Determinants of students’ behavior in using light rail transit in Hanoi

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Abstract. On November 6th, 2021, the first light rail transit (LRT) began operating in Vietnam after a decade of construction. This project aimed to alleviate traffic congestion in the road network of the Hanoi capital. However, despite the deployment of the transit service, passenger volume remains under-capacity, raising questions about how to encourage people, particularly young individuals, to use the new public transit. Hence, this study investigated students' behavior in choosing the LRT as a means of transport. Statistical analysis of the questionnaire survey showed that the satisfaction level was the dominant factor affecting the mode choices of students. Besides, distance from home to school and LRT station accessibility significantly influenced students' traveling behavior. These findings provide fundamental insight into young Vietnamese individuals' behavior regarding a new transit service. We believe these outcomes would help support policy-makers and service providers in improving the LRT projects' efficiency.

Keywords: Light rail transit; student; mode choice; public transport; LRT; Ha Noi.

1 Introduction

Motorization has greatly affected urban socio-economic aspects. In addition to positive impacts, such as significantly increasing human mobility and inspiring the automobile industry, motorization is also a source of air pollution. As of 2019, the transport sectors accounted for about 27% of global emissions [1]. Most studies agree that heavy dependence on private motorized vehicles for travel is responsible for various negative impacts. These adverse influences include traffic congestion, wasted travel time, and high accident rates, threatening sustainable development goals achievement (SDGs).

In response to this problem, promoting public transport (PT) usage by improving accessibility and capacity plays a critical role. For the former, the coverage of the PT...
system is the indicator. As reported by [1], about 25% of the urban population in developing countries has convenient access to PT, indicating a low level of service. Regarding the second factor, it is worth investing in mass rapid transit systems, which are now attracting the attention of developing economies for construction.

Compared to other mass rapid transit travel modes, the light rail train (LRT) has gained popularity in emerging nations. LRT is favored over bus rapid transit (BRT) or metro because it is in the middle of the capacity, construction, and operating cost spectrum. LRT also has a favorable socio-economic impact on metropolitan regions. For instance, a research article claims that the LRT's operation will raise property values, population density, new enterprises, and household income [2]. On the other hand, LRT would encourage active travel modes, decrease travel expenses and times, discourage self-driving, and minimize air pollution emissions [3–5].

As LRT provides various advantages, many countries in Southeast Asia have invested in this type of PT and integrated it into the transportation system. For instance, the Manila LRT project in the Philippines commercial operated in 1984, the Kelana Jaya (1996) and Ampang Lines (1998) in Kuala Lumpur, and the Jakarta LRT in Indonesia started opening in 2019. These projects have successfully served numerous passengers annually at about 65, 95, and 1.8 million passenger boardings for Manila, Kuala Lumpur, and Jakarta, respectively [6–8].

Lately, Hanoi city deployed the first LRT project in Vietnam in 2021. After one year of operation, the ridership of this project reached about 7.3 million passenger boardings, equivalent to about 32 thousand passenger boardings daily, which is relatively low compared to the designed capacity of up to one million passenger boardings a day [9]. Though new projects usually experience a low passenger volume, this value is much lower than other LRT systems in Southeast Asia [10]. The under-capacity operation underscores the inefficiency of the project in both economic and social terms. This problem raises questions about why people refuse to use LRT service and how to increase their usage intention. To address these questions, understanding the passenger mode choice behavior is one of the crucial factors.

The young take up a substantial share of PT users, especially in developing countries. Currently, students, including university and vocational schools, account for about 15% of the total population in Hanoi [11]. Recent studies have examined the travel behavior of this group. For example, [12] investigated determinants that cause Hanoi students to stop using buses. The study indicates that demographic factors, such as age and gender, are significant variables. Likewise, [13] examined determinants of school trip mode choice among students in Danang city. The authors found that only age and motorcycle ownership status significantly correlated with PT intention. However, these studies did not relate to the LRT mode. Since young people's behavior has a long-term influence on their usage, we propose that investigating their behavioral intention would be worthwhile for promoting the ridership of the LRT project in the future.

For the abovementioned matters, the current study aims to investigate the travel behavior of Hanoi Architectural University students in using mass public transport for their study trips. Specifically, we aim to address the following research questions: (1) Which factors influence students in choosing LRT as their means of transportation? and (2) Which travel behavior determinants have a stronger impact compared to others?

We believe that the outcomes of this study will be helpful in better understanding the behavior of young people in using public transport. The results will support project management in improving the service and enhancing the attractiveness of LRT.

The remaining part of the study consists of four sections. Section 2 presents the data collection process and analysis methodology. Section 3 presents the main results. We will discuss the results in section 4 and present our conclusions in section 5.
2 Data and methodology

2.1 Data collection

To address the research questions, we conducted a questionnaire survey at Hanoi Architectural University from the first of February to the fourth of March, 2023. After one month of collecting, the valid responses were 423. Table 1 summarises the final data set.

Relating to the research objective, we define the dependent variable as the status of having used LRT in Hanoi or not (question C14 in the questionnaire). This variable has two values, 0 indicates never using LRT, and 1 presents the experiencing LRT at least once. Surprisingly, about 50% of respondents have never used LRT since the project operated (refer to Table 1).

In terms of independent variables, we collected individual and traveling habit information. For the first aspect, the primary information includes major studying, gender, and studying grade (from C1 to C3 in table 1). We further collected the interviewee the status of vehicle ownership, and driving license status, represented by questions C5 and C6, respectively. Other factors that might affect individual travel behavior were also obtained, including the accommodation type, distance from home to school, and part-time job status (C7 to C9).

<table>
<thead>
<tr>
<th>No</th>
<th>Variable</th>
<th>Explanation</th>
<th>Type</th>
<th>Value</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C14</td>
<td>Have you used LRT in Hanoi?</td>
<td>Logical</td>
<td>0: False (No); 1: True (Yes)</td>
<td>0: 216; 1:207</td>
</tr>
<tr>
<td>2</td>
<td>C2</td>
<td>Gender</td>
<td>Factor</td>
<td>0: Female; 1: Male</td>
<td>0:127; 1:296</td>
</tr>
<tr>
<td>4</td>
<td>C5</td>
<td>Private motorized vehicle ownership</td>
<td>Factor</td>
<td>0: No; 1: Yes</td>
<td>0: 82; 1: 341</td>
</tr>
<tr>
<td>5</td>
<td>C6</td>
<td>Driving license status</td>
<td>Factor</td>
<td>0: No; 1: Yes</td>
<td>0: 79; 1: 344</td>
</tr>
<tr>
<td>6</td>
<td>C7</td>
<td>Type of accommodation</td>
<td>Factor</td>
<td>0: Rental; 1: Family/relative</td>
<td>0: 245; 1: 178</td>
</tr>
<tr>
<td>7</td>
<td>C8</td>
<td>Distance from accommodation to school (km)</td>
<td>Num</td>
<td>0 - 3 - 50 (*)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>C9</td>
<td>Part time job status</td>
<td>Factor</td>
<td>0: No; 1: Yes</td>
<td>0: 204; 1: 219</td>
</tr>
<tr>
<td>9</td>
<td>C10</td>
<td>Average study trips per day</td>
<td>Factor</td>
<td>0: One; 1: More than one</td>
<td>0: 250; 1:173</td>
</tr>
<tr>
<td>10</td>
<td>C11</td>
<td>Common travel mode</td>
<td>Factor</td>
<td>0: Non-motorized; 1: Public mode; 2: Private mode</td>
<td>0: 60; 1: 38; 2: 325</td>
</tr>
<tr>
<td>11</td>
<td>C12</td>
<td>Average travel time to school (min)</td>
<td>Num</td>
<td>2 - 15 - 120 (*)</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Data set description
Regarding traveling characteristics, we first observed the respondents traveling frequency, the average number of trips made in a day (C10). C11 indicates the usual travel mode of students. Likewise, C12 and C13 present the average travel time and cost, respectively. Besides, C17 denotes the distance from the student’s home to the nearest LRT station. Finally, we reviewed the student’s opinions about LRT service using question C18. In this question, interviewees express their viewpoints on five LRT aspects, including ticket price, safety and comfort, easy to use, accessibility, and waiting time. We then converted these factors into three levels, dissatisfied, somewhat satisfied, and satisfied. Notably, there was only about 7% of respondents dissatisfied with the LRT service.

### 2.2 Statistical analyses

Regarding the data structure and dependent variable type, we employed a logistic regression model to reveal the travel behavior of Hanoi students. The model was conducted using the R program version 4.2.2 and related packages [14]. Besides, we have tested the variance inflation factor value for each explanatory variable. The threshold was set at 3.3 to control the multicollinearity problem as recommended by [15].

### 3 Results

Table 2 expresses the results of logistic regression. As shown in the table, the results indicate four significant variables were associated with the student's behavior in using LRT. These factors are the studying grade, the distance from home to school, the distance from home to the nearest LRT station, and the satisfaction level. We will use the odds ratio to interpret the results expressed below.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std Error</th>
<th>t Ratio</th>
<th>Odds Ratio</th>
<th>OR CI (95%)</th>
<th>VIF</th>
<th>Base Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>-1.342</td>
<td>0.741(*)</td>
<td>-1.811</td>
<td>0.261</td>
<td>0.061 ~ 1.116</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1: 1</td>
<td>0.336</td>
<td>0.279</td>
<td>1.206</td>
<td>1.399</td>
<td>0.810 ~ 2.416</td>
<td>1.399</td>
<td>0.261</td>
</tr>
<tr>
<td>C2: 1</td>
<td>-0.378</td>
<td>0.235</td>
<td>-1.610</td>
<td>0.685</td>
<td>0.433 ~ 1.086</td>
<td>0.685</td>
<td>0.685</td>
</tr>
<tr>
<td>C3: 2</td>
<td>0.730</td>
<td>0.359*</td>
<td>2.034</td>
<td>2.076</td>
<td>1.027 ~ 4.196</td>
<td>2.076</td>
<td>2.076</td>
</tr>
<tr>
<td>C3: 3</td>
<td>0.394</td>
<td>0.371</td>
<td>1.063</td>
<td>1.483</td>
<td>0.717 ~ 3.066</td>
<td>1.483</td>
<td>1.483</td>
</tr>
<tr>
<td>C3: 4</td>
<td>0.785</td>
<td>0.385*</td>
<td>2.037</td>
<td>2.193</td>
<td>1.030 ~ 4.667</td>
<td>2.193</td>
<td>2.193</td>
</tr>
<tr>
<td>C3: 5</td>
<td>0.323</td>
<td>0.424</td>
<td>0.761</td>
<td>1.381</td>
<td>0.602 ~ 3.168</td>
<td>1.381</td>
<td>1.381</td>
</tr>
<tr>
<td>C5: 1</td>
<td>-0.535</td>
<td>0.371</td>
<td>-1.443</td>
<td>0.585</td>
<td>0.283 ~ 1.212</td>
<td>0.585</td>
<td>0.585</td>
</tr>
<tr>
<td>C6: 1</td>
<td>-0.190</td>
<td>0.317</td>
<td>-0.601</td>
<td>0.827</td>
<td>0.444 ~ 1.538</td>
<td>0.827</td>
<td>0.827</td>
</tr>
</tbody>
</table>
2.2 Statistical analyses

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interviewees express their viewpoints on five LRT aspects, including ticket
home to the nearest LRT station, and the satisfaction level. We will use the odds ratio to
indicate four significant variables were associated with the student’s behavior in using LRT.
These factors are the studying grade, the distance from home to school, the distance from
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variance inflation factor value for each explanatory variable. The threshold was set at 3.3 to

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cost per month nearest LRT station (km) -

\begin{tabular}{cccccc}
\hline
Variable & Average travel cost per month & distance from home to school & distance from home to the nearest LRT station & travel time & travel cost \\
\hline
A1 & 0.190 & 0.535 & 0.323 & 0.785 & 0.394 \\
A2 & 0.317 & 0.371 & 0.424 & 0.385* & 0.359* \\
A3 & 0.827 & 0.444 ~ 1.538 & 0.283 ~ 1.212 & 0.602 ~ 3.168 & 1.030 ~ 4.667 \\
A4 & 0.394 & 1.417 & 1.990 & 1.548 & 1.548 \\
A5 & 1.685 & 1.093 & 1.298 & 1.027 ~ 4.196 & 0.810 ~ 2.416 \\
A6 & 1.381 & 1.381 & 0.261 & 1.399 & 0.279 \\
A7 & 2.001 & 2.001 & 1.000 & 1.206 & 1.811 \\
A8 & 0.000 & 0 & -0.770 & 1.000 & 1.399 \\
A9 & -0.074 & 0.034* & -2.168 & 0.929 & 0.869 ~ 0.993 \\
A10 & 1.598 & 0.585** & 2.732 & 4.943 & 1.571 ~ 15.555 \\
A11 & 2.001 & 0.562*** & 3.560 & 7.395 & 2.458 ~ 22.25 \\
\hline

\end{tabular}


\begin{align*}
\text{C7: 1} & \quad -0.126 & 0.248 & -0.506 & 0.882 & 0.542 ~ 1.435 & 1.424 & 0 \\
\text{C8} & \quad 0.087 & 0.032** & 2.705 & 1.091 & 1.024 ~ 1.161 & 3.051 & 0 \\
\text{C9: 1} & \quad 0.057 & 0.22 & 0.261 & 1.059 & 0.689 ~ 1.628 & 1.141 & 0 \\
\text{C10: 1} & \quad -0.341 & 0.218 & -1.568 & 0.711 & 0.464 ~ 1.089 & 1.084 & 0 \\
\text{C11: 1} & \quad -0.202 & 0.467 & -0.433 & 0.817 & 0.327 ~ 2.039 & 1.868 & 0 \\
\text{C11: 2} & \quad -0.088 & 0.356 & -0.246 & 0.916 & 0.456 ~ 1.840 & 1.868 & 0 \\
\text{C12} & \quad -0.016 & 0.011 & -1.490 & 0.984 & 0.963 ~ 1.005 & 2.279 & 0 \\
\text{C13} & \quad 0.000 & 0 & -0.770 & 1.000 & 1 ~ 1 & 1.128 & 0 \\
\text{C17} & \quad -0.074 & 0.034* & -2.168 & 0.929 & 0.869 ~ 0.993 & 1.860 & 0 \\
\text{C18: 1} & \quad 1.598 & 0.585** & 2.732 & 4.943 & 1.571 ~ 15.555 & 1.072 & 0 \\
\text{C18: 2} & \quad 2.001 & 0.562*** & 3.560 & 7.395 & 2.458 ~ 22.25 & 1.072 & 0 \\
\hline
\text{AUC} & & & & & & & 0.687 \\
\text{F Score} & & & & & & & 0.639 \\
\text{P value} & & & & & & & 0.000 \\
\text{Rho2-McFadden} & & & & & & & 0.080 \\
\text{Accuracy Rate} & & & & & & & 0.631 \\
\end{align*}

(*) * ** *** represents for the significant level of < 0.1, <0.05, <0.01, and <0.001 respectively.

OR - Odds Ratio; CI - Confident interval; VIF - Variance inflation factor

Regarding studying grades, senior students are more likely to use LRT than first-grade
students. Specifically, second and fourth-year students have associated with a 107.6% and
119.3% increase in odds ratio, respectively. However, there was no distinction between
third- and fifth-year, and first-year students in choosing LRT as a transport mode.

In terms of distance, we found that students who live far from school have a higher
intention of using the LRT than those who live near the school. An increase in the 1 km
distance from home to school would increase by a 9.1% odds ratio. By contrast, the
distance from home to the nearest LRT station reduces the possibility of using the LRT. As
results indicate, the odds ratio would decrease by 7.1% when the distance between home
and station increases by 1 km.

Regarding satisfaction level, the results demonstrate that high satisfaction would
significantly associate with using LRT. A student who is somewhat satisfied with the
service would prefer to use LRT compared to a dissatisfied student. The odds ratio
increased by 394.3% for these students. Likewise, the satisfied group saw a 639.5%
increase in the odds ratio.

Remarkably, the common factors such as private vehicle ownership, driving license,
travel time, and travel cost did not correlate with the student’s behavior in choosing LRT as
the mean of transport.

4 Discussions

Consistent with previous studies, our results demonstrate that satisfaction is the most
significant factor motivating students to use LRT. For instance, a study in Kuala Lumpur
claims that, besides service quality and perceived value, satisfaction positively impacts the
public transport usage of Malaysians [16]. For Hanoi, the LRT project introduces a new
public service with luxury features that differ from the existing public modes, including
BRT and traditional buses. The new LRT takes advantage of a separate way, spacious trunk space, convenient ticket service, etc., to ensure reliability and comfortability, which satisfies not only young people but other commuters.

Satisfaction, however, has a strong relationship with passengers' perception, which has an intrinsic relationship with service quality. Though the new LRT project is operating with a high grade of service, the condition may decrease gradually. Therefore, the LRT operator should maintain the system regularly. The measures may include improving infrastructure such as information provision, facilities, signage, safety, and security. On the other hand, enhancing services, for instance, ticketing systems, frequency, cleanliness, and comfort, would be worthwhile to preserve customer satisfaction [17,18].

Regarding student's grade, our study result differs from the finding of [19] and [12]. In these studies, senior students were less likely to use public transport than first-year students. The authors claimed that new students would rely on buses because of their quality, and older students may switch from public transport to private modes due to changes in their home location and job status. We argue that this phenomenon is not necessarily true. New students, who mainly migrate to Hanoi from suburban or rural areas, prefer choosing accommodation close to the university. Short home-school trips are more suitable for active modes, e.g., walking and cycling, than motorized modes, including buses or LRT. As they move to higher grades, they become familiar with the city network and confident with the new style of travel mode that does not exist in their hometown. Also, from the second year, students consider finding part-time jobs and new accommodation that adapts to their lifestyle. As a result, they are more likely to use public transport than before when the home is far away from school. However, some students prefer using motorcycles to public transport when they want to control their time flexibly.

The effect of travel distance in the current study is consistent with the findings of [20] in Italy. On the other hand, this result contradicts the studies of [21] in America and [12] in Vietnam. Note that the first two cases analyzed student mode choice in developed countries that might not be suitable to compare with the Vietnamese context. We suggest that this factor represents travel cost, which includes time value, comfortability, and health matters. Firstly, alternative travel modes may outperform LRT for a short trip because of less access and egress time. Likewise, commuters might face traffic congestion, air pollution exposure, and uncomfortable weather during a long journey. These problems are common in large Vietnamese cities when traveling with private modes or even buses. Thus, a long home-school trip school could encourage students to choose LRT as a means of transport. Nonetheless, the distance seems to have a threshold. Some studies have declared that public transport modes outperform others when the trip length is longer than 7 km [22].

As expected, the easy accessibility positively affects students' LRT usage intention. This finding is also consistent with other studies in China and Thailand [23,24]. A short distance from home to the LRT station enables commuters to access the LRT by walking. Consequently, they can be independent of vehicles to move from home to the station. Note that Park and Ride (P&R) infrastructures are currently unavailable for the Hanoi LRT project. Thus, proximity to the station is one of the convenient factors for passengers using public transport. Furthermore, this finding suggests that local administrators should invest in P&R facilities and develop transport-oriented development plans to enhance the effectiveness of the LRT project.

Remarkably, besides statistically significant factors, the current study did not find a relationship between some common variables and students' behavior in choosing LRT as a travel mode. Of these insignificant variables, gender and private vehicle ownership are interesting factors. For gender, although this finding is consistent with previous studies from Indonesia and America [21,25], other researchers have reported a distinction between male and female students in choosing public transport as a means of transport in Lebanon.
and China [22,26]. Additionally, other studies have suggested that physical health or concerns about sexual and gender harassment may cause differences between girls and boys in using public transport [12]. We argue this issue is still ambiguous and needs further investigation and discussion.

Although vehicle ownership and driving license status are typically associated with low levels of PT usage [19,25], this does not seem to be the case among students in Hanoi. There may be a possibility that this phenomenon is due to a change in young people's perceptions. As the data illustrated, approximately 80% of interviewees owned a motorized vehicle and driving license (Table 1). Additionally, traffic conditions in Hanoi are worsening due to insufficient PT and a low-capacity network. Therefore, commuting by private mode often results in congestion, excess time, and air pollution exposure, which can be extremely distressing for commuters. The operation of the LRT highly remedies these problems and may influence young people to switch from private mode to PT. However, the extent of this effect is still unclear, suggesting a need for further investigation.

Living with family, having a part-time job, and high travel costs are commonly associated with driving to school instead of using PT [25,26]. Ordinarily, students who live in the city have high confidence in commuting and are more likely to self-driving to school or share a ride with family members. Similarly, having a part-time job may encourage students to control their time and be independent of PT, leading to self-driving. However, these factors were insignificant in the current study, which is inconsistent with the findings of [12]. We propose that the difference in objectives between LRT and bus might account for this inconsistency.

### 5 Limitations and conclusions

The current study has examined the students' behavior using a new LRT project in Hanoi city. The logistic regression model results on the 423 respondents indicate that the satisfaction level was the dominant determinant of choosing LRT as a travel mode for Hanoi architectural university students. Besides, the distance from home to the nearest LRT station and school is also the main factor affecting the student mode choice preference. These results demonstrate that the long school trip and short access to a station would encourage students to use LRT.

The current study's findings would contribute to the practice and academics at two points. First, they provide a good reference for policy-makers and LRT service operators in enhancing the service quality and thus improving the passenger volume. Second, to our knowledge, this is the first study that examines the students' travel behavior regarding the new transit mode in Hanoi. We propose that these outcomes would be worthy for under-construction projects in Vietnamese cities and developing countries.

Some limitations exist in the study, including the observation size and homogeneity. Since the data collecting time was short, the respondent population was mainly observed at Hanoi architectural university. This fact may affect the quality of the data when the individual characteristics seem to be homogeneous. Thus, we propose to expand the targeted interviewee to other educational institutions in future studies. Besides, we also plan to investigate the effect of LRT on the travel mode choice of young people. This action might help address the issue of how to shift private vehicle dependence to public transport.

### References


