ГЛАСНИК Српског географског друштва 104(1) 383-404
BULLETIN OF THE SERBIAN GEOGRAPHICAL SOCIETY 2024

Original scientific paper

UDC 656:[057.875+378-057.175]
https://doi.org/10.2298/GSGD2401383M

Received: March 24, 2024
Corrected: May 09, 2024
Accepted: May 23, 2024

Amine Mehdi Meribai[1*], Youcef Lazri[*]

** 8 Mai 1945 – Guelma University, Laboratory of Hydraulic and Civil Engineering (L.G.C.H), Department of Architecture, Guelma, Algeria*

ACADEMICS' MOBILITY IN THE AGGLOMERATION OF CONSTANTINE: A TRANSPORTS POST-USE EVALUATION

Abstract: The purpose of this study is to closely examine and analyze the increasing phenomenon of academics' urban mobility among students and teachers in the Constantine agglomeration through the examination of their movements. The employed methodology incorporates diverse qualitative research methods, such as covert participant observation, acquiring documentary and statistical data, establishing a research basis on the context, and post-use evaluation through an e-questionnaire survey. The analysis was conducted using tools such as GIS and SPSS. The evaluation utilized distinct criteria, such as origin-destination patterns, modal utilization, travel expenses, and frequency, travel timetables, commuting duration, and disparities between outbound and return journeys. The findings indicate that the commuting circuits of academics are mainly deployed in high-traffic circulation routes. The focus is on intermodality, which entails utilizing transportation modes other than personal vehicles and university buses, primarily due to the presence of a tramway line connecting the Constantine universities. The bus and taxi are frequently employed as the principal means along the tramway. The transport method, its cost, and the frequency of movement are significantly correlated. The travel schedules include peak periods in the morning and evening, and commute time is influenced by factors such as choice of transport mode, accessibility, and traffic congestion. The transport system in the Constantine agglomeration witnesses substantial usage during the academic period.

Key words: academic mobility, students and teachers, post-use evaluation, modes of transport, Constantine agglomeration

[1] meribai.amine@univ-guelma.dz (corresponding author)
Amine Mehdi Meribai (https://orcid.org/0000-0002-9592-0090)
Youcef Lazri (https://orcid.org/0000-0003-0888-9986)

Introduction

Urban planning, since the late 1800s, has encompassed the process of creating and enlarging cities and urban areas. The concentration of urban growth has resulted in alterations to the physical arrangement and comprehension of urban spaces (Choay, 1965; Mériaudeau, 1988; Spiegato, 2023). The idea of a city has evolved into the concept of urban agglomeration, leading to alterations in the urban structure (Barré, 2004; Lynch, 1960). This phenomenon, known as urban sprawl, seeks to distribute growth between central and peripheral areas to alleviate congestion in city centers (Monnet, 2002) while encouraging mobility. The transport systems played a crucial role in the creation of a new urban configuration, regardless of its organization (Kearsley, 1983; Rambinintsoa, 2018; Rejeb Bouzgarrou et al., 2019), design model (Barré, 2004; Panerai et al., 1997), or development plans (Dupont & Pumain, 2000; Gaschet, 2003). This suggests the presence of several peripheral centralities encircling a historical center (Debbabi, 2020; Howard, 1965). The decentralization has led to the spatial segregation of the four primary urban functions emphasized in the initial CIAM conference in 1928 and the Athens Charter of 1933 (Denefle et al., 2006). It is important to mention that the functions are interconnected and dependent on the fourth function, mobility.

Urban mobility encompasses both the physical and time-related aspects. Considered a challenge of the new urban form (Rallet & Torre, 2004), it has attracted considerable attention from researchers (Bassand & Brulhardt, 1983; Kaufmann & Jemelin, 2004; Merlin & France. Direction de la documentation française, 1985). The latter contend that it is intricately linked with urban form. Therefore, it is important to investigate the increasing demand for transport (Souche, 2009), which leads to a surge in road traffic, and congestion within the road network, resulting in an impact on accessibility (Benmechiche & Cherrad, 2018) which varies across different urban settings and cities sizes. This perspective considers the prevalence of automobile usage (Massot et al., 2004), alternative modes of transport, the incorporation of mobility and urban planning policies, and the state's expertise in this domain (Renders et al., 2020). It also investigates transport management and the expenses associated with daily mobility (Deymier et al., 2013; Nicolas et al., 2012) in diverse settings, including professional, student, and household contexts. Simultaneously with the progress of urban areas (Benmechiche, 2019; Dechaicha & Alkama, 2020) through the decentralization of activities, there has been an increase in peripheral centers (Debbabi & Benidir, 2015), urban hubs, and their territorial attractiveness.

Transport policies have advocated for public transport, specifically on-site transport, since the late 1900s (l'Hostis et al., 2013) Implementing regulations that promote the organization of urban development based on collective transport necessitates reintroducing tramways in cities of developed countries, as exemplified by the Law on the Orientation of Inland Transport (LOTI, 1982) in France. The incorporation of this mode into the organization of public transport is essential in urban planning, particularly in light of the Solidarity and Urban Renewal Law (SRU, 2000) (Gouin & Certu, 2007). Subsequently, the United Nations Human Settlements Program recommends the coordination between urban expansion and transport by the implementation of tramlines and the BHNS transports for medium-sized cities with fewer than 500,000 inhabitants in developing countries (Cervero et al., 2013; Debizet, 2011; UN-Habitat, 2011). These measures facilitate the use of multiple modes of transport for a single trip, known as intermodality (Agamez-Arias & Moyano-Fuentes, 2017). Additionally, it promotes multimodality, which entails the existence of diverse

transport modes connecting two locations (Baba Slimane & Baouni, 2023). This approach aligns with the objectives set forth at the 6th World Urban Forum in Naples (Italy, 2012), which prioritize the development of housing, academic institutions, and the reduction of environmentally harmful urban mobility, for clean cities.

It is important to highlight the fact that academic institutions are generators of mobility both at the international level (Germain & Vultur, 2016) and national or interuniversity "residential mobility" (Cattan et al., 2005; Pierronnet, 2020) and at the local level in the so-called university cities where we find a concentration of academic infrastructure (Ferrez et al., 2019). A considerable number of researchers have devoted themselves to analyzing university-based mobility in its various facets geographical or inter-urban with short distances (Baron et al., 2005), with a view to the economic importance of these movements (Pierronnet, 2020) and their impact on urban dynamics in the city (Dhaher, 2010) and transport systems (Terrier et al., 2017). In the urban context, training mobility has been the subject of several researches, the main sample of which is university staff, whether in major university cities in developed countries, such as Canada, France, or Switzerland (Bendjaballah, 2023; Hardouin & Moro, 2014; Rérat, 2021), or in North African developing countries such as Tunisia or Algeria, whose number of universities has been increasing since decades and academics as a result (Acherard & Boukerzaza, 2020; Dhaher, 2010). The latter are interested in the mobility of this portion of the population. A significant fragment of society, offering a variety of scenarios related to the circuits and the modal practice during the home-university journey. Pendulum movements that merge into the increasing general flow of movement of the city's population during the study period.

Algerian cities underwent a demographic explosion in the absence of a coherent development policy during the post-independence period, prompting authorities to adopt centralized policies focused on mass relocation, resulting in the formation of urban complexes detached from the old nuclei. Consequently, the outskirts were expanded, and the lack of consistency emphasized the growth of urban forms (Boudjabi et al., 2018). In the early 2000s, improved financial conditions and a desire for modernization enabled the introduction of proposed city regulations. This proactive plan aimed to reduce spatial inequalities and promote the metropolization of large cities like as Algiers, Oran, and Constantine (Madani, 2017). Projects were awarded in 2006 to enhance specific sectors, such as transport and education the number of which reached 55 academic institutions in 2001(Acherard, 2017). The Project for the Modernization of the Constantine Metropolis (PMMC), a tool for the rebuilding of the urban environment whose two primary aims that interest us are: city redesign and transportation network development, was launched in 2007. In this context, we witnessed the construction of the university pole in Ali Mendjeli city (Abada et al., 2020), which has been in service since 2013, and the implementation of the Constantine tramway, which became operational the same year. Other notable developments include the construction of the Trans-Rhummel Constantine 8th bridge and the cable car in 2008, the Bardo urban park, which has been partially open to the public since 2018 but is still in development, and the Zouaghi Slimane multimodal station project currently in hold (Zehioua & Labii, 2009).

Constantine Known as the city of knowledge and the metropolis of the eastern Algerian region (Kherouatou, 2016), holds a significant position in the academic circle (Cherrad, 2020; Zehioua & Labii, 2009). The new macro form and university character; which is an element of the urban dynamics of the Constantine agglomeration (Abada et al., 2020),

indicate a substantial influx of pendulum movement flows related to the academics' commuting representing 7% of the total displacements recorded, as evidenced by population mobility studies in the study context (Benmechiche, 2019). These studies tackle the issue of congestion in the area's road network and transport system. This active population fringe (Acherard & Boukerzaza, 2020), which is approaching 90,000 individuals divided between teachers and students (Ministère des Finances et al., 2020, p. 75), a considerable number if we compare it to attractive university metropolises such as Montpelier or Montreal that respectively house 51,000 and 185,000 students in 2023 (Bendjaballah, 2023; Université de Montpellier, 2020), is the focus of this work's investigation, which attempts to analyze the increased phenomenon of mobility specific to this segment of society and its effects on the efficiency of the transport system, their travel circuits, and transport usage trends in the agglomeration during the academic period. This work can potentially improve transport policies in university towns (Hardouin et al., 2013) such as Constantine. The study employs an exploratory research approach known as post-use analysis "qualitative study". This method has demonstrated its effectiveness in the field of urban geography, particularly in examining mobility and transport in metropolitan areas like Constantine (Bachiri & Després, 2008; Benmechiche, 2019).

Study area

Constantine, a district in Eastern Algeria, serves as the regional capital (Boudjabi et al., 2018), is situated in the northern part of Algeria, approximately 245 km from the Algerian-Tunisian border and 431 km from Algiers (Acherard Sabrina, 2017). It has a land area of 2,187 km2, a population of 1,310,952 individuals, and a large car fleet of 283,092 vehicles (Ministère des Finances et al., 2020, p. 16) ranked 4th nationally (Office National des Statistiques, 2019). It's a major transit point, as it's crossed by the national roads: 5, 3, 79, 20, 10, 27; with a length of 239km and the East-West highway. Since achieving independence, the site has become one of the primary locations for universities in metropolitan Algeria (Abada et al., 2020). As per Law n° 84-February 9, 1984, which pertains to the country's territorial organization, Constantine consists of twelve municipalities organized into six Dairas (Ministère de l'Intérieur, 2015). Constantine, renowned as a hub of intellectual pursuits, has prioritized the development of urban infrastructure and modern amenities, focusing on its esteemed university institutions. These institutions have become prominent landmarks and are conveniently accessible through well-established transport networks.

The Constantine agglomeration consists of the Constantine municipality and four adjacent municipalities within a 20-km radius: Hamma Bouziane, Didouche Mourad, El Khroub, and Ain Smara. Its area is 778.2 km2, which accounts for 34.29% of the district's total area (URBA Constantine, 2017, p. 3). The area's population is 1,123,718 individuals, accounting for 85.71% of the total population (Ministère des Finances et al., 2020, p.16). It is a central hub for various communication routes, making up 48.44% of the network. These routes include national roads, the East-West highway, and a railway that links it to the Algerian Northeast and the rest of the country. It contains the district's most important urban centers, including the metropolis Constantine, the new city Retba in Didouche Mourad, the new city Massinissa, Ain Nahass in El Khroub, and the new city Ali Mendjeli. The latter presents a new type of planned urbanism where the population has reached 300,000 inhabitants and serves as a relay for Constantine in its functions of

command and organization (Hassani, 2009; Lakehal, 2008, 2013). This city is home to two universities in addition to the two in Constantine city, as a result, the agglomeration boasts four higher education institutions. The tram line connects these two towns passing by the four universities (Abada et al., 2020).

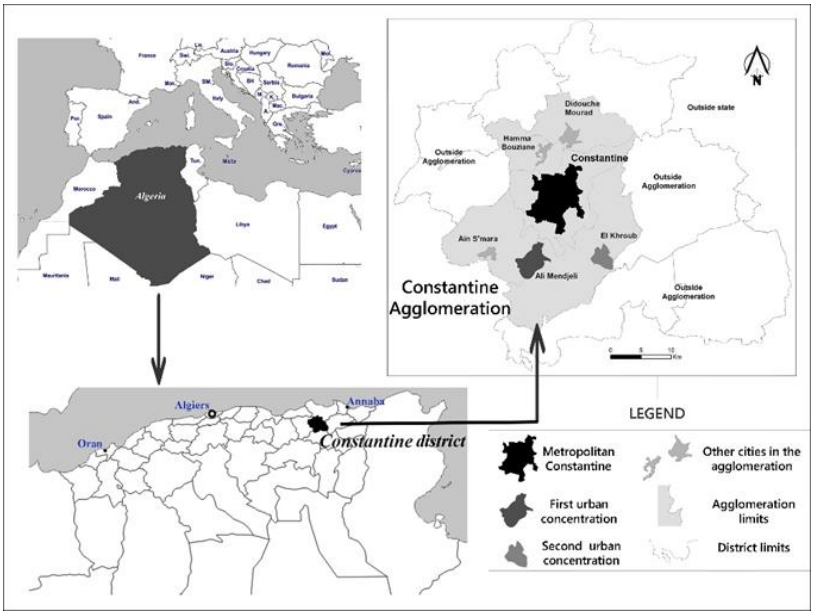


Fig. 1. The geographical positioning of the Constantine agglomeration

Material and methods

To assess the influence of Constantine's university-based mobility on road congestion and transport issues in the agglomeration, we ask the following question: how does the mobility of students and teachers at Constantine's universities affect the efficiency of the transport system? The hypothesis posits that the commuting of this particular segment of society is accountable for significant travel patterns observed during the study period. Furthermore, it suggests that the circuits of this one are inserted in the main traffic axes in the Constantine agglomeration, thereby exerting pressure on various modes of transport. The objective is to understand and analyze the phenomenon of enhanced university mobility by examining the circuits in the Constantine agglomeration. To test the hypothesis and accomplish the desired objective, we will employ an exploratory research methodology known as the post-use analysis "qualitative study" utilizing various approaches.

The first method is incognito participant observation, which involves monitoring transport usage frequency during training and vacation periods. To comprehensively analyze the recurrence of this phenomenon in transport, it is crucial to consider that road congestion in the Constantine agglomeration (Benazzouz et al., 2019) is significantly reduced during peak hours in the holiday period compared to the study period. This on-site intervention aims to compare the usage rates of the two most popular modes of transit; tramway and bus (Diabi & Lazri, 2021), by analyzing photographs taken at the respective stations and modes. These photographs were taken during the study period, on March 29,

2022, at 9 a.m., at tram station “Zone Industrielle PALMA” because it is directly connected to “Palma Constantine terminal”, an exchange hub with 20 directions, and close to “Saharawi Tahar terminal.” The photos of urban buses were taken at the «Djnen Zitoune» station, which is significant because it is close to the exchange hub and on the southern bypass route; it has a high rate of 3,000 v/h (Direction Des Travaux Publics Constantine, 2020) (Figure 4). The same stations and modes were also photographed during the spring break on April 3, 2022, at 9 a.m.

We also collected documentary and statistical data from district administrations and organizations on the urban form (URBA Constantine, 2017), road network and traffic, tram line, and university establishments (Ministère des Finances et al., 2020). This data was used to project these components onto the map of the study context (Figure 4), allowing us to observe these elements’ geographical organization in the Constantine agglomeration. Next, we examined crucial statistics regarding the distribution of the student and teacher masses in universities, including student registrations, pedagogical seats, university accommodation, and transport. This data serves as a foundation for assessing the current situation in our case study.

Finally, our qualitative approach involves conducting a post-use evaluation of urban transport modes in Constantine. This evaluation is based on an origin-destination survey among university students and teachers. We will use a random e-questionnaire via Google Forms to gather data on circuits, travel trends, and the use of transport modes by the university community. The selected sampling method is a simple random probabilistic approach, which enables statistical inference, particularly when examining a sizable population (Gumuchian et al., 2000). The decision is also associated with the limited time budget (Dixon & Leach, 1978), as the responses to the questionnaire need to be gathered before the conclusion of the 2021/2022 academic year. A total of 1500 invitations were dispatched to university professors through their official email addresses, as listed on the official websites of Constantine’s universities. In addition, around 1000 flyers with a hyperlink to the electronic questionnaire were disseminated to students at the four universities over three months. Approximately 2500 invitations were distributed, in addition to the invitations shared on the social networking platform Facebook within the groups and pages dedicated to Constantine academics, which function as exchange. If we take into account the response rate, a suitable sample size would be 20%. This calculation was performed using a specialized website (CheckMarket, n.d.) for a total population of 91448 individuals, with a confidence rate of 95% and a margin of error of 5% (Gumuchian et al., 2000). Based on the simulation, the estimated number of replies would be 383.

Nonetheless, we obtained a total of 245 responses, out of which 215 were considered suitable for our research. After verifying on the same site, this number reflects a margin of error of 6.68%. This appears rational and indicative given the consistency between the results obtained and the data collected, as well as the findings of a previous study conducted on population mobility in the Constantine agglomeration, which employed a similar methodology (Benmechiche, 2019). The urban, mobility, and transport data that has been obtained, along with its geographical aspect, is displayed on a map using AutoCAD. This provides an overview of the current situation in the agglomeration. GIS is also utilized to analyze the survey results in terms of movement flows. SPSS statistical processing software is utilized to analyze survey data related to travel trends, transit usage and cost, intermodality practice, schedules, and variations in mobility time budget. The subsequent

diagram provides an overview of the research methodology, the specific steps are explained further below.

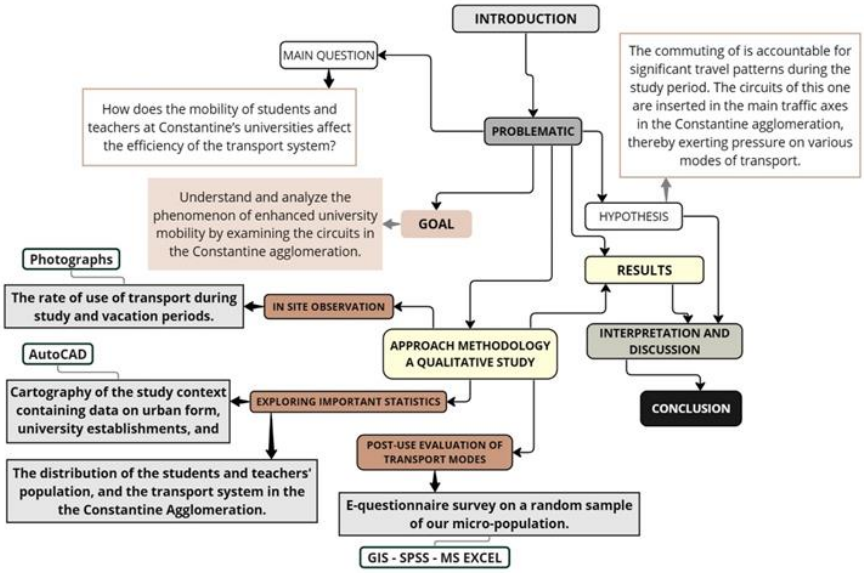


Fig. 2. Research methodology chart

In-site observation approach

Figure 3 illustrates that during the holiday season, the two modes of transport; tramway and bus, do not reach their maximum capacity. However, during the study period, they experience a high influx of travelers, reaching or even exceeding their capacity. This observation demonstrates the contrasting usage patterns between the two periods.

Fig. 3. Usage rate of tramway and urban bus in study and holiday periods (note. Panel A, B, C: Study period. Panel D, E, F: Spring break period)

Exploring key facts about universities and transportation in the Constantine agglomeration

As we can see in Figure 4 below, the district universities and independent university schools are situated within the Constantine agglomeration, specifically in the cities of Constantine and Ali Mendjeli, except for the veterinary institute, which is located in Khroub (Acherard & Boukerzaza, 2020). Due to its abundance of higher education institutions and extensive housing capacity, the agglomeration exerts a substantial territorial attraction on the eastern region of the country. A considerable proportion of students come from areas outside the district, providing insight into the patterns of incoming and outgoing movements within the agglomeration (Acherard & Boukerzaza, 2020). The occupancy rate of pedagogical seats at universities is approximately 89.75%, and 69.89% in independent university schools (Ministère des Finances et al., 2020, p. 95).

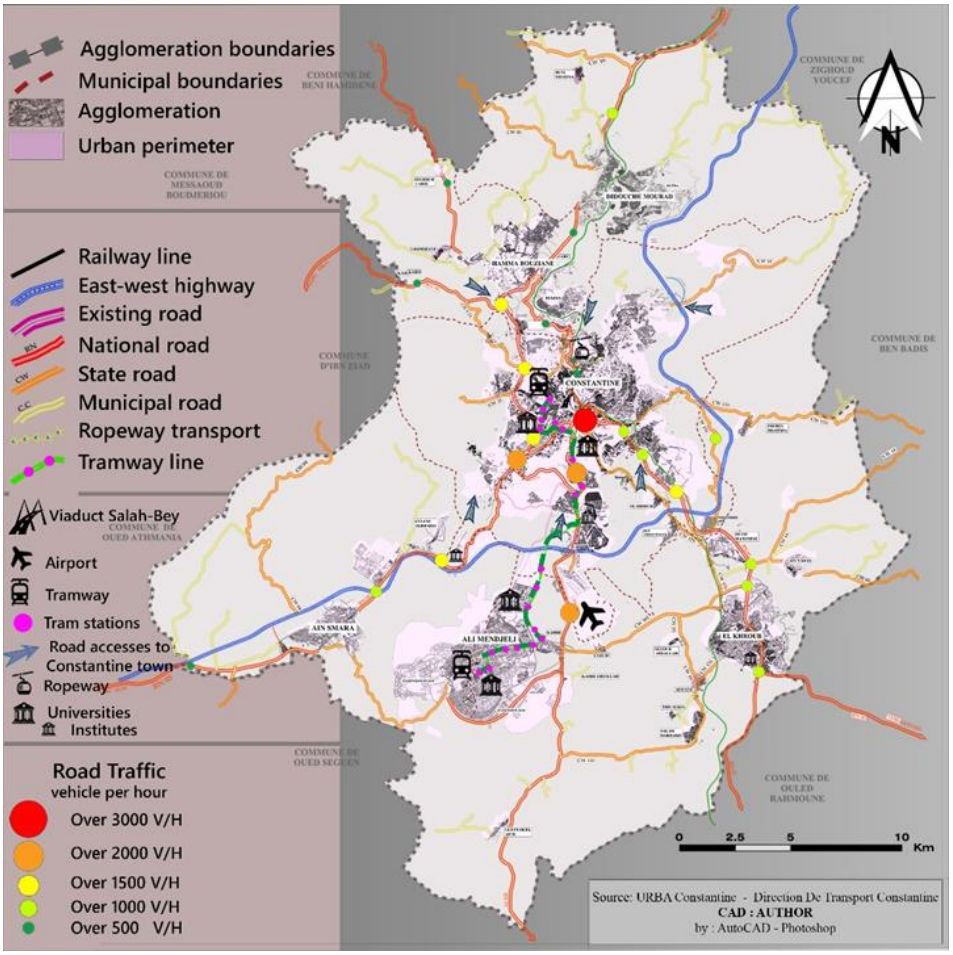


Fig. 4. Mobility map of the Constantine agglomeration

The urban transport system in the Constantine agglomeration consists of 2,361 buses and 3,604 taxis, which operate from four terminals and eleven urban stations (Ministère des Finances et al., 2020, p 74 - 78). The tramway in Constantine was officially opened in

2013 by the Algerian company SETRAM. Subsequently, two extensions were implemented in 2019 and 2021. The road links the central area of Constantine with the southern part of Ali Mendjeli's newly developed city, providing transport access to the four universities. There are 21 stations along the 18.5 km rail line (SETRAM, n.d.). The current daily ridership of the tramway is estimated to be around 50,000 individuals per day (Algérie Presse Service, 2022) and has a 73% usage rate among users aged 20 to 30 (Diabi & Lazri, 2021); It is worth noting that university students belong to this age category. The VTC, which stands for Vehicle for Hire with a Chauffeur, serves as a viable alternative to traditional taxis (tourismealgerie.com, 2023). It is similar to the American Uber (Uber.com, 2023), Yassir, and other similar companies in Algeria. Illegitimate taxis often target areas with limited transport options, underserved by public transit (Benmechiche, 2019), sometimes even rivaling taxis by offering more affordable transport services.

Qualitative approach: post-use evaluation

The urban environment is a multifaceted system comprising various domains, interconnected by urban mobility, which serves as the lifeblood sustaining and facilitating the proper operation of the city by enabling the movement of individuals. Within this particular ideology, the concept of mobility is characterized by its diverse range of applications and modes, its intricate relationship with the urban structure, and the various activities that occur within it. This intricate system can be considered highly complex in its own right. Based on the principles of logical reasoning, our approach to this system involves engaging with an active segment of society, namely university students and teachers.

The post-use evaluation (PUE) is a systematic examination of performance under typical use conditions. In the field of transport, the PUE allows for the verification of the operational performance of a set of modes of transport (Oillo, 2021). In this study, we use the PUE to assess the efficiency of the transport system's organizational plan in the Constantine agglomeration while used by university students and teachers during the academic period. Our survey's analysis criteria are as follows:

- Origin and destination patterns: this component allow us to collect essential information on the travel directions of academics (Belghith Feres et al., 2013; Hardouin Magali et al., 2014) and project them onto the general context of travel in the Constantine agglomeration.
- Use of transport modes: this section discusses the trends in transport modes and intermodality practice (Hardouin Magali et al., 2014); it will allow us to better analyze the interaction between spatial planning, transport, and users.
- Frequency and cost of travel: this component allows us to assess the regularity, the frequency of travel, and its impact (Proulhac, 2022). The cost of transport which is a factor that generally influences travel practices and mode choice (David, 2022; Kaufmann, 2023). In In this sense, we shall attempt to verify the relation between these two parameters through the collected responses.
- Schedules, daily frequencies, commuting time, and variations: The travel schedules indicate at what times of the day the transport system is stressed. The daily frequency reflects the number of outwards and returns made during the day and the conditions under which they are made. As for the commuting time and variations thereof, we are attempting to understand the causalities that make the difference in travel time between outward and return journeys (Mazengani et al., 2022); several factors may be at work.

Results and discussion

Several origins for three destinations

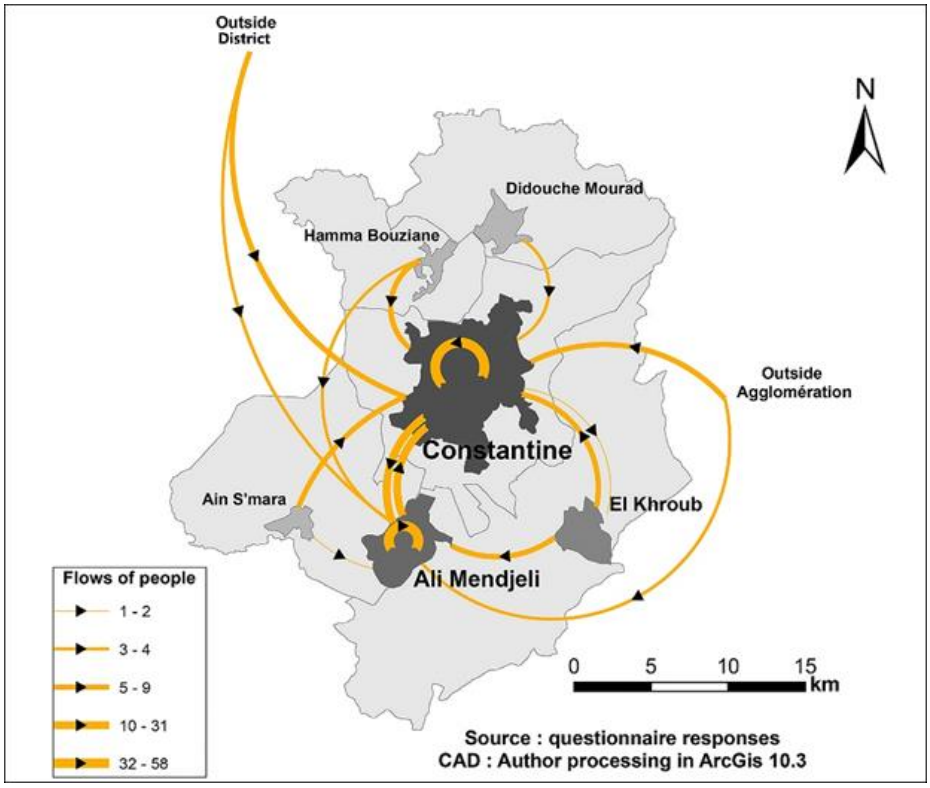


Fig. 5. Constantine agglomeration: flow chart of academics' movements (origin-destination)

The examination of the origin-destination movement patterns of individuals surveyed who are traveling to universities, as depicted in the provided Figure 5, reveals that Constantine is the most popular destination (Benmechiche, 2019), accounting for 56.3% of all responses, 47.9% of which are local trips. Inter-urban trips are represented by 17.4% from Ali Mendjeli, 7.4% from El Khroub and Ain Smara, 5.8% from Hamma Bouziane, and 3.3% from Didouche Mourad, while those from outside agglomeration are represented by 5% and outside district by 5.8%. Ali Mendjeli comes in second with 42.7% of the total number of responses collected, 44.6% of which are local trips; for inter-urban trips, the rate is 31.5% from Constantine, 8.7% from El Khroub, 3.3% from Hamma Bouziane, and 1.1% from Ain Smara; and those who remain are from outside agglomeration (6.5%) and outside district (4.3%). El Khroub takes third place, with only 1% of total travel circuits coming from Constantine. Based on traffic patterns, Constantine and Ali Mendjeli appear to have nearly equal territorial attractiveness (Debbabi, 2020; Naidja, 2017). Ali Mendjeli is an important urban and university hub in competition and complementarity with Constantine metropolis (Abada et al., 2020), as it contains university residences that house many of Constantine's students (Ministère des Finances et al., 2020, p 95).

Use of transport modes

Constantine and Ali Mendjeli gather all modes of transport in response to the significant road traffic on the major circulation axis that links them within the agglomeration. This traffic volume surpasses 2000 vehicles per hour (direction des travaux publics Constantine, 2020).

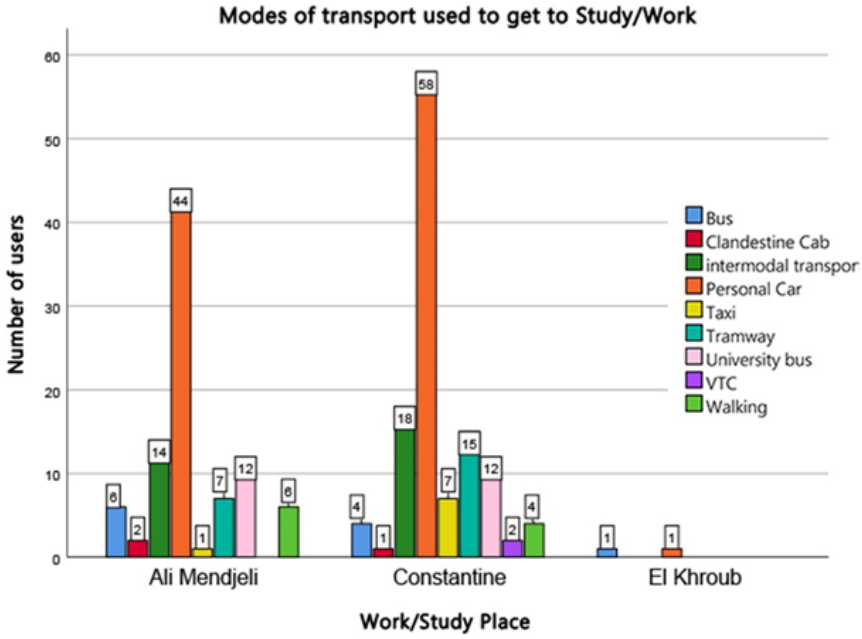


Fig. 6. Modal usage according to destinations

The personal car is the most popular mode of transport as we can see in Figure 6 above, followed by intermodality, which is used by 15% of travelers and appears to be gaining traction due to the tram line connecting the three universities. The tram appears to be competing for third place with university transport because, as previously stated, the latter is at capacity. The bus and taxi are less common modes of transport, but they appear to be quite useful for some users. Informal transport and VTC are the least used modes. The results also show that a handful of students and teachers living on or near the campuses prefer to walk.

Use of transports according to the profile: student/teacher

As illustrated in Figure 7 below, the primary choice for students is the university bus, followed by the tramway that serves the three universities. Subsequently, using personal vehicles ranks third in preference, then intermodality; primarily related to tramway, which is present 84% of the time in the combinations of modes of transport. Walking follows immediately, students prefer to use an active mode. The remaining modes are bus, informal transport, taxi, and VTC. The bus, although slow due to frequent stops, is comparatively economical. Informal transport compensates for formal transport's lack of coverage. VTC services exhibit similar speed to taxis or private cars.

Because they have the financial resources, 65% of teachers drive, intermodality comes in second with 15%, primarily a combination of the tram and a second mode of transport. This finding indicates that the tram line efficiently collects and transports passengers to other modes of transport, particularly the bus and taxi. Only 20% of all trips are made using the remaining modes of transport.

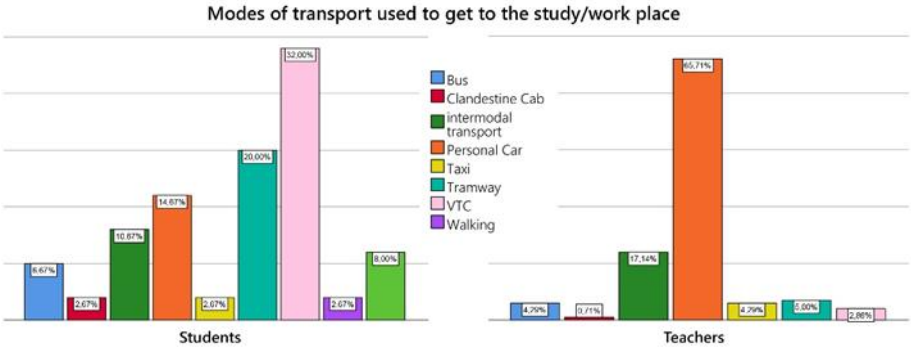


Fig. 7. Modal usage according to the user's profile

Intermodality practice: common combinations of modes

The findings indicate that combinations are limited to two modes per trip. In 90% of cases, the tramway is utilized, while the bus is used in 62% of cases, and the taxi in 48%. The first three combinations catch our attention (Figure 8).

- Tram-Bus: with a 50% rate, this is the most commonly used combination. This is the case with all visits to Constantine and Ali Mendjeli. These cities attract travelers who use this combination due to the tramway and adequate coverage of urban bus lines.
- Tram-Taxi: the availability of line taxis near some tram stations explains why the taxi is in second place with 31%; despite the higher cost, the taxi is significantly faster and more comfortable than the bus. This is also true for trips to Constantine and Ali Mendjeli, but most of the origins are from outside the agglomeration and district.
- Bus-Taxi: this combination, which ranks third with only 9%, is used when the tram is not appropriate, even on local trips. The destinations are Constantine from Constantine itself and Ali Mendjeli, from outside the agglomeration and district.

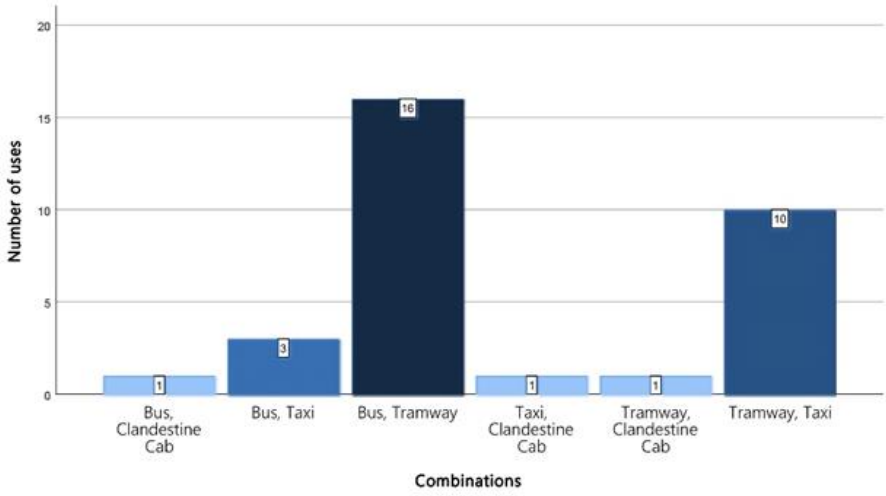


Fig. 8. Intermodality practice according to modal combinations.

These transport combinations demonstrate a functional link and proximity in the distance between the tramway, bus, and taxi. This finding strengthens the tramway's position as the primary mode of transport on-site, connecting metropolitan Constantine to Ali Mendjeli. In terms of intermodality, we can see that Constantine is the most well-served by modes of transport, and the crossing of all national roads passing through the district in this city serves as a relay point between Ali Mendjeli and the rest of the agglomeration's cities that are located further north (Benazzouz et al., 2019).

Frequency and cost of mobility

First and foremost, we observe in Figure 9 below, that the more we travel, the less we spend on a displacement; we will next attempt to analyze the following three frequency categories since they appear in 94% of the answers:

- Daily frequency: 61% of travelers travel daily and globally spend less than 400 DZD/day (approx. 2.92 USD), while most of this category spend less than 200 DZD/day (approx. 1.46 USD); 76% of students fall into this category, compared to 36% of teachers.
- Twice a week frequency: In 45% of the total responses, a more equitable distribution of travel costs was indicated, even if most of the costs recorded are still less than 200 DZD (approx. 1.46 USD). Approximately 15% of students and 57% of teachers are in this group.
- Weekly frequency: this category accounts for only 11% of all responses; the most frequently documented expenditures are less than 200 DZD (approx. 1.46 USD) and between 410 and 600 DZD (approx. 2.92 to 4.37 USD). This category includes 8% of students and 6% of teachers.

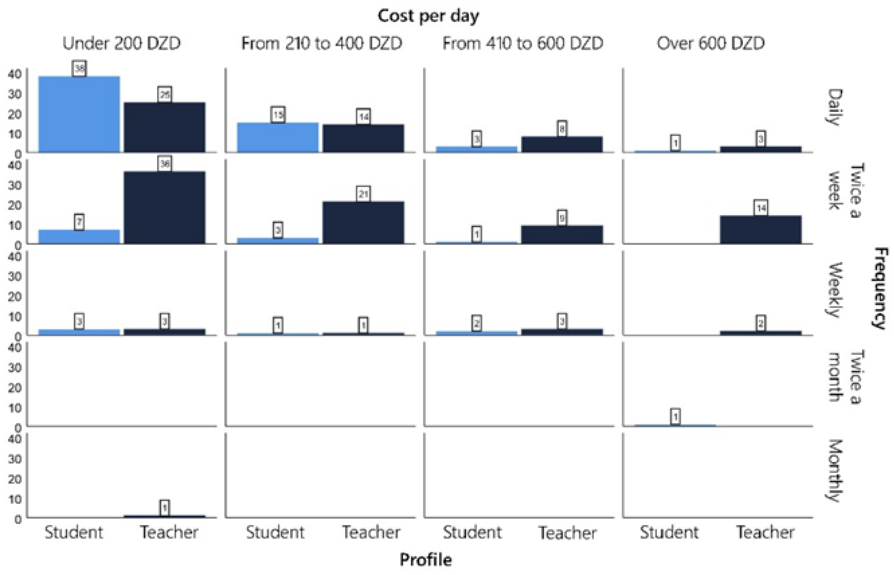


Fig. 9. Commuting frequency and cost according to the users' profile

Students travel more frequently and spend less money on transport. Teachers, on the other hand, travel less often and spend more. Students prefer low-cost modes of transport. Aside from the automobile, whose fuel cost is proportional to the distance traveled and who does not benefit from university transport, intermodality appears to be more expensive for teachers due to their modes' choices.

Travel schedules, frequency of round trips, and commuting time

According to Table 1, only 5 of the 215 respondents make two round trips during the day. The current case involves three students living near the university and traveling locally in Constantine and Ali Mendjeli by foot and tram. It is also about two teachers who go on local car trips.

Tab. 1. Frequency of trips through a study or work day

Frequency/day	2 trips	4 trips	Total
Number of travelers	210	5	215
Number of trips	420	20	440

Table 2 below summarizes the total outward and return trip travel schedules. According to the schedules of home-work / study outward trips, there are three categories: The first category includes 84% of travelers in the sample who travel between 7.00 and 9.45, while the second, which represents 12% of the total workforce, travels between 10.00 and 11.45, and the third, which represents the remaining 4%, travels between 12.00 and 13.45; the last two categories are primarily made up of teachers. According to the work/study-home return trip schedules, there are three categories. The first one includes 47% of sample travelers who travel between 16.00 and 17.45, the second includes 42% of total travelers between 14.00 and 15.45, and the third category covers the remaining 11% who travel between 12.00 and 13.45. The last two categories primarily include teachers.

Tab. 2 Number of trips according to travel timetables through a study/work day

Travel schedules	7.30 – 9.00 Outward	10.00 – 11.45 Outward	12.00 - 13.45 Outward	12.00 - 13.45 Return	14.00 – 15.45 Return	16.00 – 17.45 Return
Number of trips	184	28	8	25	91	104

Commuting time and variations

On the first reading (Figure 10), the commuting times of our sample are classified as follows: “21 to 40 min” with about 36%, “10 to 20 min” with 29%, and “41 to 6 0min” with 18%. These 3 categories alone represent 83% of the recorded cases. Then, we note the categories: “61 to 90 min” with 7%, “more than 120 min” with 6%, “91 to 120 min” and “less than 10 min” with 2% each.

- The “less than 10 min” category only concerns local trips.
- The “10 to 20 min” time budget mainly concerns local trips but also many inter-urban within the agglomeration, particularly circuits between Constantine, Ali Mendjeli, and El Khroub.
- The “21 to 40 min” category includes inter-urban trips from all origins.
- The “41 to 60 min”, “61 to 90 min”, and “91 to 120 min” time budgets concern the longest circuits in the grouping: Didouche Mourad-Constantine, Hamma Bouziane-Ali Mendjeli, and Ain Smara-Constantine, and also part of the circuits between Constantine or Ali Mendjeli and the cities from outside agglomeration.
- The “more than 120 min” category includes all the circuits to and from outside the district and some from outside agglomeration.

The figure also shows the variations of commuting time between outwards and returns, which affect 28 travelers out of 215. Only the categories “Less than 10 min” and “more than 120 min” are not affected by variations.

Causes of commuting times variations: between outward and return trips

After data crossing, it has been found that (Figure 11) 75% of these variations’ phenomena show extensions of the return duration compared to the aisle of the same circuit, while 25% show a narrowing of this duration. Nevertheless, these changes are due to several causes.

Accessibility is the most important cause of variations, it is strongly present in both phenomena (Debbabi & Benidir, 2015). However, the impact differs according to the origins and destinations of the circuits.

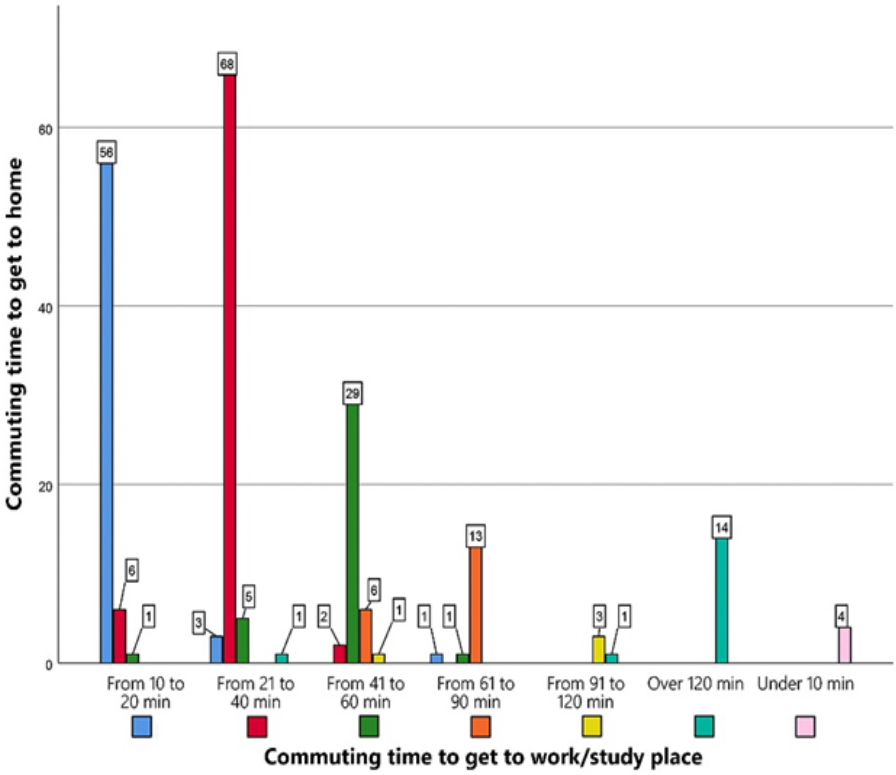
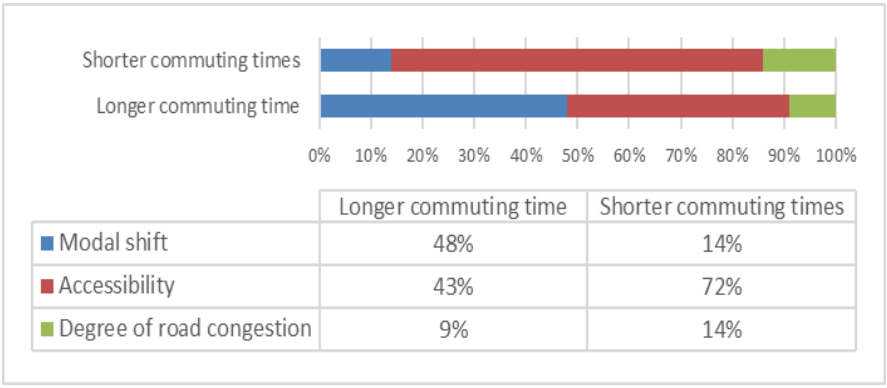


Fig. 10. Commuting times and variations between outgoing and return trips



	Longer commuting time	Shorter commuting times
Modal shift	48%	14%
Accessibility	43%	72%
Degree of road congestion	9%	14%

Fig. 11. Causes of commuting time variations between outgoing and return trips

In the case of the extension, it represents 43% and concerns the directions Constantine - El Khroub, El Khroub - Constantine, Constantine - Ali Mendjeli, and Ali Mendjeli – Constantine. Thus, we notice poor entry accessibility to these three cities in the afternoon. In these two axes, Ali Mendjeli-Constantine and Constantine-El Khroub, travelers respectively use the RN79 and the RN03, which intersect on the southern bypass of Constantine. It represents an overflow of traffic on the road (Figure 4), causing a craze during evening

peak hours. Regarding narrowing, Constantine-Hamma Bouziane, Constantine-Didouche Mourad, Constantine-Ain Smara, Ali Mendjeli-El Khroub, and Ali Mendjeli-Hamma Bouziane account for 72% of cases. The road network becomes less congested as we travel away from Constantine and Ali Mendjeli (Figure 4).

The modal change is the second leading cause of variations and can cause both phenomena (Diabi & Lazri, 2018; Rubens et al., 2011).

In the case of the extension, it represents 48% of cases, we recorded changes from fast to slower modes in the return trips:

- Using Intermodality, opting for VTC, or walking instead of a personal car.
- Practicing Intermodality, or using urban buses instead of university transport.

In the case of narrowing, representing 14% of it, we are talking about faster modes of transport on the way back in the case of intermodality:

- Using the combination « tramway-taxi » instead of « tramway-bus ».

The degree of road congestion (Debbabi, 2020), a minority cause representing only 9% in longer commuting time cases and 14% in shorter ones, it affects local traffic in Constantine and Ali Mendjeli cities. The variations in commute time whether prolonged or narrow, depend on the traffic jams that may change in magnitude during the afternoon.

Conclusion

The study aimed to understand mobility among university students and teachers in the agglomeration of Constantine by analyzing their travel circuits. It investigated the impact of their commuting on transportation routes and modes. The research utilized a methodological approach focusing on post-use evaluation of transit modes to draw conclusions based on specific criteria.

Three destinations exist, Constantine and Ali Mendjeli are significant. These cities have a strong appeal due to identified circuits. They are key urban and educational centers with numerous institutions and university accommodations. El Khroub is the third destination and home to one of the 28 institutions. Local and inter-urban circuits use various transport modes. Modal usage shows different mobility patterns among students and teachers. Intermodality proves advantageous for both parties and helps overcome university transport schedule issues. Travelers often combine different modes like tram and bus or tram and taxi when practicing intermodality.

The relationship between transport cost and frequency of travel is inversely proportional. Students, who travel more often, have lower costs compared to teachers. Apart from university transport and personal car, students prefer "tram-bus" or direct urban "bus" while teachers prefer "tram-taxi" or VTC. Morning journeys are between 7:00-9:45, afternoon journeys are split into 16:00-17:45 and 14:00-15:45. Commuting duration is constant for outbound and inbound trips, with most trips lasting less than 40 minutes for inter-urban and less than 20 minutes for local trips.

Circuits from other cities in or out of the agglomeration and district have more time allocation based on distance. Travel expenses vary for return trips compared to outbounds when transport mode changes. Trips to Constantine, Ali Mendjeli, or El Khroub have

longer inbounds due to the evening rush hour accessibility challenge. Other locations have shorter travel times and better accessibility during evening rush hours. The road network of Constantine and Ali Mendjeli shows congestion during high demand, impacting return travel times.

To summarize, the findings support the hypothesis regarding the significance of university students' and teachers' travel patterns. This study provides an inventory that may help the enhancement of transport planning by emphasizing the importance of considering university-related mobility in the manufacturing policy of Algerian university cities or in other countries which generally favor the establishment of academic institutions near major transport axes, especially in cases where the university transport service is not provided. An aspect of mobility that must be taken care of in student cities, particularly in large metropolitan areas like Constantine. This study concentrates on the obliged displacements linked to higher education, a growing demand for mobility within this segment of society, regardless of non-obliged movements, which could be the subject of a study investigating the way this group practices the city.

Conflicts of Interest: The authors declare no conflict of interest.

References

Abada, R., Labii, B., & Guenadez, Z. (2020). Le rôle et la place du pôle universitaire Constantine 3 dans la dynamique territoriale de Constantine metropole. *Revue Académique Des Etudes Sociales et Humaines, 12*(2), 21–33.

Acherard, S., & Boukerzaza, H. (2020). La mobilité pour les études universitaires dans la ville nouvelle Ali Mendjeli. Lecture et analyse des flux de déplacements. *Revue Des Sciences Humaines, 31*(2), 961–977.

Acherard, S. (2017). *Métropolisation et territoires préférentiels de la mondialisation en Algérie. Le cas de Constantine* [Thèse de doctorat, Université Frères Mentouri - Constantine I].

Agamez-Arias, A.-M., & Moyano-Fuentes, J. (2017). Intermodal transport in freight distribution: a literature review. *Transport Reviews, 37*(6), 782–807. https://doi.org/10.1080/01441647.2017.1297868

Algérie Presse Service. (2022, January 19). *Constantine: hausse significative de la fréquentation du tramway*. https://rb.gy/vug0f

Baba Slimane, N. E. H., & Baouni, T. (2023). Transport et mobilite urbaine face aux defis géo historiques et geomorphologiques d'Alger. cas de la premiere couronne d'Alger. *Urban Art Bio, 2*(1), 53–78. http://dx.doi.org/10.35788/uab.v2i1.93

Bachiri, N., & Després, C. (2008). Mobilité quotidienne dans la communauté métropolitaine de Québec d'adolescents résidant en territoires rurbains. Enfances Familles Gé-

nérations. *Revue Interdisciplinaire Sur La Famille Contemporaine, 8*. https://doi.org/10.7202/018490ar

Baron, M., Caro, P., Cuney, F., & Perret, C. (2005). Mobilités géographiques étudiantes: quelles disparités regionals. https://shs.hal.science/halshs-00109681

Barré, A. (2004). Rémy Allain : Morphologie urbaine. Géographie, aménagement et architecture de la ville. *Espace Populations Sociétés, 3*, 695–696.

Bassand, M., & Brulhardt, M.-C. (1983). La mobilité spatiale: un processus social fondamental. *Espace Populations Sociétés, 1*(1), 49–54.

Belghith, F., Le Corgne, S., & Verley, E. (2013). *La vie étudiante: transports et déplacements quotidiens* https://publication.enseignementsuprecherche.gouv.fr/eesr/6/EESR6_ES_15la_vie_etudiante_transports_et_deplacements_quotidiens.php

Benazzouz, I., Ghenouchi, A., & Layeb, H. (2019). Le centre-ville générateur et captif des flux de circulation: cas de Constantine. *Revue Des Sciences Humaines, 30*(4), 147-166.

Bendjaballah, I. (2023). *La carrière migratoire des étudiants maghrébins à Montréal L'influence de l'expérience urbaine sur leur rétention dans la ville d'accueil*. INRS.

Benmechiche, M. (2019). *Urbanisation, mobilité et transport urbain dans le groupement de Constantine* [Thèse de doctorat, Université Frères Mentouri - Constantine I].

Benmechiche, M., & Cherrad, S. E. (2018). La circulation routière à Constantine et son effet sur son accessibilité. *Sciences & Technologie, 47*, 189–197.

Boudjabi, N. H., Bouzahzah, F., & Bouchareb, A. (2018). Lire la ville d'aujourd'hui… réécrire celle de demain! Constantine le legs: entre permanences et mutations. *Sciences & Technologie, 47*, 199–210.

Cattan, N., Berroir, S., & Saint-Julien, T. (2005). La mobilité des étudiants entre les universités franciliennes. *Les Cahiers de l'IAURIF, 143*, 76–84.

Cervero, R., Iuchi, K., & Suzuki, H. (2013). *Transformer les villes grace aux transports en commun: integration des politiques en matiere de transports et d'amenagement du territoire a l'appui d'un developpement urbain durable-resume analytique*. The World Bank.

CheckMarket. (n.d.). *Sample Size Calculator*. Retrieved November 13, 2022, from https://fr.checkmarket.com/calculateur-taille-echantillon/

Cherrad, M. M. (2020). Ali Mendjeli, une ville nouvelle universitaire? *Human Sciences Journal*, 777–792.

Choay, F. (1965). *L'Urbanisme, utopies et réalités: une anthologie*. Éditions du Seuil.

David, Q. (2022). Gratuité des transports en commun et congestion routière: revue de la littérature et implications pour Paris 1. *Revue d'économie Politique, 32*(3), 421–452.

Debbabi, S. (2020). *La polycentralite urbaine: pour la restructuration d'un territoire fragmente. Cas d'etude: le groupement urbain de constantine*. [Thèse de doctorat, Université Constantine 3 Salah Boubnider, Faculté d'architecture et d'urbanisme].

Debbabi, S., & Benidir, F. (2015). Constantine: Vers la formation d'une agglomeration polycentrique. *Sciences & Technologie*, 41–52.

Debizet, G. (2011). L'évolution de la modélisation des déplacements urbains en France 1960-2005: Le poids de l'organisation institutionnelle des transports. *Flux, 3*, 8–21.

Dechaicha, A., & Alkama, D. (2020). A spatio-temporal cartography and landscape metrics of urbanization patterns in algerian low-sahara. the case of ouargla city. *Journal of Fundamental and Applied Sciences, 12*(3), 1235–1252.

Denefle, S., Bresson, S., Sussuet, A., & Roux, N. (2006). *Habiter Le Corbusier: pratiques sociales et théorie architecturale*. PU Rennes.

Deymier, G., Gaschet, F., & Pouyanne, G. (2013). Formes urbaines et coûts de la mobilité: une approche à partir du compte déplacement territorialisé de l'agglomération bordelaise. *Les Cahiers Scientifiques Du Transport, 64*, 61–90.

Dhaher, N. (2010). Aménagement universitaire et mutations urbaines en Tunisie. *Cahiers de Géographie Du Québec, 54*(152), 337–353.

Diabi, A., & Lazri, Y. (2018). L'influence du développement des transports sur les formes de mutation urbaine : cas de la ville de Constantine. *Sciences & Technologie. D, Sciences de La Terre*, 31–45.

Diabi, A., & Lazri, Y. (2021). *Systèmes de transports urbains et pratiques d'intermodalité à Constantine–le cas du Tramway* [Thèse de doctorat, Université Frères Mentouri - Constantine I].

Direction Des Travaux Publics Constantine. (2020). Recensement du Trafic Routier - Année 2020 - RN T.J.M.A - Les Deux (02) Sens [Road Traffic Census - Year 2020 - RN T.J.M.A - The Two (02) Senses].

Dixon, C. J., & Leach, B. (1978). *Sampling methods for geographical research*. UK: Geo Abstracts.

Dupont, V., & Pumain, D. (2000). *De la ville compacte aux métropoles polycentriques*. Publications des scientifiques de l'IRD.

Ferrez, E., Haldimann, L., Heers, M., Kleiner, B., Rérat, P., & Stam, A. (2019). Entre mobilité temporaire et ancrage local: portrait de la jeunesse Suisse. *Série scientifique ch-x, 25*.

Gaschet, F. (2003). Émergence de pôles secondaires et rôle des macroagents urbains au sein de l'agglomération bordelaise. *Revue d'Économie Régionale et Urbaine, 5*, 707–732.

Germain, A., & Vultur, M. (2016). *Entre mobilité et ancrage: les étudiants internationaux à l'INRS*. Centre Urbanisation Culture Société.

Gouin, T., & Certu, F. (2007). *Planification urbaine et tramway en France: les leçons de l'expérience du tramway français modern*. Rapport Technique.

Gumuchian, H., Marois, C., & Fèvre, V. (2000). *Initiation à la recherche en géographie: aménagement, développement territorial, environnement*. PUM.

Hardouin, M., & Moro, B. (2014). Étudiants en ville, étudiants entre les villes. Analyse des mobilités de formation des étudiants et de leurs pratiques spatiales dans la cité: Le cas de la Bretagne. *Norois, 230*, 73–88.

Hardouin, M., Moro, B., & Leray, F. (2013). Mobilités de formation et ancrage des étudiants dans les villes universitaires: exemple de la Bretagne (France). *Enfances Familles Générations. Revue Interdisciplinaire Sur La Famille Contemporaine, 19*.

Hassani, I. (2009). Processus de métropolisation et étalement urbain, quelles conséquences sur la ville de Constantine. *Sciences & Technologie. D, Sciences de La Terre*, 29, 79–86.

Howard, E. (1965). *Garden cities of to-morrow*. Mit Press.

Kaufmann, V. (2023). *Innovation et créativité dans la mobilité urbaine*. Ville et Créativité.

Kaufmann, V., & Jemelin, C. (2004). La motilité, une forme de capital permettant d'éviter les irréversibilités socio-spatiales. Espaces et Sociétés Aujourd'hui. *Colloque de Rennes*, 21–22.

Kearsley, G. W. (1983). Teaching urban geography: The Burgess model. *New Zealand Journal of Geography, 75*(1), 10–13.
Kherouatou, M. (2016). La mémoire vive au cœur des cultures constructives à Constantine: un enjeu de sauvegarde. *Sciences & Technologie. D, Sciences de La Terre, 43*, 49–57.
Lakehal, A. (2008). *La périphérie de Constantine: émergence de nouvelles centralités et évolution des modes de vie*. halshs00380578
Lakehal, A. (2013). La fabrication plurielle de centralités dans la périphérie de Constantine: le cas de la Ville nouvelle Ali Mendjeli. *Les Cahiers d'EMAM, 22*(22), 131-132. http://dx.doi.org/10.4000/emam.566
L'Hostis, A., Soulas, C., & Wulfhorst, G. (2013). La ville orientée vers le rail et l'intermodalité. *Economica*, 115-126.
Lynch, K. (1960). The Image of the city. *City, 19*, 50.
Madani, S. (2017). Le tramway de Sétif: projet urbain ou simple projet de transport? *Cahiers Géographiques de l'Ouest, 12–13*, 169–178.
Massot, M.-H., Armoogum, J., Bonnel, P., & Caubel, D. (2004). Une ville sans voiture: utopie ? *Revue d'économie Régionale et Urbaine, 5*, 753–778.
Mazengani, R., Josset, J.-M., & Soulié, N. (2022). Conditions, activités, habitudes et bien-être dans les transports quotidiens: étude de cas à Paris-Saclay. *RTS-Recherche Transports Sécurité, 2022*, 17.
Mériaudeau, R. (1988). Pierre Merlin, Françoise Choay. —Dictionnaire de l'urbanisme et de l'aménagement. *Revue de Géographie Alpine, 76*(3), 304–305.
Merlin, P., & France. Direction de la documentation française. (1985). *Les politiques de transport urbain*. La Documentation française.
Ministère des Finances, Direction Générale du Budget, Direction Régionale du Budget - Sétif, & Direction de la Programmation et du Suivi Budgétaires de la Wilaya de Constantine. (2020). Annuaire statistique de la wilaya de Constantine
Monnet, J. (2002). *Centre et périphérie au Mexique: dialectiques et dynamiques géographiques à plusieurs échelles*. Les Rapports Centre-Périphérie Dans Les Démocraties Modernes, 393p.
Naidja, H. (2017). L'attractivité territoriale des entrées de ville : Entre vecteur de développement local et support de marketing urbain. Cas de l'entrée sud de Constantine-Zouaghi/Ain El Bey. *Sciences & Technologie. D, Sciences de La Terre*, 33–48.
Nicolas, J.-P., Vanco, F., & Verry, D. (2012). Mobilité quotidienne et vulnérabilité des ménages. *Revue d'économie Régionale et Urbaine, 1*, 19–44.
ONS. (2019). *Répartition du parc national automobile selon la wilaya et la source d'Energie au 31/12/2019*. https://www.ons.dz/IMG/pdf/e.wil_ener31-12-2019.pdf
Oillo, B. (2021). La performance opérationnelle des systèmes de transport collectif: pour une analyse microscopique des conditions d'exploitation. *Transports Urbains, 1*, 34–40.
Panerai, P., Castex, J., & Depaule, J.-C. (1997). *Formes urbaines: de l'îlot à la barre*. Editions Parentheses.
Pierronnet, R. (2020). *Que peuvent les villes universitaires pour la mobilité internationale des étudiants?* Editions Universitaires de Lorraine.
Proulhac, L. (2022). Formes d'organisation du travail et mobilité quotidienne des actifs franciliens. *Economie et Statistique, 530*(1), 87–107.
Rallet, A., & Torre, A. (2004). Proximité et localisation. *Économie Rurale, 280*(1), 25–41.
Rambinintsoa, M. (2018). École de Chicago et Modèle de Burgess

Rejeb Bouzgarrou, A., Claramunt, C., & Rejeb, H. (2019). Visualizing urban sprawl effects of a Tunisian city: a new urban spatial configuration of Monastir. *Annals of GIS, 25*(1), 71–82. https://doi.org/10.1080/19475683.2018.1557252

Renders, D., Morand-Deviller, J., & Spannowsky, Wi. (2020). *La mobilité urbaine*. BRUYLANT.

Rérat, P. (2021). Pratiques et politiques de mobilité dans un campus universitaire: le cas de l'Université de Lausanne (Suisse). *Économie, Géographie, Politique, Droit, Sociologie, 12*(1). https://doi.org/10.4000/developpementdurable.19038

Rubens, L., Gosling, P., & Moch, A. (2011). Favoriser le report modal: connaître les raisons liées au choix d'un mode de déplacement pour le changer. *Pratiques Psychologiques, 17*(1), 19–29.

SETRAM. (n.d.). *Constantine Ville Des Ponts*. Retrieved November 29, 2023, from https://www.setram.dz/fr/tram-constantine

Souche, S. (2009). Un exemple d'estimation de la demande de transport urbain. *Revue d'économie Régionale et Urbaine, 4*, 759–779.

Spiegato. (2023). *Qu'est-ce que l'urbanisme?* https://spiegato.com/fr/quest-ce-que-lurbanisme-2

Terrier, P., Berdier, C., & Bouyer, M. (2017). La mobilité sur le campus Lyon Tech-la-Doua: Approche systémique et scénarios en éco-mobilité. *Développement Durable et Territoires. Économie, Géographie, Politique, Droit, Sociologie, 8*(1). https://doi.org/10.4000/developpementdurable.11622

tourismealgerie.com. (2023). Algérie vehicule de tourisme avec chauffeur Algérie VTC UBER YASSIR 2023. https://www.tourismealgerie.com/algerie-vtc.html

Uber.com. (2023). A guide for how to use Uber. https://www.uber.com/us/en/ride/how-it-works/

Université de Montpellier. (2020, September 1). *Rentrée universitaire: 51 000 étudiants à l'université de Montpellier*. https://www.umontpellier.fr/articles/rentree-universitaire-a-luniversite-de-montpellier

UN-Habitat (2011). *Cities and climate change: global report on human settlements 2011*. https://unhabitat.org/global-report-on-human-settlements-2011-cities-and-climate-change

URBA Constantine. (2017). Groupement De Constantine Étude Socio-Démo-Économique Période 2017

Zehioua, B. H., & Labii, B. (2009). De l'effet structurant du projet urbain à l'analyse prospective des projets du PMMC à Constantine. *Sciences & Technologie D, 29*, 9–18.