews were conducted using semi-structured questions, which assisted in gaining insights into specific information and close discussion.

Qualitative method: EFA is applied to identify factors affecting attitude and usage intention toward E2Ws for high school students in Hanoi.

4.2. Questionnaire design

Based on the hypotheses, a questionnaire survey with the stated preferences was developed to understand the attitude and use intention of E2W users.

The survey questionnaire is divided into 4 parts. Part I is general information on E2Ws. Part II is psychological questions to find out the perception of E2W users as well as their attitude and intention toward E2W usage. Part III is to collect other data on E2W usage. Part IV is personal information.

Part 1 includes information related to E2Ws such as type of E2Ws, brand, price and production place. Part 2 consists of psychological statements with an ordinal scale. The respondents were asked whether they agreed or disagreed with the 44 statements or variables, which are divided into 11 factor groups. Their given answers were judgments on a five-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree. Part 3 consists of questions related to E2W usage such as the purpose of E2W usage, how often E2Ws are used, limitation of using E2Ws and change to other vehicles if possible. Part 4 includes some personal information such as gender, age and educational level.

4.3. Data collection

Hanoi has 180 high schools and 190,934 students [7]. Data were collected from ten high schools in Hanoi through 300 survey questionnaires, averaging 30 survey questionnaires for each high school. These schools are located in crowded areas, scattered through 6 districts in Hanoi. The sample focused on teenagers from 15 to 18 years old or from 10th to 12th grade. The interviews were at lunchtime, school break time or after school time and lasted for 45-60 minutes.

Over 2 months, from September 2017 to November 2017, 238 survey questionnaires were collected with sufficient information. The response rate to the survey questionnaires was nearly 80 percent. 238 survey questionnaires were sufficient to implement an EFA. According to Hair et al. (2006), the minimum sample for an EFA is 100 units. According to Bollen (1989), the sample size in comparison with variables must be at least 5:1 or the minimum sample size must be five times the number of variables [28].

4.4. Data analysis

With the support of SPSS (Statistical Package for Social Science) and AMOS (Analysis of Moment Structure) software, data analysis was implemented through 5 steps as follows: (i) Statistic description, (ii) Reliability analyses: Cronbach's Alpha test and EFA, (iii) Model fitness test, (iv) Analysis with structural equation modeling, (v) Analysis of variance (ANOVA) with t-test was conducted to find significant differences in attitude and intention to use E2Ws among different groups of students.

Four steps of EFA.

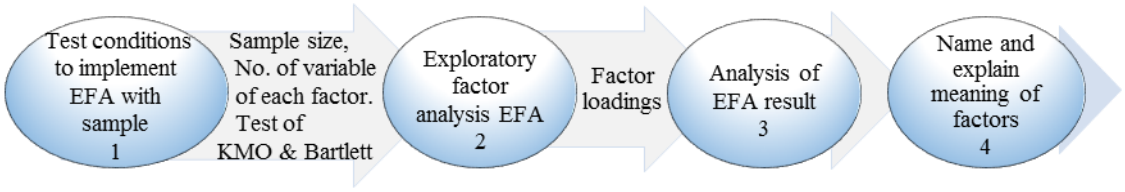

Figure 2. Four steps to analyze EFA.
Source: Hoang Trong and Chu Nguyen Mong Ngoc (2008) [28].

5. Survey results and discussion

5.1. Statistics of survey

Gender and age: 69.4% is the percentage of E2W use by female high school students compared to 30.6% used by males. E2Ws are used mostly by teenagers from 16-17 years old (respectively 42.2% and 43.5%).

Vehicles, brands and manufacture places: 46.6% of the E2Ws are electric motorcycles, and 53.4% electric bicycles. Electric bicycles are used more than electric motorbikes (1.06 times higher). The Nijia brand is used the most, 22.4% of the total, followed by Giant brand with a rate of 18.2%, X-men brand 10.9%, Momentum brand 7.8%, Aima has the lowest rate of 1.2%, after Yadea 2.5% and Fuji 2.7% and some other brands. E2Ws produced domestically in Vietnam accounted for the highest percentage of 40.1%; E2Ws produced in China were 24.4%; from Taiwan, 15.5%; from Japan 18% and from other countries 1.9%.

Vehicle usage duration and average travel distance per day: 45.6% of the high school students have used an E2W for more than one year, 35.2% of the students have used an E2W from 1-2 years, 15.3% of the students from 2-3 years, 1.6% of the students from 3-4 years and only 1.9% of the students have used an E2W for more than 4 years.

Teenagers or high school students are potential customers for the E2W market. This market segment will be sustainable and well developed. 29.6% of the students using E2Ws, on average, travelled less than 10km per day, 37.1% from 10-20km/day, 18.4%, from 20-30km/day, 11.2% from 30-40km/day, and 3.7%. travelled more than 40km/day. E2Ws are convenient to use for short travel distances of less than 30km/day in the inner urban area.

Distinguishing between electric bikes and electric motorcycles: 94.8% of high school students distinguished the difference between electric bicycles and electric scooters, only 5.2% did not distinguish the difference between these two vehicles.

Frequency of use and usage purpose: 97.1% of the high school students used an E2W only as their means of transport, 2.3% of the high school students used one less often, and only 0.6% rarely used an E2W. 96.1% of the students used an E2W to go to school daily, moving mainly from home to their study location, 27.1% used an E2W to go shopping and to entertainment, 6.5% to go to exercise, 7.1% for part-time work and 11.4% for other usage.

Limitation of using E2Ws: 86.5% of the high school students said that an E2W was inconvenient when it was raining, 22.6% said that an E2W was limited when there was a traffic jam due to easily running out of battery, 29.8% said that an E2W was not convenient for battery charging. 17.5% said that an E2W is not convenient when there is no battery-charging infrastructure. Fuel motorcycles are still the dominant means that replace E2Ws when an E2W is not being used (51.2%) or when there is an opportunity to change from an E2W (55.3%).

5.2. Factors affecting attitude and intention towards E2W usage

Results from tests of Cronbach's Alpha (> 0.6), KMO and Barlett in SPSS indicate that 40 variables or scales are meaningful and significant (see Appendix 1, Table 1). A Principal component analysis (PCA) with varimax rotation technique was employed to identify factor groups affecting attitude and intention toward E2W usage. The results of EFA indicate 40 variables or scales were divided into 13 factor groups (see Appendix 2, 3, 4, 5), in which, attitude toward E2W usage was influenced by 7 groups of factors, namely: perception of economic benefit, usage convenience, convenience in replacing components, size - weight, usage safety, perception of environmental friendliness, perception of environmental pollution and unsafety of using a fuel motorcycle. Intention to use E2Ws was influenced by 5 groups of factors, including: attitude toward E2W usage, subjective norm, business's sale policy, perceived behavioral control, and attraction of fuel motorcycles (Figure 1).

Structural Equation Model analyses (SEM) indicates the research model fits with the survey data (see Appendix 6, Figure 1). The test results show the following:

There are significant relationships between factors of perception of economic benefit, usage convenience, size - weight, perception of a friendly environment and attitude toward E2W usage. And there are significant relationships between factors of attitude toward E2W usage, subjective norm, attraction of fuel motorcycles and intention to use an E2W.

There are no significant relationships between factors of replacement convenience of components, usage safety, perception of environmental pollution and unsafety of using fuel motorcycle and attitude toward E2W usage. There are no relations between factors of business sale policies or perceived behavioral control (Table 5).

The analytical results (presented in Table 5) show that attitude towards E2W usage is descendingly influenced by (i) perceptions of economic benefit, (ii) convenience in use, (iii) environmental awareness, and (iv) stylish design. Usage intention towards E2Ws is determined respectively in descending order by (i) subjective norm, (ii) attitude towards E2W usage and (iii) the attraction of fuel motorcycles (Figure 2).

Table 5. Standardized coefficient in SEM

			Unstandardized coefficient	**Standardized coefficient**	**Standard error**	**C.R.**	**P-value**
TD	<---	TK	-.158	-.162	.059	-2.665	.008
TD	<---	LI	.363	.465	.087	4.196	***
TD	<---	TH	-.041	-.076	.037	-1.100	.271
TD	<---	MT	.346	.345	.090	3.865	***
TD	<---	AT	-.021	-.033	.051	-.405	.685
TD	<---	XT	.037	.057	.052	.705	.481
TD	<---	TT	.303	.454	.059	5.132	***
DD	<---	XM	-.120	-.219	.053	-2.249	.025

			Unstandardized coefficient	Standardized coefficient	Standard error	C.R.	P-value
DD	<---	KS	.028	.032	.090	.309	.758
DD	<---	DN	.005	.008	.056	.085	.932
DD	<---	CC	.281	.522	.070	3.990	***
DD	<---	TD	.385	.449	.089	4.344	***

Source: Research result from Trinh Thu Thuy (2018) [5].

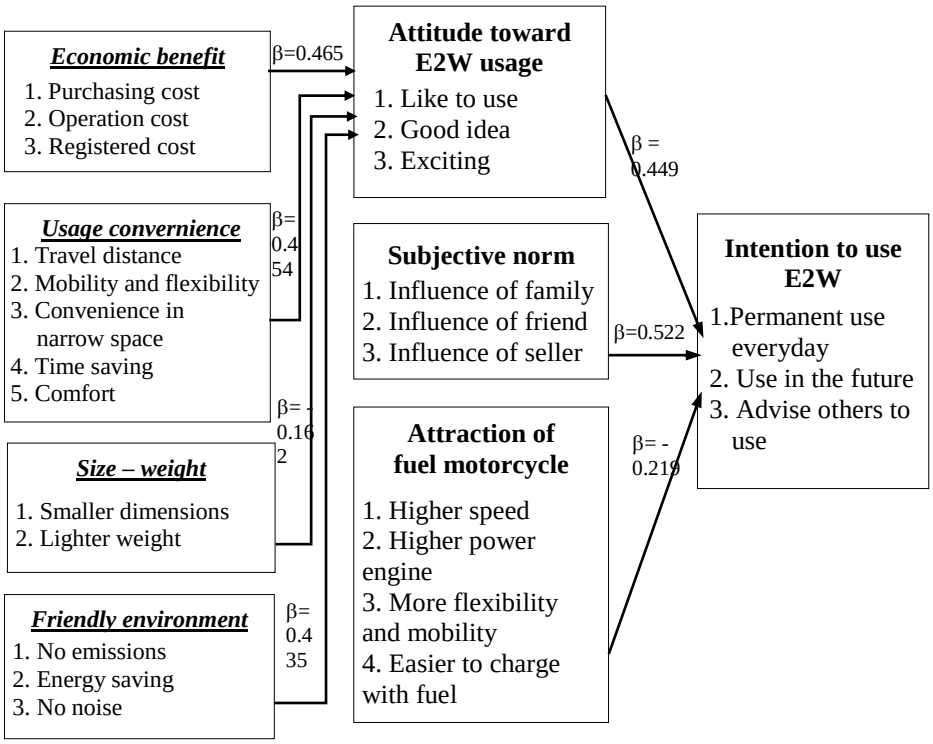

Figure 2. Factors impacting on intention to use E2Ws of high school students in Hanoi.
Source: Research result from Trinh Thu Thuy (2018) [5].

Testing the significant differences between groups: ANOVA test results showed that there was an insignificant difference in attitude and intention to use E2Ws between male and female student groups, and between different age groups.

5.3. Main findings and implications

The research results have met the initial research purpose. The main findings show seven groups of factors affecting attitude: perception of economic benefits, usage convenience, convenience in replacing components, size - weight, use safety, environmental friendliness, environmental pollution and unsafety caused by fuel motorcycles. Intention to use E2Ws is influenced by five factors: attitude towards E2W usage, subjective norm, perceived behavioral control, business's sales' promotion and attraction of fuel motorcycles

The attitude toward E2W usage is influenced respectively in descending order by (i) perceptions of economic benefit, (ii) usage convenience, (iii) friendly environmental awareness, (iv) stylish design. Usage intention towards E2Ws is determined respectively in

descending order by (i) subjective norm, (ii) attitude toward E2W usage, (iii) the attraction of fuel motorcycles.

Factors such as convenience in replacing components, size - weight, use safety, environmental pollution and unsafety caused by fuel motorcycles have no significant relationships with attitudes toward E2W usage and factors of perceived behavioral control and business's sales' promotion have no significant relationships with intention to use E2Ws.

This research and its findings have not been explored in any previous research in Vietnam and in any other studies on electric vehicles with the new approach from the psychology of consumer's behavior towards E2W.

Some implications are proposed from the research results:

E2W producers may expand E2W sales in the market by reducing production costs in terms of operation costs to compete with fuel motorcycles, establishing professional sales and sales consultants, and improve and innovate E2W attributes in terms of enhancing usage convenience such as longer battery life with shorter charging time and diversifying stylish designs.

Local authorities and policy-makers may encourage effective E2W usage to replace fuel motorcycle usage in order to reduce air pollution in Hanoi city by controlling and limiting fuel motorcycle usage, enhancing perception and attitude of consumers towards friendly, green products, encouraging E2W usage for short distance travel in the city, managing and controlling E2W quality to increase E2W usage, researching and developing new technology in the battery industry, enabling the replacement of lead-acid batteries and orienting to develop the E2W industry and electric vehicle industry in the near future.

In the coming time, this research model should be expanded to study more latent variables, scales and scale levels, which have not been included in this research and research areas should be expanded to various cities, regions, and provinces with different ages and occupations of consumers.

6. Conclusion

The advantage of various stylish designs, compact size, ease of control, ease of operation and smooth running, make E2Ws suitable for youth, especially for pupils and students. E2Ws are convenient for travel in narrow and small lanes with many intersections and are convenient in narrow spaces for stopping and parking.

However, due to limitations in battery technology and the travel distances possible per charge means E2Ws are more convenient for travelling short distances in urban areas. In addition, the battery life is relatively short. All of these factors have limited the adoption of E2Ws for personal transport.

The results of this research may help producers to manufacture E2W products suitable for the consumer's taste if producers want to expand their market share of E2Ws and increase their sales. The results of this research may also help authorities and policy-makers to understand more about the behavior of E2W users, especially the youth, to more efficiently manage and control E2Ws, which are prominent personal transport vehicles in Vietnam's urban areas,

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APPENDIX 1

Table 1. Test of KMO and Bartlett

First round	KMO efficient (Kaiser-Meyer-Olkin Measure of Sampling Adequacy)		0.752	Test of two rounds: 0.7 < KM0 < 0.8 Sig. = 0.000 < 0.05 → satisfy to EFA
	Bartlett's Test of Sphericity	Approx. Chi-Square	1,713.999	
		df	276	
		Sig.	0.000	
Second round	KMO efficient (Kaiser-Meyer-Olkin Measure of Sampling Adequacy)		0.738	
	Bartlett's Test of Sphericity	Approx. Chi-Square	1,115.833	
		df	91	
		Sig.	0.000	

Source: Trinh Thu Thuy (2018) [28].

APPENDIX 2

Table 2. Total Variance Explained - TVE

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of variance	Cumulative %	Total	% of variance	cumulative %	Total	% of variance	umulative %)
1	4.433	20.151	20.151	4.433	20.151	20.151	2.747	12.484	12.484
2	2.878	13.083	33.235	2.878	13.083	33.235	2.247	10.215	22.700
3	1.805	8.203	41.438	1.805	8.203	41.438	2.145	9.751	32.451
4	1.600	7.275	48.712	1.600	7.275	48.712	1.962	8.920	41.371
5	1.353	6.148	54.861	1.353	6.148	54.861	1.807	8.213	49.585
6	1.183	5.377	60.238	1.183	5.377	60.238	1.727	7.852	57.436
7	1.095	4.977	65.215	1.095	4.977	65.215	1.711	7.779	65.215
8	0.938	4.262	69.477						
9	0.866	3.936	73.413						
10	0.685	3.113	76.526						
11	0.682	3.102	79.628						
12	0.638	2.902	82.529						
13	0.557	2.530	85.059						
14	0.517	2.349	87.408						
15	0.462	2.102	89.510						
16	0.424	1.929	91.439						
17	0.374	1.700	93.139						
18	0.363	1.651	94.790						
19	0.337	1.530	96.321						
20	0.303	1.376	97.697						
21	0.277	1.261	98.958						
22	0.229	1.042	100.000						

Extraction Method: Principal Component Analysis.

APPENDIX 3

Table 3. Rotated Component Matrix[a] . First Round

Variable	Factor loadings						
	1	2	3	4	5	6	7
LI1					0.723		
LI2					0.826		
LI3					0.617		
TT1	0.530						
TT2	0.528						

TT3	0.792					
TT4	0.803					
TT5	0.763					
TT7					0.784	
TT8					0.837	
TK2						0.843
TK3						0.782
AT1				0.510		
AT2				0.798		
AT3				0.701		
MT1			0.776			
MT2			0.690			
MT3			0.720			
XT1		0.536				
XT2		0.732				
XT3		0.792				
XT4		0.653				

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 8 iterations.

APPENDIX 4

Table 4. Total Variance Explained - TVE. Second Round

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	3.792	25.278	25.278	3.792	25.278	25.278	2.774	18.495	18.495
2	2.244	14.962	40.240	2.244	14.962	40.240	2.047	13.643	32.138
3	1.622	10.812	51.052	1.622	10.812	51.052	1.901	12.673	44.811
4	1.307	8.711	59.763	1.307	8.711	59.763	1.776	11.843	56.654
5	1.076	7.170	66.934	1.076	7.170	66.934	1.542	10.280	66.934
6	0.804	5.358	72.292						
7	0.767	5.111	77.402						
8	0.634	4.225	81.627						
9	0.601	4.007	85.634						
10	0.510	3.399	89.033						
11	0.490	3.268	92.302						
12	0.376	2.504	94.806						
13	0.318	2.123	96.929						
14	0.271	1.808	98.737						
15	0.189	1.263	100.000						

Extraction Method: Principal Component Analysis.

APPENDIX 5

Table 5. Rotated Component Matrix[a]. Second Round

Variable	Factor loadings				
	1	2	3	4	5
TĐ1			0.773		
TĐ2			0.791		
TĐ3			0.679		

CC1		0.784			
CC2		0.863			
CC3		0.683			
CC5				0.869	
CC6				0.888	
KS1					0.828
KS2					0.827
XM1	0.777				
XM2	0.834				
XM3	0.567				
XM4	0.737				
XM5	0.708				

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 6 iterations.

APPENDIX 6

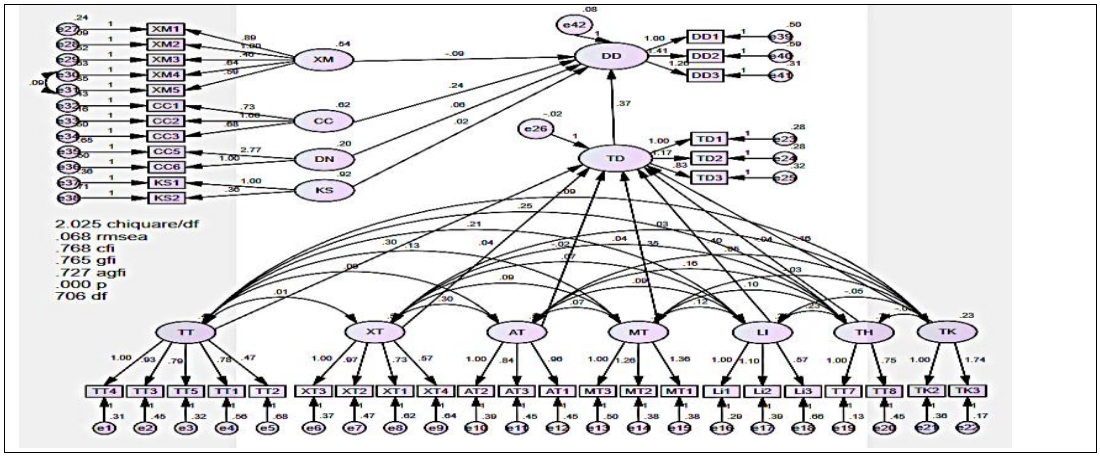

Figure 1. Correlation and causal relationship between concepts in the model of exploratory factor analysis EFA.
Source: Research result from Trinh Thu Thuy (2018) [28].