



## *Application of planning standards for land uses of schools and educational facilities to reduce educational mobility as means to reduce traffic congestion in Cairo*

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### **Abstract**

Greater Cairo and other capitals of the Egyptian governorates and major cities suffer from traffic congestion, despite the tangible efforts of the state in opening new road axes, expanding and developing the existing road network. The traffic congestion in Cairo costs the Egyptian economy 3.6% of the gross national product (According to the report of the World Bank Group), which represents a large and remarkable percentage.

The traffic congestion in Greater Cairo had resulted from several factors, including misdistribution of land uses for services and the changes and modifications that were applied later, including educational services, as well as the expansion and great diversity of educational programs for international and foreign private schools. Such schools differ in terms of education quality from traditional schools, as well as the diversity in school activities and the financial level of students. The afore factors have created a large gap compared to education in public schools and also a desire among parents to enrol their children in distinguished schools despite their distance from their residence areas. This concept has led to increasing the service scope of those schools where it could be more than 40 km, which contributed in increasing traffic density on roads as a result of various means of transportation.

Using means of transportation other than school buses to transport students had reduced safety and reliability factors and increased traffic density on those roads. School transport represents a large proportion of traffic trips on the main and secondary roads in Greater Cairo. This coincides with the morning rush hours and

evening traffic on the roads, which contributes to increasing congestion rates during peak hours. By adjusting the distribution of educational services locations, defining their ranges, changing study dates, expanding distance education, and facilitating school bus rides for parents, it is possible to reduce traffic congestion rates on the Greater Cairo roads.

**Keywords:** School Bus, Educational Mobility, Traffic Congestion.

## 1. Introduction

Traffic congestion is one of the most important problems that Greater Cairo suffers from and drains a large proportion of the gross national income of the country, as about 3.6 percent of the GDP in Egypt, equivalent to about 47 billion Egyptian pounds (equivalent to 8 billion US dollars) is wasted annually in The Greater Cairo area due to traffic congestion (1).

This is in addition to many other negative results such as wasting energy and resources, wasting money and time and also resulting pollution. This is due to several reasons, including the lack of parking spaces, poor road conditions, poor public transportation networks, and the distance of workplaces and studies from places of residence and others such as transportation of educational facilities in general and schools in particular.

This research discusses the impact of school trips or school transportation - which is the movement between places of residence and places of educational services in general, and schools (pre-university education) in particular - on the additional traffic density on the roads, which is estimated at about 25% of the total traffic density on them in rush hours.

This is despite the fact that the planners considered that the distribution of services - especially educational - within the residential areas and the determination of the service scope and standards - which is the distance between the place of service and the farthest beneficiary housing - as one of the most important determinants and planning criteria. As the primary school and the kindergarten, the middle and secondary schools are considered the center of the residential neighborhood, as to enable determining the walking distances for students of different stages in proportion to their age, level of awareness of movement dangers in different paths, especially the motorized ones.

The first to take an interest was Clarence A. Perry 1929, followed by N.L. Engelhardt, Jr. as well as Clarence Stein's 1942, and all of them have built on the same idea, which is to define the scope of educational services at their levels to be a tool for defining the neighborhood, and city spaces.

However, due to the non-compliance with the maps of land use in some areas in Egypt and the transformations that have taken place for many reasons, and with the increase in population density in some areas in the old urbanization and the expansion of urban estates and urban expansion, there has been a defect in the sufficiency of spaces allocated for educational services and the density of classes has increased by accepting excessive numbers exceeding their capacity.

With participation of the private sector in investing in the education sector to bridge the gap and as a result of some profit-oriented policies at the expense of the educational system efficiency and to attract more parents, educational programs varied between language schools and various international schools.

All these factors have contributed to a large disparity in the levels and types of educational services, which in turn led to the creation of competition between schools in attracting more students, even from areas relatively far from those schools. There are students who travel distances of more than 40 km in the morning and the same in the evening as to enroll in specific schools that fit the culture of their parents and help them achieve an advanced level of education.

Also, there is a lack of coordination regarding school schedules to coincide with the schedule of work trips, which made peak hours widening and becoming more intense, and all of this puts severe pressure on the local road network of Greater Cairo. Whereas it reduces the general feeling of the state's efforts in the field of developing the road networks and creating new axes and expanding the existing ones.

Several methods have been used to calculate this excess percentage of traffic by calculating the difference between the intensity of traffic on school days and school holidays only, in addition to calculating the lengths and number of trips for daily bus traffic lines, as well as other private and collective transportation (cars with students) and comparing it to the intensity of total traffic on roads and locating educational services. As well as calculating the lengths of trips and bus trip routes and stops locations.

By analyzing the causes of the problem and its constituent focus, it was found that the most important factor is poor distribution of places used for educational services in relation to the housing areas and the failure to follow the foundations, rates and planning standards for service areas for educational services. This is in addition to the poor distribution of those uses related to the housing areas, and the failure to design and plan the paths for movement of school tankers and parking areas, and also setting the timings to match the movement peak hours.

As well as the disparity in education programs, quality and activities between different educational facilities, thus comparing challenges with opportunities and creating opportunities to face challenges can provide effective solutions to that problem and contribute to reducing its negative effects.

This research aims to discuss the possibility of reducing traffic density on Cairo roads, where educational transportation in general and school transportation in particular contribute to a large percentage of its overcrowding, with long-term plans that depend on redistribution of educational services places in neighborhoods and the city in general.

This is in addition to medium-term plans that depend on organizing school transportation, designing school bus itineraries, defining pick-up stations, and facilitating the use of school buses from other means that are less safe and more effective in causing traffic congestion by making them less expensive as to reduce fees for parents.

Also set short term plans through specifying a scope area for each school that is adequate to its size, capacity and specialization, and at the same time change the school's movement times so as not to intersect with the peak times of movement within each city.

## **2. Research Problem**

In the last five decades, the state began to encourage establishment of private schools, language schools, and international schools, due to the state's inability to keep track of the steady population increases and provide the educational services required for those increases on its own. It has initially allowed the private sector and individuals to build schools to accommodate those increases where the state alone could not provide adequate educational facilities equivalent to the increasing number of students and to fill the gap and shortage in the number of required classes.

Then there was a strong shift towards investment in the educational process, and the different types of schools of various categories, names and educational programs spread, and the education sector became a fertile field for investment, and there was intense competition between these schools in providing distinctive and unique activities. In addition to excellence in teaching some foreign languages and providing some recreational and sports activities that attract students and their spouses.

With lack of spaces - especially within cities and crowded neighbourhoods - the spaces allocated for each student in the general site of the school and in educational classrooms began to shrink, and there has become a scarcity of vacant lands suitable for schools. So most of the sites within cities and crowded neighbourhoods have obtained certificates of validity to establish schools. Then schools with different age groups of students lost the service scope and diversity and difference in the social and material level of students and also their accommodation on one hand, as well as the diversity in school levels and educational activities and provided services on the other hand.

Thus, there are students enrolled in schools that are tens of kilometres away from their residential areas in search of better educational services and social levels. This has contributed to the need to provide different means of transportation that are provided by the school itself, such as school buses, which turned into a means of investment for the school and a source of its income. This factor has prompted some of the students' families to search for other means with less cost and that does not consume the students' time, such as private cars for parents or service cars, which provides this service in the form of a school joint trip for a group of residents of the same area at the same school.

This has contributed to an increase in the movement of educational transport in general and school transport in particular, and has affected the increase in traffic density on the urban roads of Greater Cairo.

In order to achieve more safety for students, most school buses deliver students from door to door, which contributes in increasing the time required for the school trip and polluting the internal environment of residential areas with the exhaust of school transport vehicles.

## **3. Research Methodology**

The research relied on the descriptive approach in collecting data and the method of data collection, whether through using a questionnaire or a survey of the method of transporting students, bus routes, preparing participating students, and preparing daily trips to a number of schools in a specific geographical scope.

The research also relied on the rational deductive approach by analyzing relevant data and trying to reach its actual impact level on the research problem.

#### **4. Theoretical Approach**

Education transportation in general and school transportation is of great societal importance, because it affects a very sensitive age group, where the most important factor that is safety and reliability for that user of a special nature and different behavior. Thus, many research papers and scientific papers were concerned with this educational transfer process from different perspectives and multiple points of view.

Education transportation is carried out by several means that depend on the social, economic and urban environment (planning) in which the student and his family are present. This includes walking, using bicycles, using the school bus, using public transportation, using private cars of the family and using non-school cars. For mass transport (line - cycle - domestic-3), the school transport stakeholders include students, their parents, siblings, friends, teachers, school transport bus drivers, school transport companies and bus supervisors.

Each of them is responsible or co-responsible for the school transportation process. Teachers and parents are responsible for teaching students the appropriate behavior and basic rules for riding such means of transportation, while drivers and supervisors are responsible for introducing students to the basic rules of behavior inside the bus.(4)

The school bus is considered the safest and most reliable means of school transportation at all. The European Commission Transportation Road Safety (5) has stated that the safety rate in school buses is approximately seven times higher than other means of transportation, while the American and Canadian transportation statistics confirm more than this percentage. The Australian Collage of Road Safety Access (6) says it is fourteen times the safety rates of other methods.

Through the study of global traffic statistics, it can be concluded that the traffic densities caused by school and educational buses in general on the roads are equivalent to only 5% of what is caused by private cars in the school transportation process, whether by parents or drivers and rented cars (7).

Therefore, school transportation by school buses reduces traffic density on the roads compared to transportation by private cars for parents or rented private cars, and it is safer than private cars and public transportation.

Some researchers have focused on studying school transport buses in general, in terms of safety and reducing journey time by designing the appropriate path, while other researches were concerned with the environmental impact of school buses.

While some other researches were concerned with the safety factor in school bus trips and studying the factors that threaten the lives of students and represent a danger to them. It was found that the most important causes of accidents are due to violation of traffic laws and rules. The Traffic Department in Athens, Greece conducted a study in 2007 and it became clear that there are 147 traffic accidents that were monitored during one month, and 27% of them were due to students not wearing a seat belt (8).

In another research conducted in 2006, it was found that 12.13% of them are due to excessive speed, but the major factor for the causes of accidents in school transport is due, according to the research, to the drivers' behavior, and it has been possible by using modern communications technologies and other methods to increase the safety rates for school trips (9).

However, there are other factors that have intensified the problem as a result of the exaggerated and insufficient prices of school bus subscriptions, which led to the reluctance of many parents to participate in school buses for their children, as the price of school bus subscription sometimes reaches four times the cost of other means such as private cars and the service that allocates paths to serve school students at lower prices, as well as private cars owned by parents or rented as school lines, which constitutes greater pressure that contributes to increasing congestion rates and reduces safety and reliability factors at the same time.

The idea of the residential neighborhood (distribution of educational services and defining their urban ranges as basis for the design of the neighborhood and the city): Since Clarence A. Perry invented the idea of the residential neighborhood in 1929 in his book 'The Neighborhood Unit', and the central idea of the 1000 elementary school: 1200 students for a residential community of 5000: 6000 people are the ones who govern the design and planning of the residential neighborhood.

His theory of residential neighborhood planning included five axes and design foundations, including the need for car roads to be outside the borders of the neighborhood and not penetrate them to achieve the safety factor and that the secondary roads of residential areas should have closed ends (cul-de-sacs) for the same purpose and that the walking distance should be from the farthest residence and the center that includes the school with a maximum of a quarter of a mile or half a kilometer for the possibility of students walking safely to and from school.





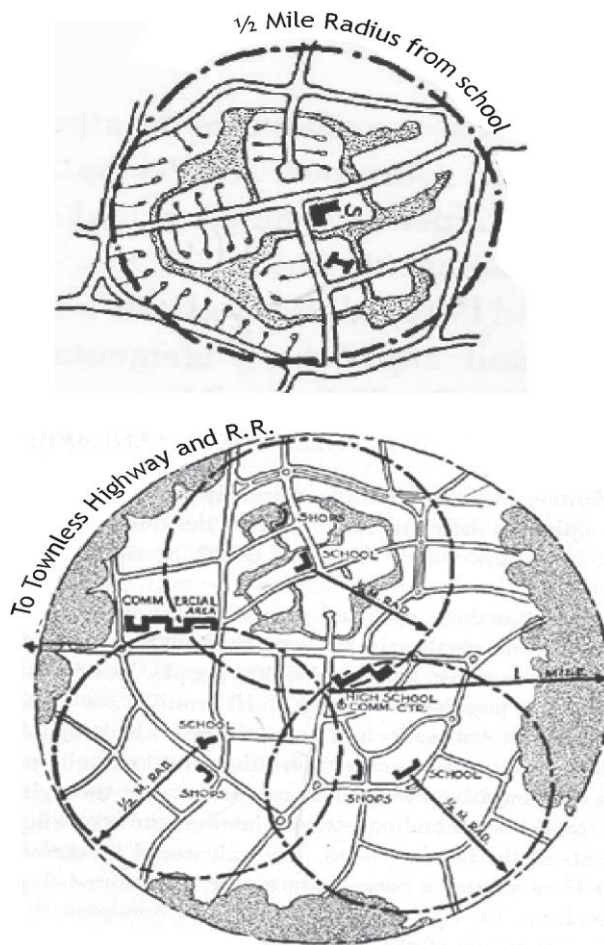


Figure 2. N.L. Engelhardt, Jr. Explains the idea of developing the residential neighbourhood by making three residential neighbourhoods, with the primary school and kindergarten in the centre of the neighbourhood, and the middle and secondary school in a middle area, the entrance to the neighbourhoods, so that the walking distance to the primary school does not exceed 400 m, and for the secondary school does not exceed 1 km.

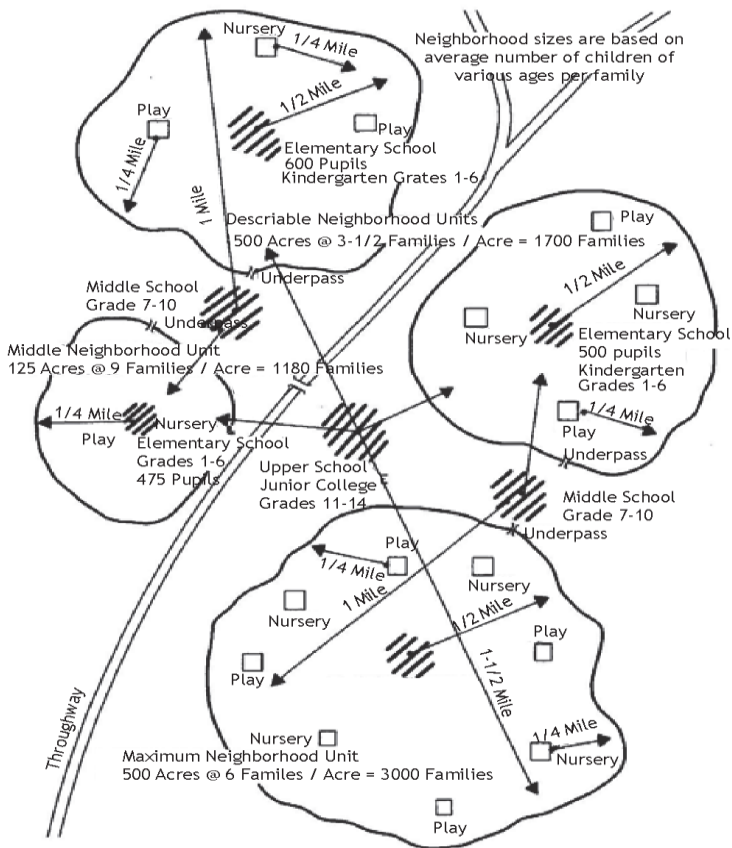


Figure 3. Clarence Stein's 1942 Scheme of Educational Services, Scope and Walking Distance of not more than 1 Mile for Colleges and Secondary Schools, 1/4 Mile for Nurseries and half a mile for Elementary Schools

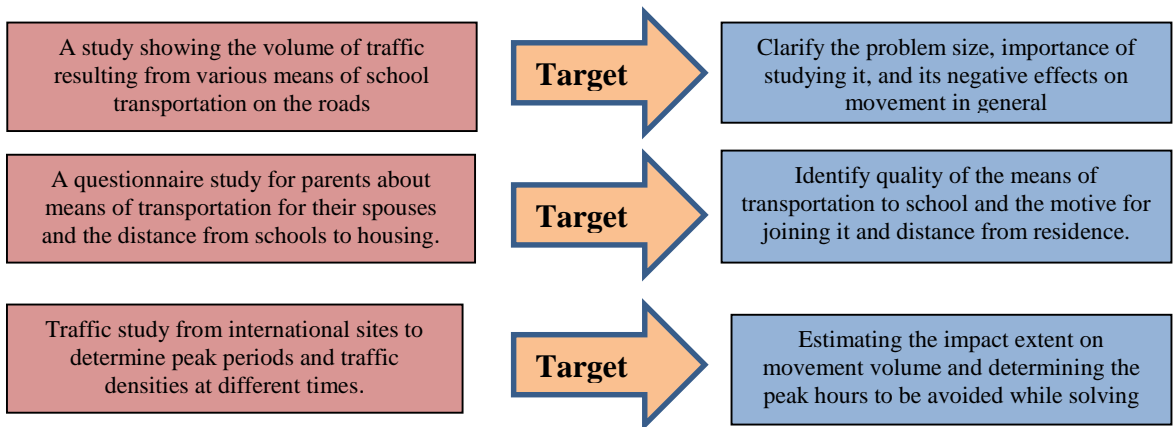
Therefore, determining the locations of educational services and making the scope of their service specific at different levels of planning was and still is the focus of the attention of planners and urbanists throughout the ages, due to the planning and urban importance of choosing their sites carefully on the social fabric and achieving the safety factors required for students and their guests, given that they represent age groups that need care and attention.

Field studies were conducted to collect some data related to the research problem and analyze them to reach indicators that measure the extent to which school transport contributes to increasing traffic densities on Cairo roads. This was performed by collecting data from school paths and school bus routes for three different schools in New Cairo as a model

showing the contribution rate of each school in the volume of traffic. Then it would be possible by knowing the approximate volume of movement in kilometers for each school and number of schools, it would be possible to know the number of kilometers that have been traveled daily to and from schools combined, and the waste of energy and deterioration of roads and pressure on the road network in general.

The second study is a questionnaire that was conducted on a segment of school parents including more than 200 questionnaires to identify the types of transportation used for school trips, the extent of trips and determining the scope of each school’s service, students’ ride stations and the reasons for affiliation to schools far from residential areas.

The third study is from one of the international websites that is interested in studying and analyzing statistics of traffic density on the roads during different hours of the day, the week and the year for the major cities of the world, including Cairo, in order to identify the differences between the traffic density on the roads during the school seasons. This process is concerned especially with examination periods, summer vacations, and the mid-term holidays. The school year as an indicator of the contribution of school transport to increasing traffic densities on the roads, and then analyzing all relevant data in a combined study linking the different studies together.



Study the lengths of school trips for schools of the Fifth Settlement and the scope of service:

The school bus movement has been studied for three schools in New Cairo (as one of the residential communities of the new cities), which includes more than one international school, languages, and private schools. (Cambridge International School at First Settlement, Egyptian Languages School in the Fifth Settlement, and the British School in the Fifth District, center of the Fifth Settlement).

Cambridge School in the First Settlement has 30 bus paths with distances ranging from 3 km to 40 km, reaching to Ghamra in central Cairo, El Sawah area, Amiriya and Hadayek Al-Qubba. These buses transport no less than 1,200 students in the morning and in

the evening, with a total walking distance of 700 km (one way) or 1,400 km (round trip) per day, and the total number of students is about 3,400 pupils, meaning that there are approximately 65% of the students who travel to school by other means of transportation.

The British School in the Fifth Settlement has 35 paths that transport 1,400 students with a total length of 750 km, or 1500 km, in both directions. The percentage of students participating in buses to the total number of students is about 40%, and the remaining 60% are transported by other means of transportation.

The Egyptian School of Languages has 45 paths, through which it transports 1800 students, with a total length of paths of 2100 km in both directions, and transports 35% of the students and 65% of the school students are transported by other means.

The attached map shows the destination points for each school bus, which can be considered as its spheres of influence that differ significantly from what it should have been in the case of distributing educational services according to rates, standards, planning determinants, and defining service ranges.

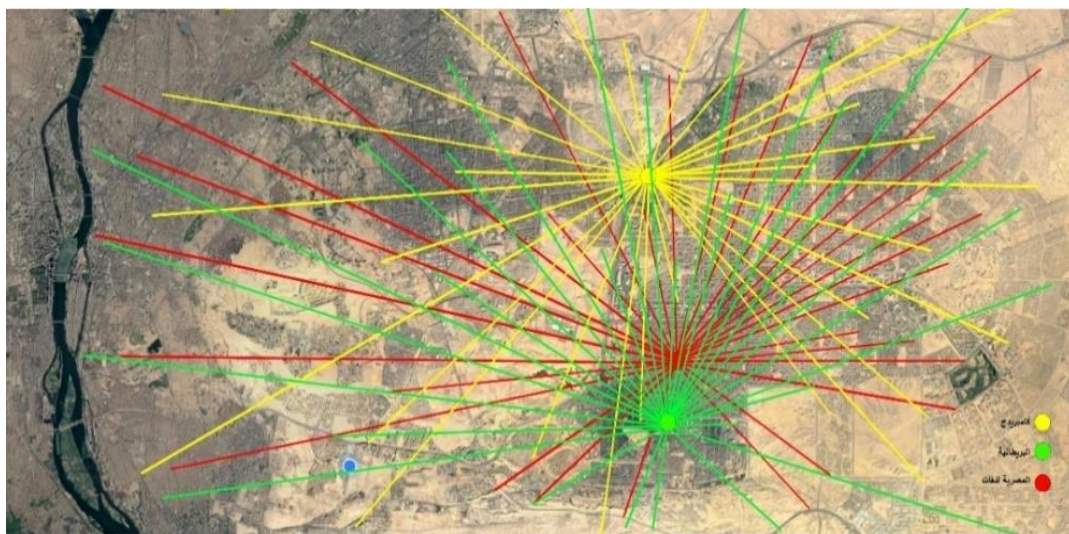


Figure 4. A map showing the scope of services for only three schools in New Cairo, some of which sometimes exceed 40 km in length. (By the researcher)

By studying the sites of all Fifth Settlement schools, which are almost in the same service ranges, we can conclude the volume of school buses traffic only without other means of transportation, and only in the Fifth Settlement, which includes more than 80 international and languages schools with approximately the same size, density and number of buses on the roads.

Thus, it can be concluded that the volume of movement resulting from school buses and other means of transportation is very large and represents severe pressure on the roads inside and outside the Settlement.

By studying the sites of New Cairo's international private and languages schools, it was found that their number at the time of the study was 81 schools, with an average number of students and buses almost identical to the three schools mentioned above. Which suggests that the total lengths of trips for school buses only may reach (the number of schools \* the average kilometers that each school bus travels in both directions) approximately 150,000 one hundred and fifty thousand kilometers. Taking into account that these trips represent only one third of the school transport capacity and the rest is a much bigger burden on the roads than bus transportation.

It could be concluded that the volume and lengths of traffic on the roads resulting from New Cairo schools alone may reach one million linear km, and if the burdens of the rest of the areas in the neighborhoods of Cairo and the new cities adjacent to Cairo are taken by analogy, the lengths of trips will reach very huge numbers that the roads cannot bear, especially during peak times.

Second study: It is a questionnaire study whose data was collected by publishing a google form data questionnaire on the websites of parents of some schools, as well as some websites of some residential areas. The questionnaire form included some simple and direct questions to obtain certain information such as the educational stage in which the student is, and the residence location, the school location, the distance between the residence location and the school location, the trip time, as well as the distance of the boarding point from the place of residence and the means of transportation used from the residence to the school and vice versa.

The answers led to the following results, according to the following table:

Table No. 1. Shows the results of the questionnaire study for parents of school students about means of transportation to and from schools, distance, time, and reasons for enrolling in relatively distant schools.

<b>Schedule of a questionnaire about opinions of students' parents of New Cairo schools regarding school transportation</b>					
Distribution of school children in the sample to different educational stages					
Kindergarten	Primary	Preparatory	Secondary		
23%	32%	28%	17%		
Distribution according to means of transportation to / from school					
Walking	Bicycle	School bus	Service	Public transp.	Parents' car

8%	5%	22%	18%	8%	39%
Average distance from home to pick up point					
Less than 20m	More than 100 m	More than 200 m			
48%	26%	26%			
Distance between school and residence					
Less than 500 m	1 km	2 km	More than 5 km	More than 10 km	More than 20 km
11%	13%	18%	29%	11%	18%
Average time of morning and evening trips					
10 min	20 min	Half an hour	One hour	More than 1 ½ hour	
9%	12%	36%	29%	15%	
Reasons for joining a school far from residence					
Educational level	Language	No nearby schools	High fees	Changing residence	
20%	30%	22%	23%	5%	

The following diagrams show the analysis results of this study, through which it can be concluded that the participating segment is consistent and expressive of reality, as the percentages of students distribution to educational stages are similar to the percentages of distribution for students throughout the country, as in diagram - Figure No. (6).

As for the diagram, Figure (5) shows the percentage of using different means of transportation between housing and school, and it is clear that the percentage of those who use the school bus, which is considered the safest and most reliable, is 22% of the students, and that the vast majority (39%) travel by private cars, whether owned by one of the parents or rented, 18% using service cars, 8% using public transportation, 8% on foot and 5% using bicycles.

Distribution according to transportation to and from school

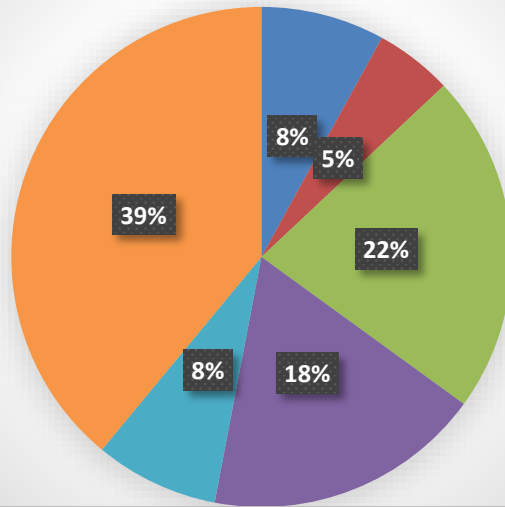


Figure 5. Shows the usage rates various means of transportation between residence and school sites, mostly using parents' cars or rented cars.

Distribution of schoolchildren to different educational levels

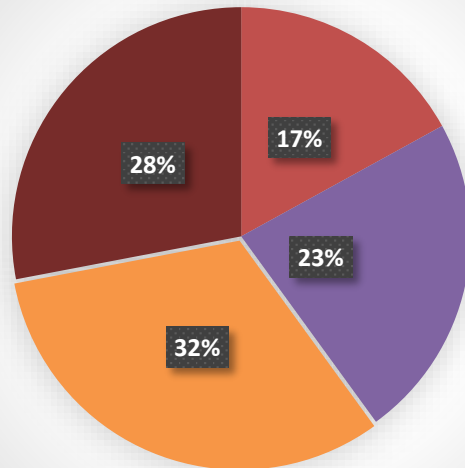


Figure 6. Shows the distribution percentages of schoolchildren to educational stages of basic education, which is similar to distribution percentages of students throughout the country.

Average distance from doorstep to pickup point

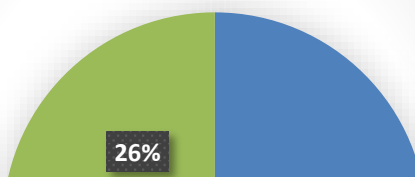


Figure 7. Shows the distance that the student walks from home to the pickup point, whether it is a bus or other means. in order to confirm that school buses penetrate residential blocks to the threshold of the house, which means poor planning of the residential blocks and neighbourhoods and poor distribution of services, with no design of school bus routes and parking points.

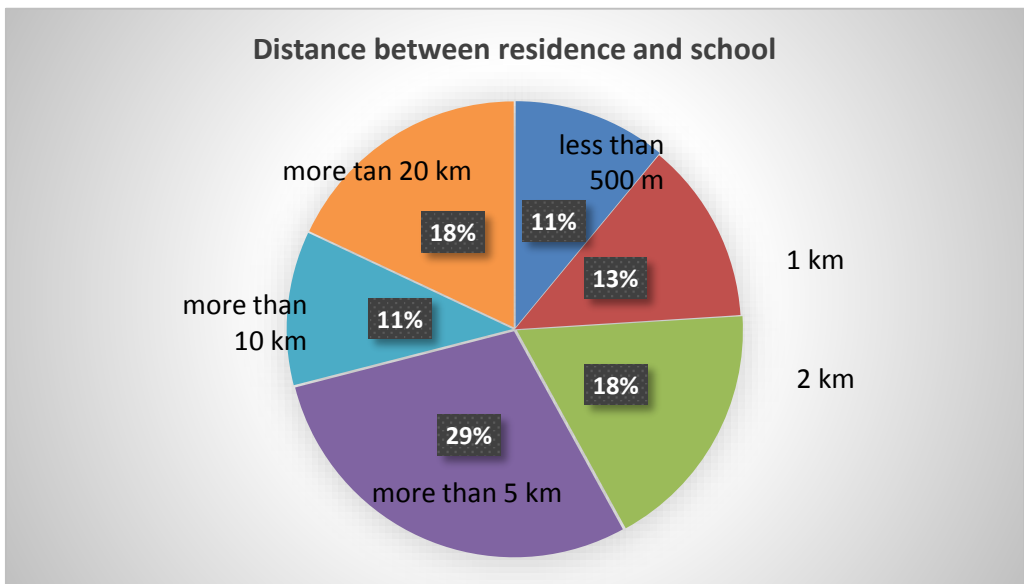


Figure 8. Shows the average distance between schools and students' housing, which according to the questionnaire may exceed 20 km, meaning that the service scope of the school greatly exceeds all local and international planning standards, which causes increases in traffic densities on the roads in general and confirms the need to find solutions that lead to fair and appropriate redistribution of educational services.



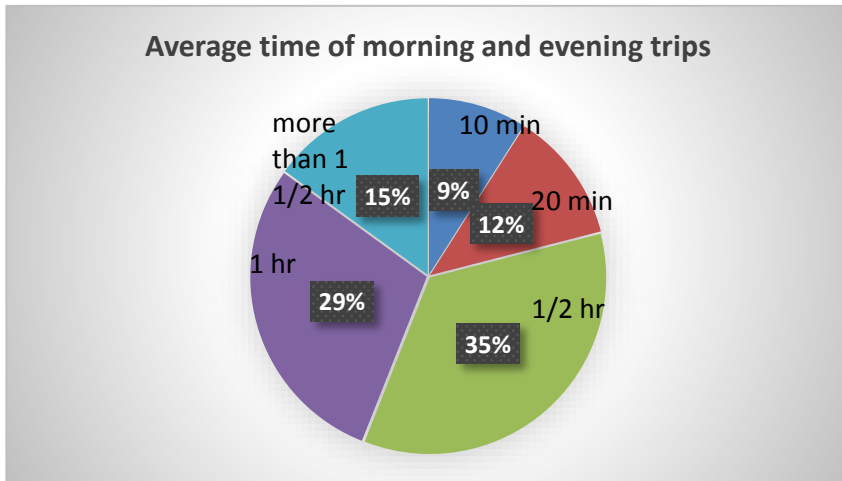


Figure 9. Shows the average journey time from home to school and back, which the student travels twice a day. The trip time may be relatively long due to the fact that the school bus transports all students from home doorstep and the absence of specific gathering points for designing bus routes, in addition to the length of distances between accommodation, schools, the timing of trips during peak hours, and sometimes penetration into heavy traffic areas. This may affect the student's psyche and learning ability, and thus the entire educational process.

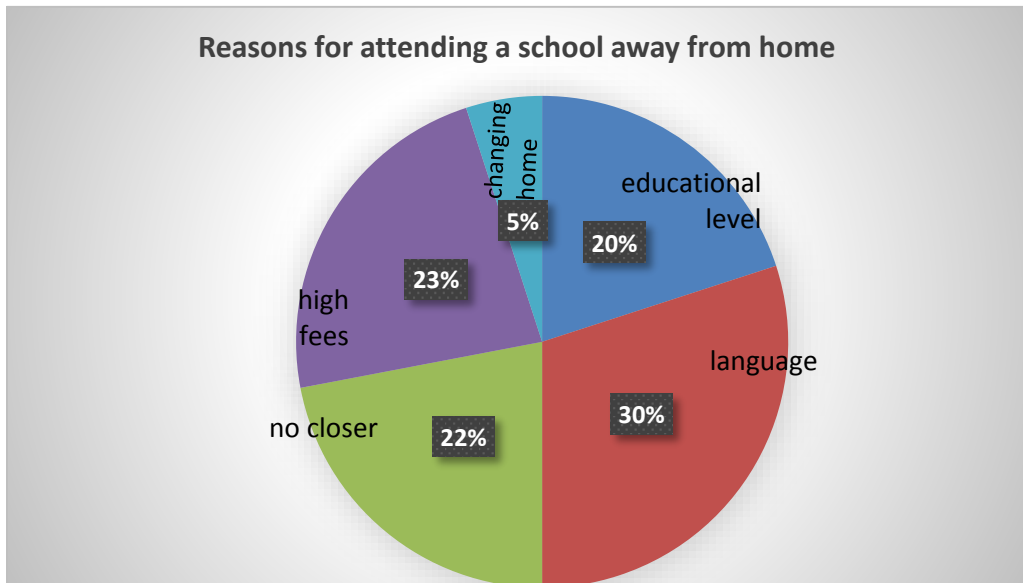


Figure 10. Illustrates some of the reasons that drive parents to prefer schools far from their place of residence, and this is at the core of the problem, as it is related to the educational policy of the country, where justice must be provided in the quality and diversity of education among all regions and the policy of unifying programs until a certain age. This is in addition to the provision of various educational programs in the same educational building and management of educational institutions by the state and the commitment of all institutions of

the private sector to the state's educational policy where investment in the field of education is limited to the facility and not the educational content.

Through this questionnaire, it can also be concluded that the largest percentage of students who use the school buses are in the kindergarten and primary levels. As for the preparatory and secondary levels, the percentage of students who use buses is much lower, and this is because the child at a young age needs safer and more reliable means, as he is not capable of using other means of transport, and the older the student, the more he is able to use other means of transport other than the school bus.

Determining school transportation role in increasing traffic congestion in Greater Cairo, given the differences in traffic densities during schooling periods and holidays:

Studying the differences in road traffic densities between study periods and long vacations:

Through studying the differences in traffic densities and congestion rates during the different months of the year through the last three years, as well as determining the traffic rush hours in Greater Cairo around the clock today, through the TOMTOM website, which is a global statistical website concerned with traffic on roads in major cities, including Cairo; shows that there is a difference between the overcrowding rates in the summer vacation months and the mid-year vacation and between the months of schooling, especially in which exams are held (May and June of each year) by 22% compared to other months

Taking into account that a percentage of Cairo's residents leave to the coastal cities during that period, which can have an impact, but not to the same extent. The morning peak hours start in Cairo from seven in the morning with congestion rates of up to 35% and gradually increase until eight a.m., which is the same as the times for going to school, and it reaches the climax in the evening between three and six p.m., which is the time for leaving schools and universities.

This is what can be easily observed by any user of Cairo roads from car drivers of all categories, especially when approaching areas that have educational facilities, whether schools, institutes or universities, where it is noticed that there are jams that reach the extent of road suffocation and the movement stops completely during those times.

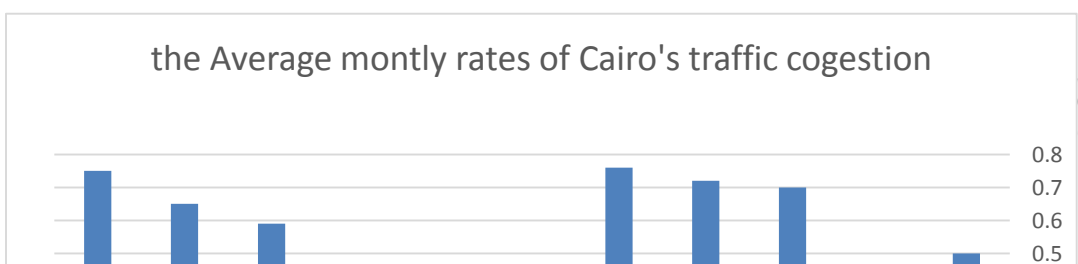
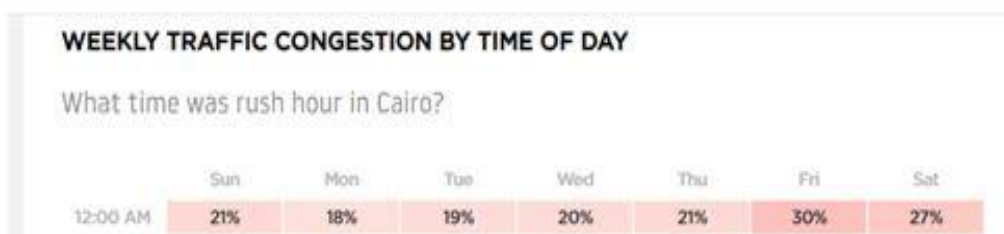


Figure 11. Shows the average rates of traffic congestion for the years 2018, 2019, 2020, and it shows that the average rates of congestion in the months of summer vacation and mid-year vacation decrease with an average of around 22%.

Figure No. (12) a study showing the increase in traffic congestion rates during the year 2021, which was during the period from the seventh week at the end of February, which coincides with the beginning of the second semester and the fifteenth week. That is, with the end of April, which is the schooling period before the second semester exams. The end of April will be the end of the semester for all transportation years, and therefore the traffic congestion rate has decreased very much after this date.

Figure No. (13) shows the peak hours in Cairo during all days of the week, which determines one of the largest traffic congestion rates. Where the maximum peak hours are between six and three o'clock during all days of the week, except for Fridays and Saturdays of each week. While it starts in the morning from seven to eight, which coincides with school start times at six in the morning and departure in the evening from private and languages schools.

## Cairo traffic



During the second semester exams period and at the end of June it was the least crowded coinciding with the beginning of the annual summer holidays for schools.

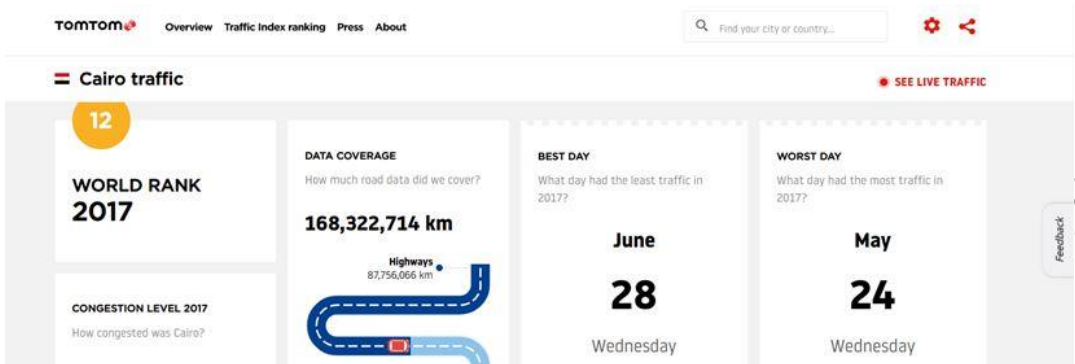


Figure 15. A statistic from the TomTom website for determining the traffic densities on the roads for some other cities, showing that the percentage of traffic congestion was at its lowest rates in August (the time of the schooling holidays and that the highest average congestion was 72% during the year 2019 was during the month of October with the beginning of the schooling period in Cairo, the first semester.

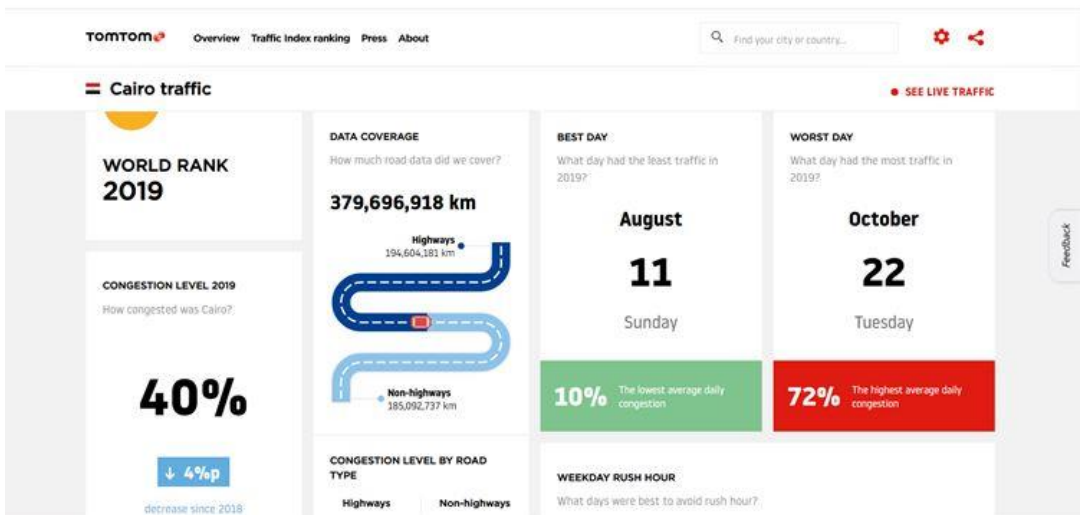
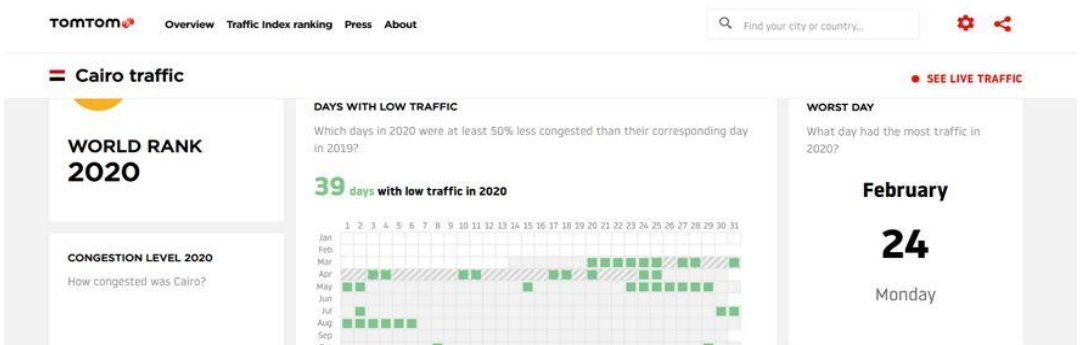
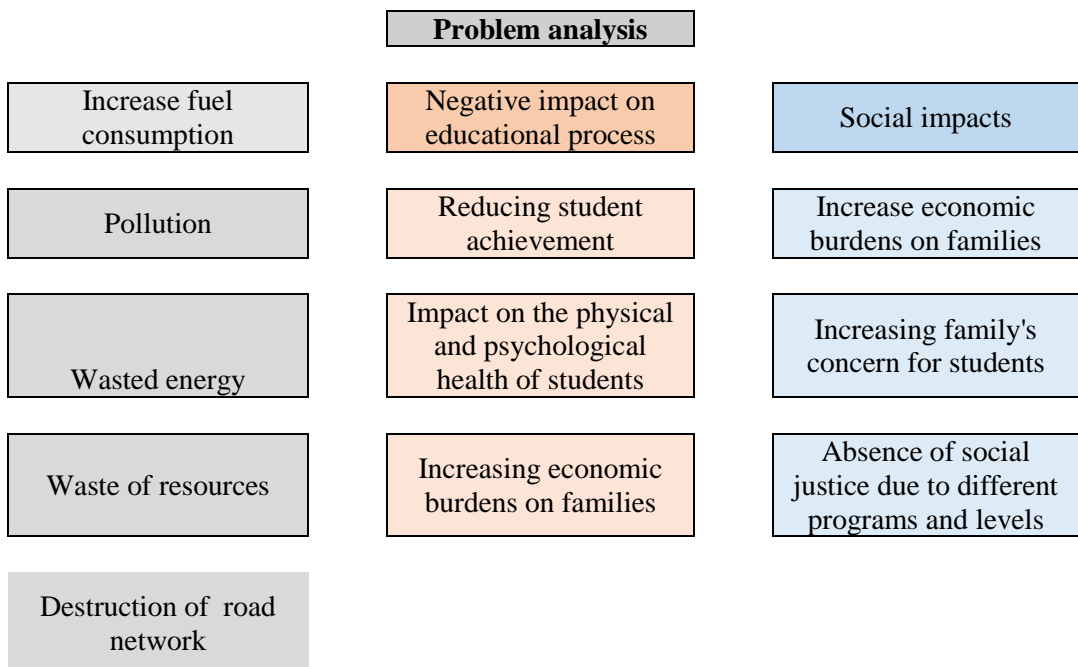


Figure 16. Shows that during the year 2020, the lowest congestion rate was during the months of March, April, May and June. In conjunction with applying the highest precautionary measures during the Covid-19 pandemic and the almost complete closure.



## 5. Analytical Approach

Through the review and analysis of the three field and applied studies (the questionnaire and the study of movement volumes resulting from transportation between residence areas and schooling areas, and also statistical studies of congestion rates in Cairo around the clock, day and year during the last three years) it is possible to conclude the real causes of the problem and its impact and negative effects on crowding rates, as shown by the following Diagram:



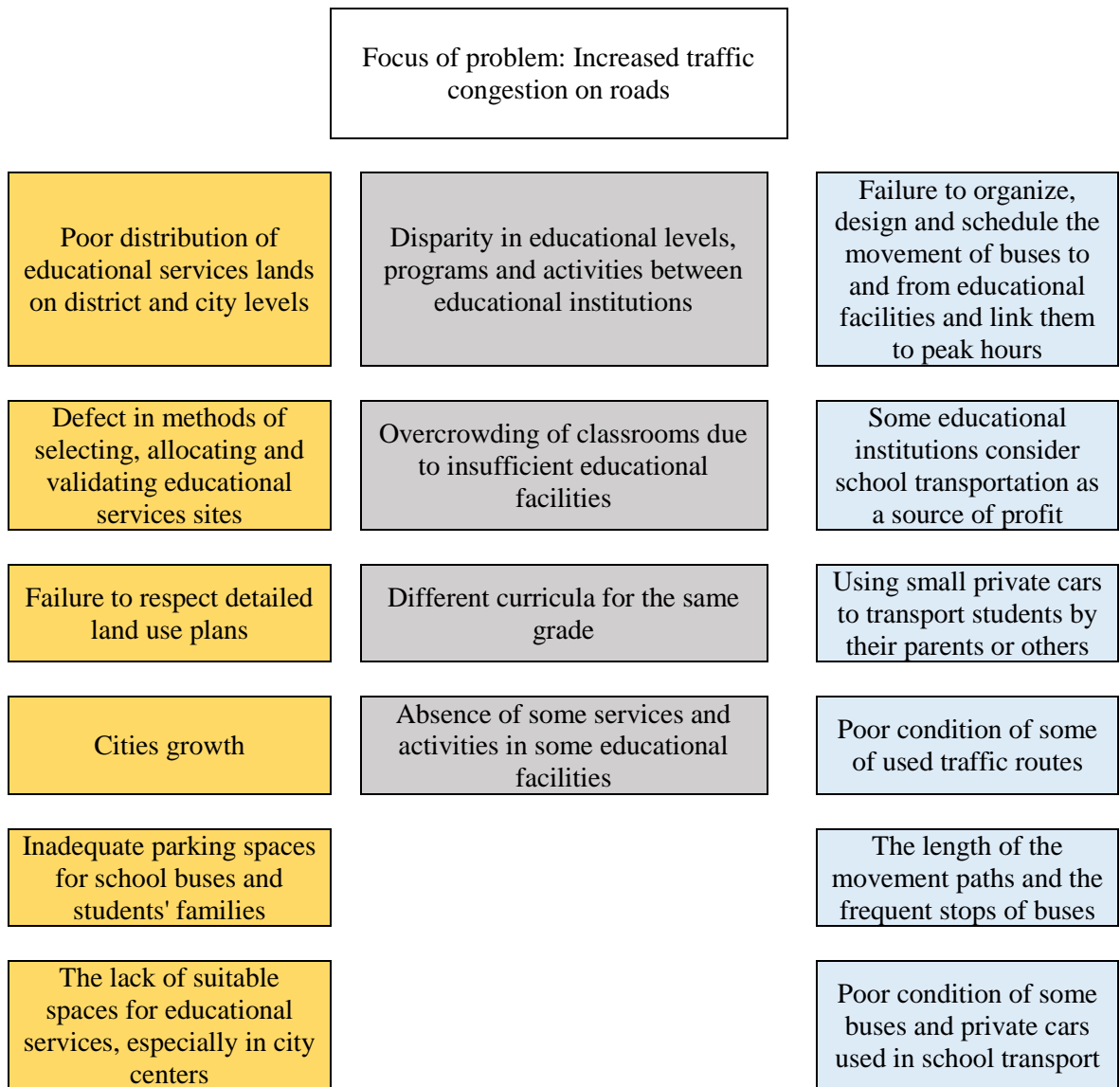


Figure 17. An illustration for analyzing causes and results of the problem and determining its focus

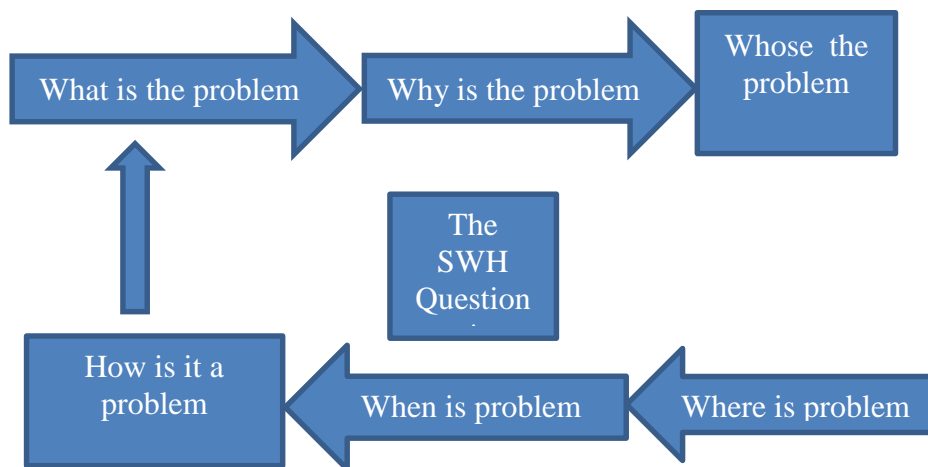


Figure 19. Problem focus analysis

### 5.1. Problem Focus Analysis

1. Where does the problem occur (where): in Greater Cairo and the capitals of the governorates?
2. When does the problem occur (when): During the peak periods of schooling seasons.
3. What is the problem (what): Excessive traffic congestion as a result of several factors, including educational transportation?
4. Why it happens (why): School transportation at peak periods during schooling seasons and using different and various means of transportation help to increase congestion, increase school services scope and length of road trips.
5. To whom the problem concerns (whose): For residents of Greater Cairo governorates' capitals and major cities.

### 5.2. Problem Effects

About 47 billion Egyptian pounds (equivalent to 8 billion US dollars) are wasted every year in Greater Cairo urban area due to traffic congestion, and it is expected to be to 501 billion Egyptian pounds by 2030.

The economic costs resulting from traffic congestion in Greater Cairo metropolitan area are estimated at 3.6% of Egypt's GDP, which in 2011 amounted to approximately \$229.5 billion. The economic costs resulting from traffic congestion are distributed to the population



residing in Greater Cairo urban area, that are estimated to be 19.6 million, and as a result, the cost per capita is about 2,400 EGP, or 400 US dollars. Assuming that the burden of this cost falls primarily on the residents of metropolitan Cairo, the cost of congestion per capita in Cairo is estimated at about 15% of the total GDP per capita, or about \$2,007 in 2010 according to the World Bank, and this is expected to continue. The numbers are on the rise until 2030. (14)

### **5.3. Proposed Solutions Strategies**

As to determine the strategies and general frameworks for solutions that can be resorted to solve the problem of traffic congestion in Cairo, a comprehensive approach and plan must be made that begins with analyzing the influential forces, whether they are driving and supporting the solution, obstructing or restrictive forces that prevent the completion of the appropriate solution.

Then work on setting priorities from projects and procedures, spreading awareness and trying to solve each problem in isolation from the other, considering that each of them achieves a set of interim goals that help to achieve the main goal, which is to reduce traffic congestion and its effects to the least possible amount, as shown in the attached sketches:

Figure No. (18) illustrates analysis of the forces affecting negatively and positively on the process of formulating solutions as to achieve the interim and final goals. Where the forces that restrict, obstruct and cause the problem are represented in poor distribution of educational services places, lack of justice in the quality level of educational services, commitment to service areas of the schools, not relying on school buses as a safe primary means of transportation, poor designs of such routes, and non-compliance with the start and end periods of schooling.

This is in addition to not relying on blended education by allocating scheduled days for e-learning in coordination with the educational administrations in the regions, and also low level of awareness of the aspects of the problem and the resulting social and economic effects on institutions and individuals.

However, there are driving and motivating forces represented in the presence of a political will in the state to solve the problems of traffic congestion in Greater Cairo, which is clearly shown in the volume of spending on roads and traffic axes in Cairo, which indicates the existence of funding sources as well, whether from the government or the private sector.

The Ministry of Education has plans and desire to develop the educational process and has planned steps to spread distance education and blended education using communication and information technology, and there remains another step to spread societal awareness among the concerned individuals and institutions.

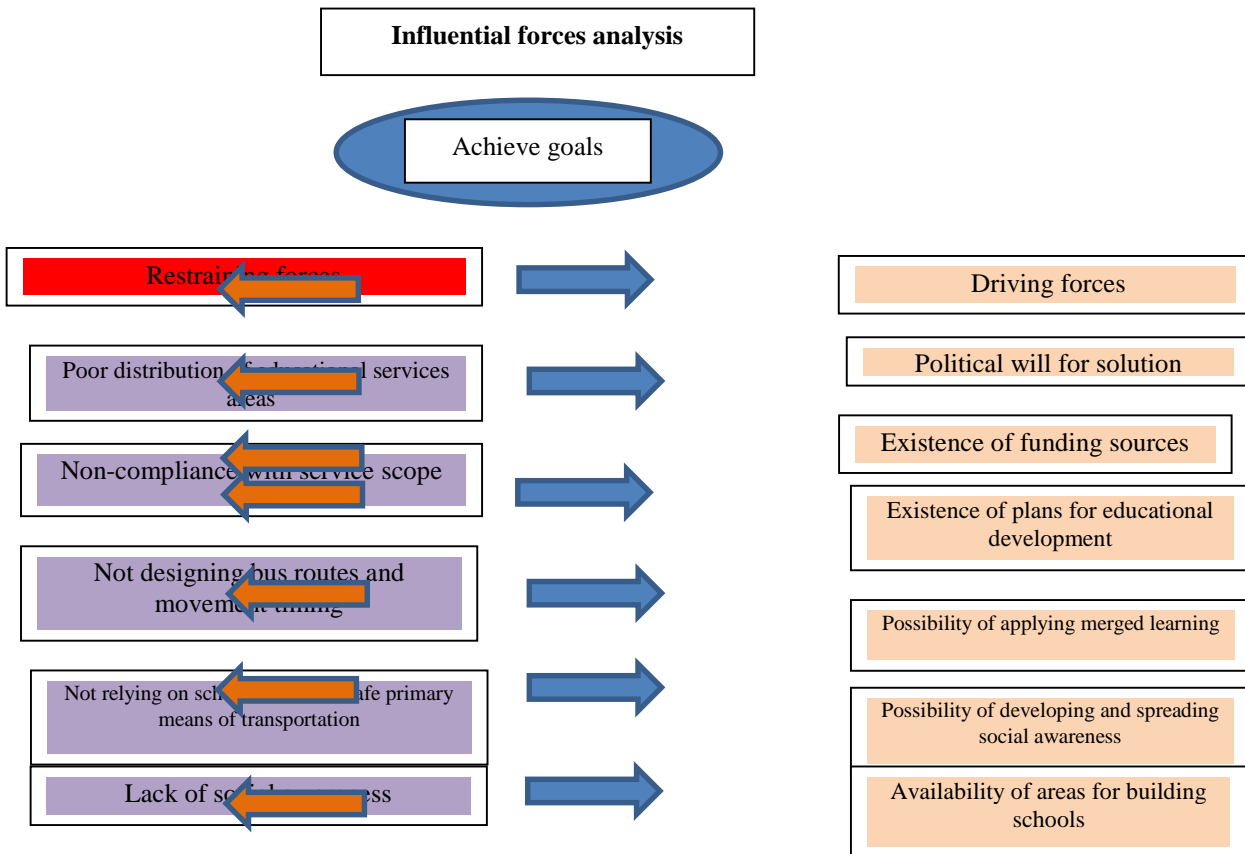


Figure 19. Shows solution strategies for the research problem (by the researcher)

## 6. Research Results and Conclusion

Non-compliance with local and international planning standards in distributing and defining scope of educational services sites, especially schools, which leads in turn to an increase in the distances between residential and schooling areas, and creates the need to use various means of transportation with a high density at peak times of traffic, that contributes significantly to traffic congestion. In Cairo, this appears in different schooling seasons and the school's exit hours.

The lack of distribution of school lands and educational services significantly affects the lack of widespread use of school buses which contributes to increase in traffic congestion in Greater Cairo.

School movement affects the increase in traffic density on Cairo roads and increases traffic congestion by approximately 25%.

Parents choose schools far from their residential areas for many reasons, including distinction of educational and social level of students, international programs, interest in learning some foreign languages, and sometimes diversity of recreational activities offered by the school to students.

The total lengths of trips for school transport in Greater Cairo represent hundreds of thousands of kilometers.

More than 75% of students in private and language schools do not use school buses but use different alternatives for many reasons, including high fees.

No special tracks are designed for school buses and therefore journeys take more time and require more travel distances.

## **7. Recommendations and solutions for short and long terms:**

### **7.1. Problem solutions:**

Solutions could be extracted from the problem causes of, which can be divided into urgent solutions that mitigate effects of the problem, and other solutions - on the long run - that help to stop occurrence of such problems in the new urban communities and prevent its aggravation and limit their effects in the old urban communities as follows:

#### **First: Urgent solutions:**

Control schooling periods to be relatively far from peak times, and therefore school and university transportation does not contribute to increasing the rates of road congestion, by altering schooling periods.

It is also possible to provide school buses at subsidized prices and as to avoid being subject to exploitation of school owners and attract parents to participate in such service. This is addition to reapplying this idea (student buses) as to serve the movement of students to and from educational facilities.

Activate distance education system (E-Learning) and merged education in schools as to reduce the movement of students and organize them while going to schools and universities so as to reduce attendance rates to 70%, thus, reduce the intensity of traffic on roads. The spreading periods of Covid-19 pandemic have shown the possibility of developing these system and dependence on it.

Design routes and stops for school buses as to reduce the time and length of journeys.

#### **Second: Long term solutions**

Achieving equality and justice in educational levels provided by schools, improving quality of education in various public and private schools, providing school activities in all

schools to achieve what is called educational justice. This will reduce parents' desire to move their children to more distant schools in search of better quality of education or schools that offer more advanced activities and programs. Thus, residential areas can be linked to school admission so that the residential areas should not be far from schooling areas by more than the distance of the service scope.

Control land uses in new residential communities so that educational services are available in the designated areas only, as well as trying to provide areas for educational services in residential areas in the existing urbanization. This is in addition to setting restrictions on issuance of validity certificates for the sites of educational facilities as to ensure being in proper areas as to achieve the considered rates of standard planning services.

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