Comparison of Trip Attraction Between a Mall and a School in the City of Dagupan, Philippines

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Abstract: Road congestion is one of the common transportation problems encountered by developing cities in the Philippines where Dagupan City is not an exemption. Dagupan City is a commercial hub north of Manila and a center of education in the region. Shopping malls and schools in the City of Dagupan are the major trip generators in the city that have significant impact on road congestion. This study aims to compare the trip attraction, their characteristics and behavior, between a shopping mall and a school in Dagupan City. Descriptive and basic statistical analyses were used to analyze the data. The jeepney is the mode of choice of majority of those going to school and mall. The results also showed that vehicle volume and pedestrian counts attracted to the school and the mall have different peak periods. This finding will have some implication when introducing travel demand management schemes to the city.

Keywords: Road Congestion, Trip Attraction, Shopping Trips, School Trips

1. INTRODUCTION

Road congestion is a common problem encountered not only by highly urbanized cities but also by developing cities. Studies show that there are a lot of factors that causes road congestion on a certain zone. The more evident cause is due to trip attraction generated by shopping malls and schools. Road congestion is further aggravated when the shopping malls and schools are located within the periphery of the central business district.

Dagupan City is a developing city which is located approximately 212 kilometers north of Manila. The city is not exempted on the repulsive sight of road congestion. The local government places road congestion problem as one of its top concern looking for best approaches to solve the problem. New traffic management schemes have been implemented, including installation of intersection traffic lights but road congestion along shopping malls and schools are still evident. The newly installed traffic lights have not effectively solved the road congestion in the City of Dagupan.

One of the contributory factors of trips attracted to shopping malls and schools is the population itself of Dagupan City as well as that of the Province of Pangasinan. Dagupan city has a population of 171,271 based on the 2015 census of the Philippines. The province of Pangasinan on the other hand is the 4th most populated province in the Philippines with a total population of 2.96 million. Four municipalities and three cities of Pangasinan are even recognized as one of the ten most populated areas in the region.

The city's growth is not only in terms of increase in population but also in its economic growth. Dagupan city became a viable choice of trip destination since it is the commercial hub in the province. One of the city's recent milestones is the recognition it obtained as the next wave cities in the Philippines. The city's strategic location in Northern

Luzon and the presence of educational institutions that provide abundant talent for the different skills needed by industries made Dagupan City as a viable destination for investments in the sectors of Information Technology and Business Process (http://dagupan.gov.ph/ 2016).

Aside from being the largest producer of the well-known tastiest milkfish (Bangus) in the world, the city of Dagupan positioned itself as the destination of choice for business investment. This is manifested with the coming of the largest chain of shopping mall in the Philippines. The economic growth of Dagupan City could also be attributed to its strategic location. The city is bounded by Lingayen Gulf in the north, San Fabian in the northeast, Mangaldan in the east, Calasiao in the south and Binmaley in the west. The location of Dagupan City is seen to be at the heart of Pangasinan's big municipalities. The city is considered as the province's industrial hub. It is a subregional center for trade and commerce, finance, high-level health and education services of Region 1 in Northern Luzon.

Consequently, with the advent of shops and schools in the city of Dagupan, traffic congestion problems become apparent as these generate trips from/to these establishments. Traffic problems relating to road congestion become a challenge to the city as it continues to position itself as a business friendly city North of Manila.

1.1 Trip Attraction in the City

The major traffic generators in the City of Dagupan are observed both in the education and business sectors. The education sector has high impacts towards trip attraction in the city as there are three (3) big universities located in the heart of the city, twelve (12) colleges, and nine (9) vocational schools. In addition to these universities and colleges are the big secondary schools situated in the downtown loop of the city. With the presence of these educational institutions, Dagupan City is considered as a major contributor in producing graduates in the region.

Figure 1. Location map of selected malls and schools in Dagupan City

The strategic location of Dagupan City results to attractiveness of business investments specially shopping malls. Most of the malls are located within the central business area thus contributed significantly to the increase of vehicle volume in these areas. There are two big shopping malls that are not located in the central business area but its impact to traffic volume is also a major concern.

Figure 1 shows the location of selected shopping malls and schools in Dagupan City. It is observed that the schools and shopping malls in the city are major contributor to trip attraction in the city that often times during their peak hours contribute to road congestions in their specific zones. Thus, this study is conceived with the aim to compare the trip attraction, their characteristics and behavior between a mall and a shop located adjacent to each other in the city of Dagupan.

1.2 Objectives

The main object of this study is to compare the trip attraction between a school and a mall in the city. The specific objectives of this study are the following:

1. determine the socio-economic and urban travel characteristics of the pedestrian generated by the school and the shopping mall in the city, and
2. to quantify the trips attracted, in terms of both pedestrians and vehicles, to the school and to the mall.

2. LITERATURE REVIEW

The need to assess impacts of traffic generators on road congestion in the city of Dagupan is an emerging challenge in the city. It was observed that due to the fast paced growth of the city over the years, road congestion is a common sight.

Boltze and Tuan (2016) stressed the need for traffic management as every country in the developing world is facing transport problems in terms of capacity, safety, environmental compatibility, and economic efficiency. Traffic congestions, traffic accidents, and environmental pollutions are challenging the sustainable development of the country. With the worldwide growth of cities, the performance of urban road systems is a question of increasing importance as various problems can impair the efficiency of urban road networks, with the most visible symptom being traffic jams (Oliviera, et.al., 2014).

The following studies focusing on transport assessment provides rich insights in the conceptualization of the present study. Nemchinov (2016), assessed the sufficiency of road network with different functional classification development as determined by the demand for transport services, which is characterized by the peak hours volumes. Jain et. al (2016) focused on predicting susceptibility to user-demand responsive transport using demographic and trip characteristics of the population. The study emphasized the demand patterns are caused by the spatial variation of demographic characteristics, and travel behavior over the city.

Congestion indicators on the other hand are classified by Oliveira, et. al (2014) into three main groups: 1) Balance between supply and demand – indicators that assess congestion based on the impairment of the traffic flow capacity of the link under analysis; 2) Velocity and time – indicators that evaluate the trip flow in terms of average speed (or its variation) or average time (or its variation); and 3)Others – indicators that cannot be classified in the above two groups.

Takayama (2015) emphasize urban traffic congestion as caused by concentrated demand for travel around the start of the workday, because firms in central business districts (CBDs) generally have fixed work schedules and workers start work at the same time. Toledo (2011) stressed that road traffic congestion produces undesirable impacts on urban city centres. Delays and air pollution are well known negative examples of these impacts and several policies have endeavored to reduce them.

3. THEORETICAL FRAMEWORK

To analyze the trip attraction between a school and a shopping mall, the classical four-step model was used. The four-step process involves trip generation, trip distribution, mode choice, and traffic assignment (Graber & Hoel, 2012). This study focused on the first step which is the trip generation with the aim to determine the number of trips generated by the shopping mall and the school. Figure 2 shows the four-step model.
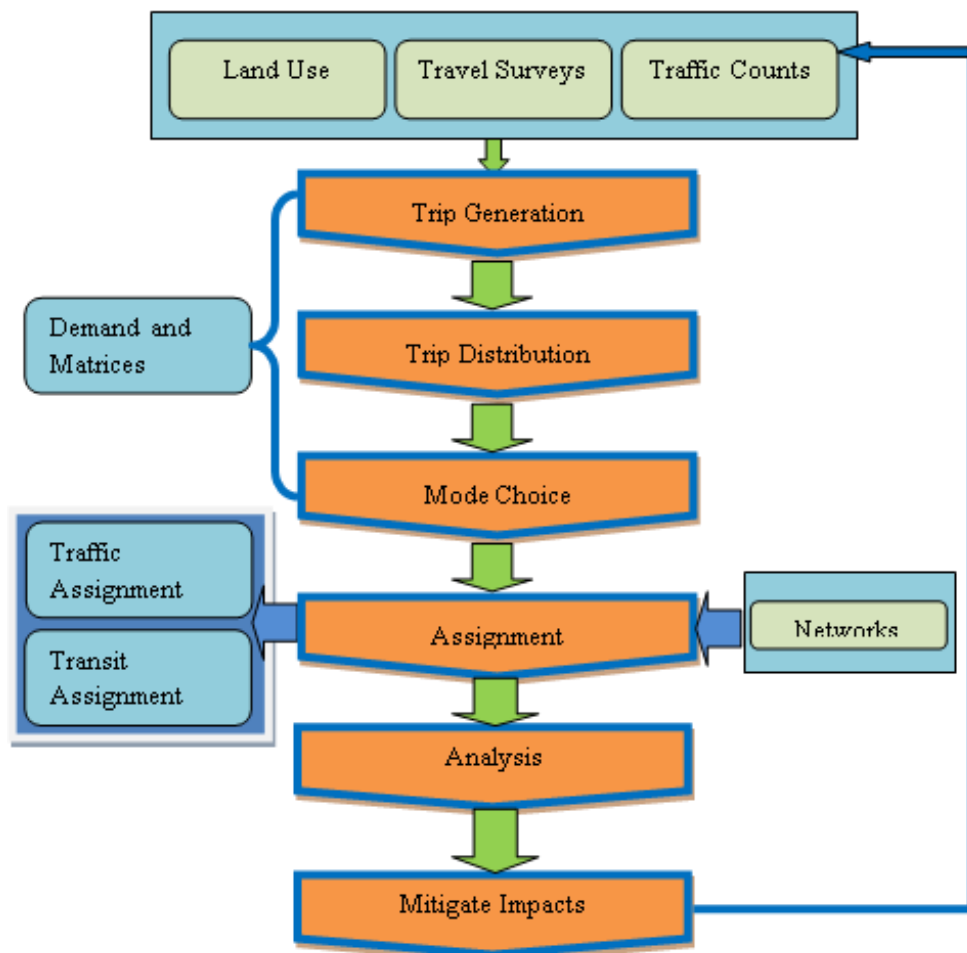

Figure 2. The Four-step transportation planning model

4. RESEARCH METHOD

This study used descriptive type of method of research. It is descriptive because it attempts to describe the travel demand generated by the school and shopping malls in the city of Dagupan.

4.1 Sources of Data

The data, both secondary and primary, used in this study include the following:

1. Road network map of Dagupan City. Documentary analysis using the data from Land Transportation Office (LTO) was used and interview with the different public and private commuters and operators were conducted.

3. Vehicles volume count. Vehicles entering and exiting the mall and the school were counted. It includes both the public and private means of transportation. The vehicle count for the school started at 6:30 AM in the morning up to 6:30 PM in the evening while the shopping mall started at 8:00 AM in the morning to 6:30 PM in the evening.

4. Pedestrian count. Pedestrian count includes the students and employees entering and exiting the school. For the shopping mall, customers and staffs entering and exiting the mall were included. The pedestrian count for the school started at 6:30 AM in the morning to 6:30 PM in the afternoon while the shopping mall started at 8:00 AM in the morning to 6:30 PM in the afternoon.

4.2 Research Design

Figure 3 shows the research design used in the study. Pedestrian and vehicle counts of the school and the mall were conducted. This data is used to compare the trip characteristics of the school and the mall and is used to investigate their effect on traffic congestion along the road that traverses these land uses.
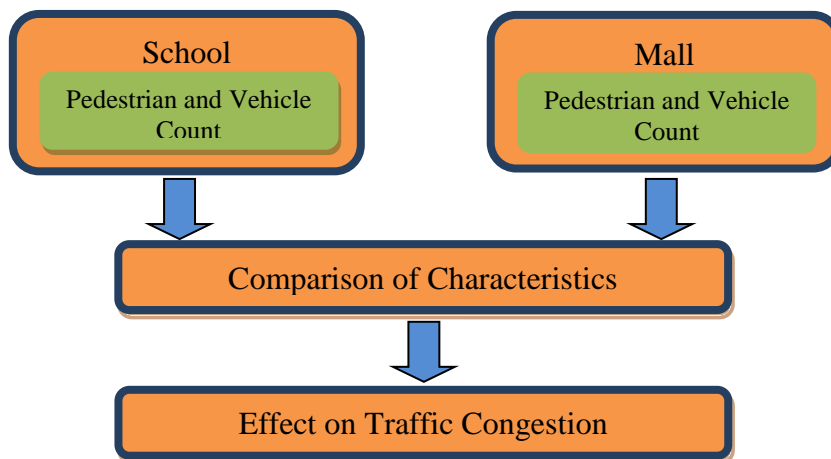

Figure 3. Research design

5. RESULTS AND DISCUSSION

This section presents the findings, analysis and interpretation of the data gathered to answer to the stated problems of this study.

5.1 Traffic Volume Characteristics in the Vicinity of the School and the Mall.

Figure 4 shows the location map of the school and the mall where both are located along the Arellano Street. The road strip has two lanes; one direction is going to Bonuan-San Fabian road while the opposite lane is going to the downtown area.

Going Bonuan	Going Bonuan
Peak Hour: 4:50-5:50pm	Peak Hour: 7:20-8:20am
Vehicle Volume:920	Vehicle Volume:1460

Going Downtown	Going Downtown
Peak Hour: 8:00-9:00am	Peak Hour: 7:20-8:20am
Vehicle Volume:1141	Vehicle Volume:1662

Vehicle Mall Exit	Vehicle School Exit
Peak Hour: 4:20-5:20pm	Peak Hour: 3:00-4:00pm
Vehicle Volume:427	Vehicle Volume:73

Vehicle Mall Entry	Vehicle School Entry
Peak Hour: 4:30-5:30pm	Peak Hour: 7:10-8:10am
Vehicle Volume:486	Vehicle Volume:110

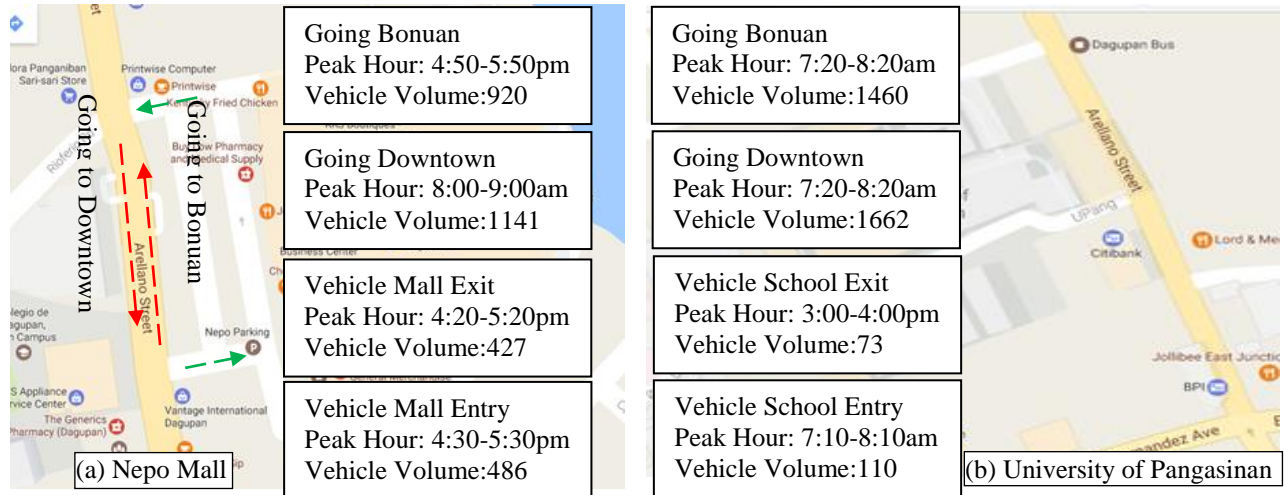(a) Nepo Mall   (b) University of Pangasinan

Figure 4. Vehicle volume count of the mall and the school

As shown in the figure, mall trip attraction and school trip attraction have different peak hour periods. For the mall trips, the peak hour for vehicles in the direction of Bonuan is found at 4:50-5:50 PM with a total volume of 920, while the opposite direction which is going the downtown area is between 8:00-9:00 AM with total volume of 1141 which is higher than the Bonuan direction. This would mean that more trips are attracted to the center of the city than those going out of the city. The route going to downtown area will pass along the road section of University of Pangasinan and towards the central business district. This is implies that vehicles coming from this area will have significant impact on the volume of vehicles meeting at the central business district. Vehicles entering the mall on the hand show the peak period at 4:30 to 5:30 PM with vehicle volume of 486. Vehicles leaving the mall have almost similar peak period, 4:20-5:20 PM with total vehicle volume of 427.

The school revealed a different peak hour period for the direction going to Bonuan. This is found at 7:20 to 8:20 AM with a total vehicle volume of 1460. The peak period for the downtown direction is also at 7:20-8:20 AM with total vehicle volume of 1662. This is almost similar to the mall peak hour where their peak hours overlap from 8:00 to 8:20 AM. This implies that during these periods, volume of vehicles at the intersection near the school will have significant increase and may result to road congestion in these areas. The volume of vehicles entering the school on the other hand had a minimal count of 110 with peak hours at 7:10 to 8:10 AM for vehicle entry along Arellano Street.

The pedestrian count for school and mall is shown in figure 5. The data reveals that during the one hour period of 11:50 to 12:50 PM, the mall had its peak period with total pedestrian count of 1,376. The main entrance of the school on the other hand had a total pedestrian count of 2,226 for the peak period of 7:10 to 8:10 AM. The peak period for exit of pedestrians from the mall is found during the 5:20-6:20 PM with total count of 1,481. The exit of pedestrians from the school however is at 11:40 t0 12:40 PM period with total volume count of 1,661.
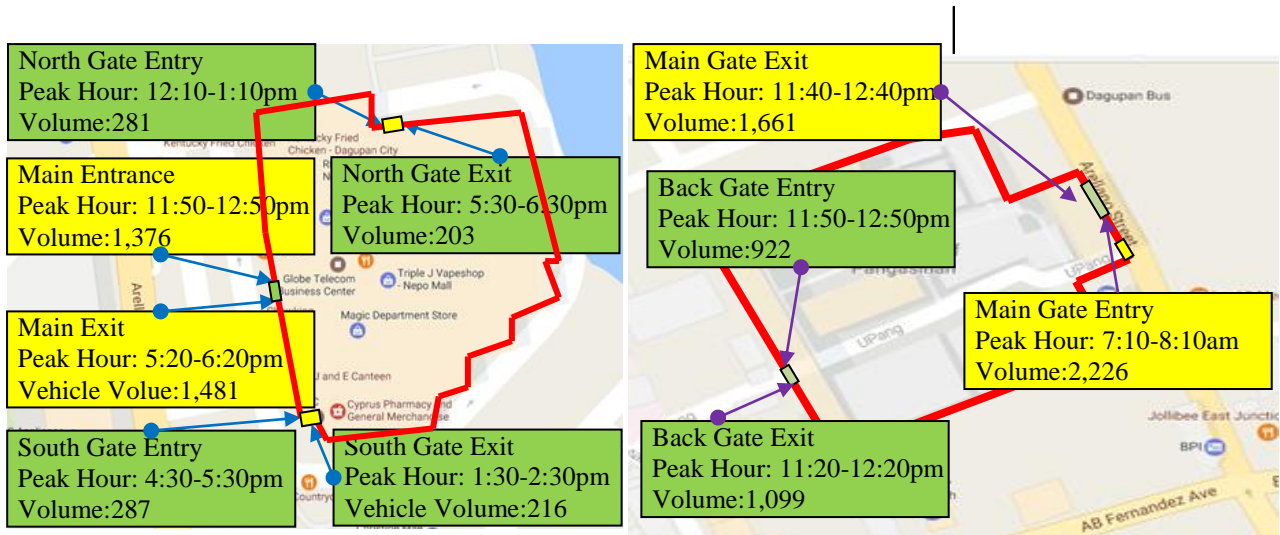
North Gate Entry
Peak Hour: 12:10-1:10pm
Volume:281

Main Entrance
Peak Hour: 11:50-12:50pm
Volume:1,376

North Gate Exit
Peak Hour: 5:30-6:30pm
Volume:203

Main Exit
Peak Hour: 5:20-6:20pm
Vehicle Volue:1,481

South Gate Entry
Peak Hour: 4:30-5:30pm
Volume:287

South Gate Exit
Peak Hour: 1:30-2:30pm
Vehicle Volume:216

Main Gate Exit
Peak Hour: 11:40-12:40pm
Volume:1,661

Back Gate Entry
Peak Hour: 11:50-12:50pm
Volume:922

Main Gate Entry
Peak Hour: 7:10-8:10am
Volume:2,226

Back Gate Exit
Peak Hour: 11:20-12:20pm
Volume:1,099

Figure 5. Pedestrian count on the mall and the school

The result shows that during the period of 11:50 to 12:50 PM, pedestrian count on the entry to the mall is at its peak while the pedestrian exit count of the school of 1,661 is on the period of 11:40 to 12:40pm. This implies that during these periods higher volume of vehicles going to the mall and leaving the school are expected which may contribute to road congestion in these areas.

5.1 Comparison of Trip Attraction Between a Mall and a School

Figure 6 shows the total vehicle count of the mall and the school in the directions going to Bonuan. The total vehicle volume includes all types of private and public modes of transportation. Comparing the trip attraction generated by the mall and the school, the data show that there are more vehicle volumes passing along the school area compared to the mall area. This implies that the school has more chances of generating traffic volumes that may lead to road congestion in the area.
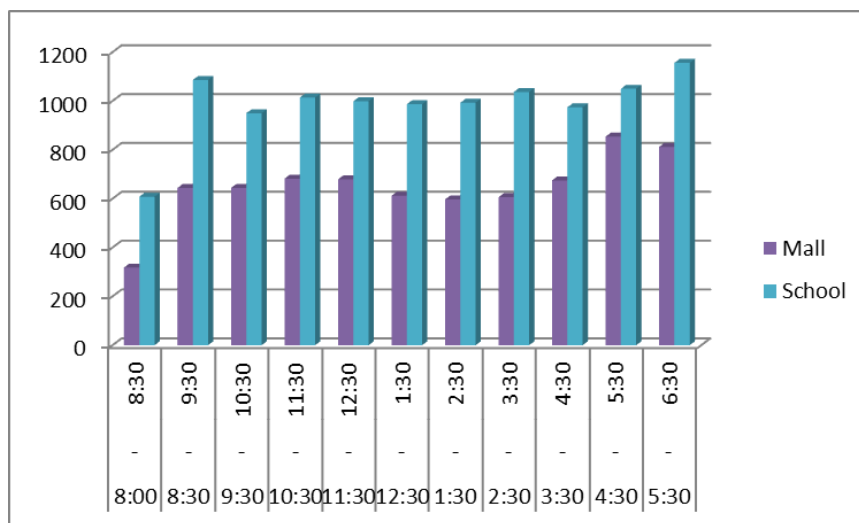

Figure 6. Comparison of total vehicle count at the mall and school Bonuan direction

Figure 7 shows the same scenario for the opposite direction where there are more vehicle volumes along the school zone as compared to the mall zone. The vehicle volume

generated by the school is almost double the vehicle volume generated by the mall. This implies that the school has more probability of generating traffic volumes along this area which may lead to road congestion.
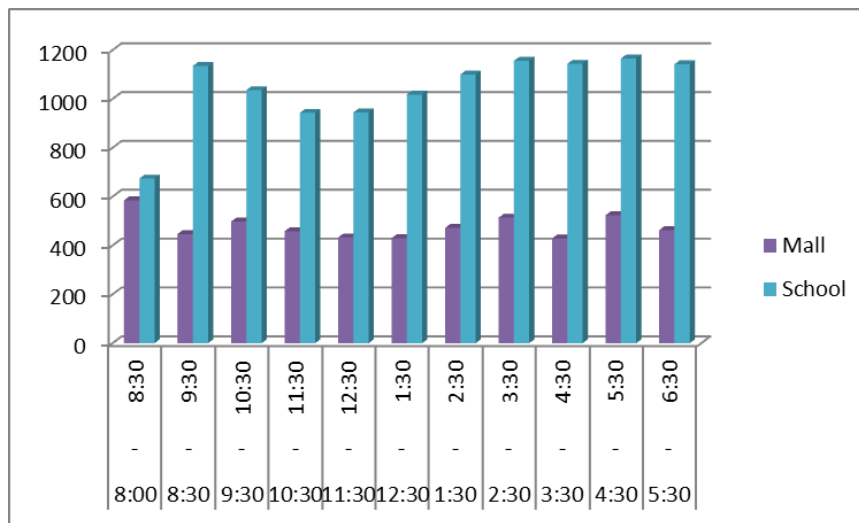

Figure 7. Comparison of total vehicle count at the mall and school downtown direction

Figure 8 shows the comparison of total pedestrian count attracted to the mall and the school from 6:30 AM to 6:30 PM in the afternoon. It can be noticed that the school has its peak period during the 7:30 to 8:30 AM interval while the mall had its peak period at 11:30 to 12:30pm interval. This implies that the school generates higher pedestrian count during the period where classes usually start, while the mall had its period during lunch time. The peak period for the mall could be attributed to students and office workers who prefer to take their lunch at the mall..
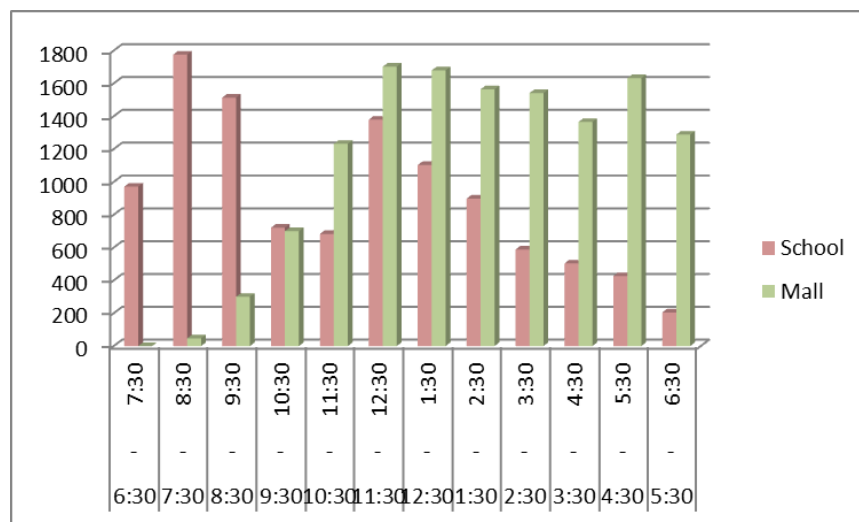

Figure 8. Comparison of total pedestrian count at the mall and school, main entrance

5.2 Descriptive Statistics of Respondents

Table 1 shows the comparison of the personal and trip characteristics of respondents going to the mall and the school. The mean age of pedestrians going to malls is 23 with standard deviation of 8.17 while the mean age for the school is 21 with standard deviation of 7.70. The

pedestrian count for the mall shows 56% of the mall goers are female while for the school, 51% are females.

Table 1. Descriptive statistics of respondents

Variables	Mall (Nepo Mall)			School (Univ. of Pangasinan)		
	N(%)	Mean	S.D.	N(%)	Mean	S.D.
Mean Age		23	8.17		21	7.70
Gender:						
Male	203(43.94)	-	-	-	258(48.96)	-
Female	259(56.06)	-	-	-	269(51.04)	-
Educational Attainment:						
Elementary	5(1.08)	-	-	0(0.00)	-	-
High School	110(23.81)	-	-	25(4.74)	-	-
Did Not Finish High School	10(2.16)	-	-	2(0.38	-	-
College Student	145(31.39)	-	-	420(79.70)	-	-
Did Not Finish College	75(16.23)	-	-	3(0.57)	-	-
College Graduate	112(24.24)	-	-	73(13.85)	-	-
Masters/PhD	5(1.08)	-	-	4(0.76)	-	-
Total	462(100)	-	-	527(100)	-	-
Income/Allowance per month		9,951.30	15,824.60		4,270.01	3243.22
Mode of Transportation Used:						
Tricycle		2.87	1.45		2.87	1.52
Jeepney		1.75	1.15		1.922	1.30
Car		4.00	1.28		3.98	1.19
Bus		3.57	1.60		3.05	1.61
Motorcyle		3.74	1.36		3.70	1.36
Walk		3.3	1.68		-	-
Others		5.0	-		-	-

On the educational attainment, 32% of the mall goers are college student and 24% are college graduate. Majority of the respondents in the school on the other hand are college students with a percentage of 79.7%. The average monthly income of respondents going to malls is 9,951.10 pesos which is higher than the average monthly allowances of respondents going to school which is only 4,270 pesos.

To determine the mode of transportation frequently used by the respondents, the Likert scale is used with the following descriptive interpretation:0 to 1.5 is "Always"; 1.5 to 2.5 is "Very Often"; 2.5 to 3.5 is "Sometimes"; 3.5 to 4.5 is "Rarely"; and 4.5 to 5 is "Never. For the malls, respondents use the following mode of transportation accordingly: Tricycle and Walking are "sometimes" used with mean value of 2.87 and 3.3 respectively. Jeepney is used "Very Often" with mean value of 1.75, while cars, bus, and motorcycles are used "Rarely".

For the school, Tricycle and Bus are used "Sometimes" with mean values of 2.87 and 3.05 respectively. Jeepney is used "Very Often" with mean value of 1.30. Cars and Motorcycles are used "Rarely" with mean values of 3.98 and 3.70 respectively. This implies that most of the pedestrians going to malls and schools prefer jeepney as their mode of transportation.

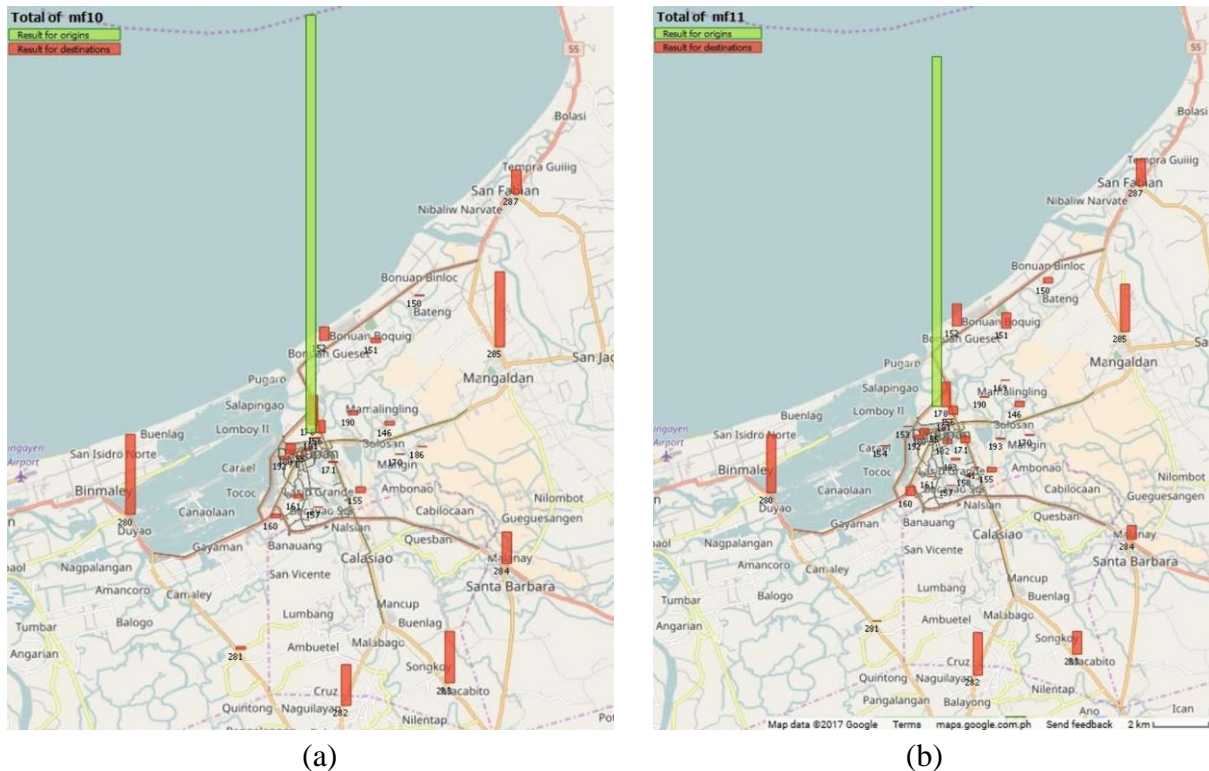(a)   (b)

Figure 9. Graphical presentation (in EMME4) of trips attracted to (a) University of Pangasinan and (b) Nepo Mall.

As shown in Figure 9, most trips attracted to the (a) University of Pangasinan as well as that to the (b) Nepo Mall come from the periphery of the city. These trip attractors would then create the congestion in the vicinity of the two land uses during the peak hour period.

6. CONCLUSIONS

The following conclusions could be drawn given the findings of this study:
1. Peak hour volume of vehicles passing the roads in the vicinity of the mall and the school happen at different time periods and directions of flow. Hence, should be considered when introducing traffic management schemes like the introduction of traffic intersection signalization in the city.
2. Similarly, the peak hour pedestrian flows entering and exiting the gates occur differently for the school and the mall. These are however predictable since this usually coincides with the starting time or dismissal of classes for the school and the opening of the mall.
3. Pedestrian volumes for the mall are greater than the pedestrian volumes going to school. In a day, more females enter the mall or the school than males.
4. The jeepney mode is the mode of choice of majority of those going to school and mall in the city.

ACKNOWLEDGEMENT

REFERENCES:

Boltze, M. and Tuan, V.A. (2016). Approaches to Achieve Sustainability in Traffic Management. Sustainable Development of Civil, Urban and Transportation Engineering Conference. *Procedia Engineering,* 142 (2016) 205 – 212. . Retrieved from www.elsevier.com, September 1, 2016.

de Oliveira, E.L. et.al (2014). Determining critical links in a road network: vulnerability and congestion indicators. *Procedia - Social and Behavioral Sciences,* 162 (2014) 158 – 16.

Garber and Hoel (2012). *Traffic and Highway Engineering*. Cengage Learning Asia Pte Ltd: Pasig City, Philippines.

Jain, S. et. al. (2016). Predicting susceptibility to use demand responsive transport using demographic and trip characteristics of the population. *Travel Behaviour and Society* 6, 44–56. Retrieved August 7, 2016 from http://ac.els-cdn.com

Moran Toledo, C. A. (2011). Congestion Indicators and Congestion Impacts: A Study on the Relevance of Area-wide Indicators. *Procedia Social and Behavioral Sciences,* 16, 781–791. Retrieved August 15, 2016 from http://ac.els-cdn.com.

Nemchinov, D.M. (2016). The assessment of the required level of road and street network development in localities and conurbations (city agglomeration). *Transportation Research Procedia,* 14, 1699-1705. Retrieved August 15, 2016 from http://ac.els-cdn.com.

Takayam, Y. (2015). Bottleneck congestion and distribution of work start times: The economics of staggered work hours revisited. 21st International Symposium on Transportation and Traffic Theory. *Transportation Research Procedia* 7, 499 – 518. Retrieved from www.elsevier.com, September 1, 2016.

http://dagupan.gov.ph/ 2016

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The city is not exempted on the repulsive sight of road congestion. The local government places road congestion problem as one of its top concern looking for best approaches to solve the problem. New traffic management schemes have been implemented, including installation of intersection traffic lights but road congestion along shopping malls and schools are still evident.

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Boltze and Tuan (2016) stressed the need for traffic management as every country in the developing world is facing transport problems in terms of capacity, safety, environmental compatibility, and economic efficiency. Traffic congestions, traffic accidents, and environmental pollutions are challenging the sustainable development of the country. With the worldwide growth of cities, the performance of urban road systems is a question of increasing importance as various problems can impair the efficiency of urban road networks, with the most visible symptom being traffic jams (Oliviera, et.al., 2014).

The following studies focusing on transport assessment provides rich insights in the conceptualization of the present study. Nemchinov (2016), assessed the sufficiency of road network with different functional classification development as determined by the demand for transport services, which is characterized by the peak hours volumes. Jain et. al (2016) focused on predicting susceptibility to user-demand responsive transport using demographic and trip characteristics of the population. The study emphasized the demand patterns are caused by the spatial variation of demographic characteristics, and travel behavior over the city.

Congestion indicators on the other hand are classified by Oliveira, et. al (2014) into three main groups: 1) Balance between supply and demand – indicators that assess congestion based on the impairment of the traffic flow capacity of the link under analysis; 2) Velocity and time – indicators that evaluate the trip flow in terms of average speed (or its variation) or average time (or its variation); and 3)Others – indicators that cannot be classified in the above two groups.

Takayama (2015) emphasize urban traffic congestion as caused by concentrated demand for travel around the start of the workday, because firms in central business districts (CBDs) generally have fixed work schedules and workers start work at the same time. Toledo (2011) stressed that road traffic congestion produces undesirable impacts on urban city centres. Delays and air pollution are well known negative examples of these impacts and several policies have endeavored to reduce them.

3. THEORETICAL FRAMEWORK

To analyze the trip attraction between a school and a shopping mall, the classical four-step model was used. The four-step process involves trip generation, trip distribution, mode choice, and traffic assignment (Graber & Hoel, 2012). This study focused on the first step which is the trip generation with the aim to determine the number of trips generated by the shopping mall and the school. Figure 2 shows the four-step model.
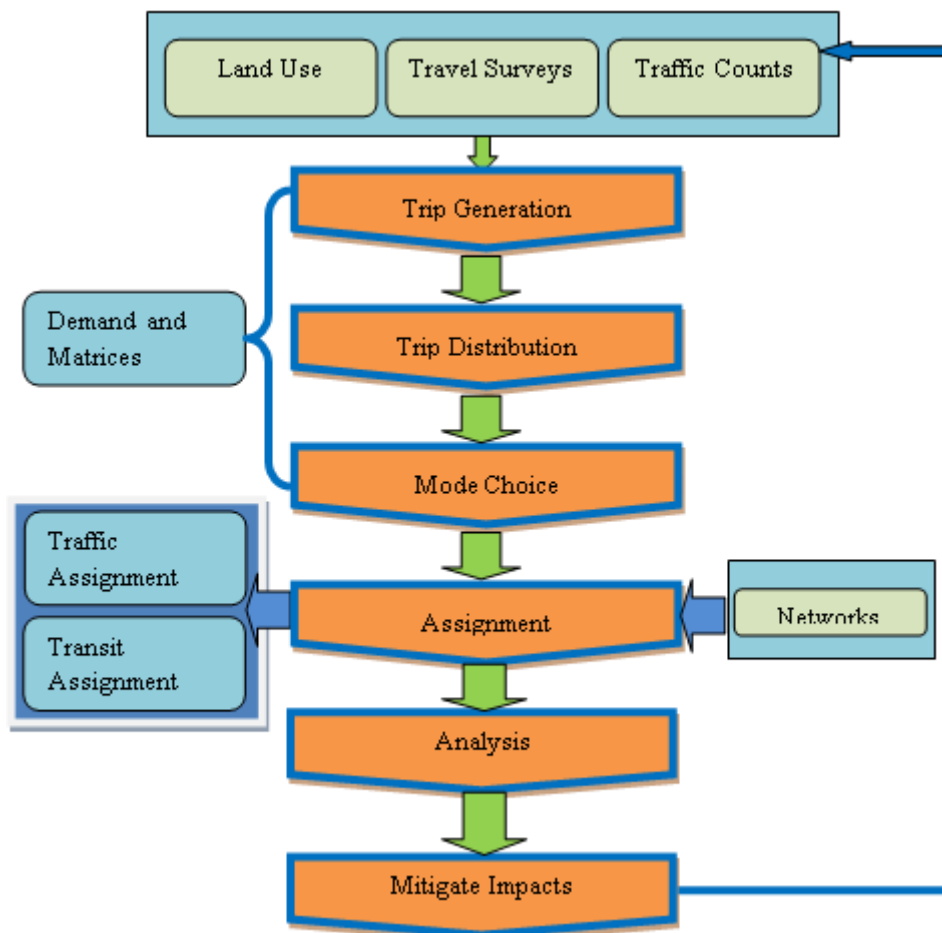

Figure 2. The Four-step transportation planning model

4. RESEARCH METHOD

This study used descriptive type of method of research. It is descriptive because it attempts to describe the travel demand generated by the school and shopping malls in the city of Dagupan.

4.1 Sources of Data

The data, both secondary and primary, used in this study include the following:

1. Road network map of Dagupan City. Documentary analysis using the data from Land Transportation Office (LTO) was used and interview with the different public and private commuters and operators were conducted.

2. Vehicles volume count. Vehicles entering and exiting the mall and the school were counted. It includes both the public and private means of transportation. The vehicle count for the school started at 6:30 AM in the morning up to 6:30 PM in the evening while the shopping mall started at 8:00 AM in the morning to 6:30 PM in the evening.

3. Pedestrian count. Pedestrian count includes the students and employees entering and exiting the school. For the shopping mall, customers and staffs entering and exiting the mall were included. The pedestrian count for the school started at 6:30 AM in the morning to 6:30 PM in the afternoon while the shopping mall started at 8:00 AM in the morning to 6:30 PM in the afternoon.

4.2 Research Design

Figure 3 shows the research design used in the study. Pedestrian and vehicle counts of the school and the mall were conducted. This data is used to compare the trip characteristics of the school and the mall and is used to investigate their effect on traffic congestion along the road that traverses these land uses.
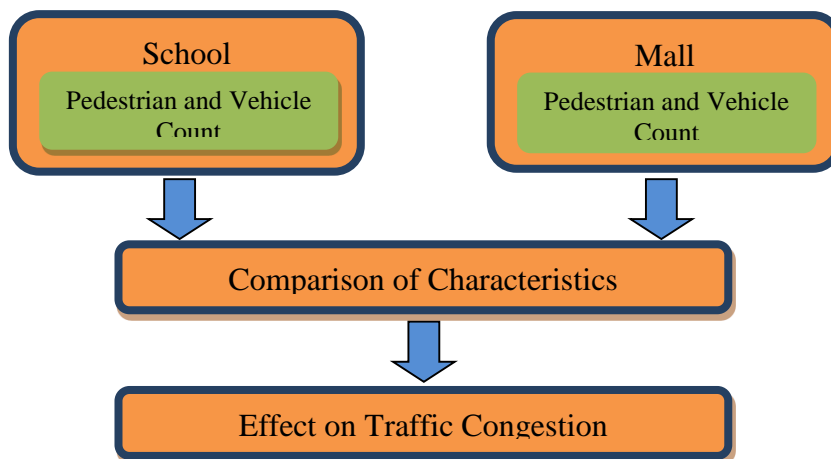

Figure 3. Research design

5. RESULTS AND DISCUSSION

This section presents the findings, analysis and interpretation of the data gathered to answer to the stated problems of this study.

5.1 Traffic Volume Characteristics in the Vicinity of the School and the Mall.

Figure 4 shows the location map of the school and the mall where both are located along the Arellano Street. The road strip has two lanes; one direction is going to Bonuan-San Fabian road while the opposite lane is going to the downtown area.

Going Bonuan
Peak Hour: 4:50-5:50pm
Vehicle Volume:920

Going Downtown
Peak Hour: 8:00-9:00am
Vehicle Volume:1141

Vehicle Mall Exit
Peak Hour: 4:20-5:20pm
Vehicle Volume:427

Vehicle Mall Entry
Peak Hour: 4:30-5:30pm
Vehicle Volume:486

(a) Mall

Going Bonuan
Peak Hour: 7:20-8:20am
Vehicle Volume:1460

Going Downtown
Peak Hour: 7:20-8:20am
Vehicle Volume:1662

Vehicle School Exit
Peak Hour: 3:00-4:00pm
Vehicle Volume:73

Vehicle School Entry
Peak Hour: 7:10-8:10am
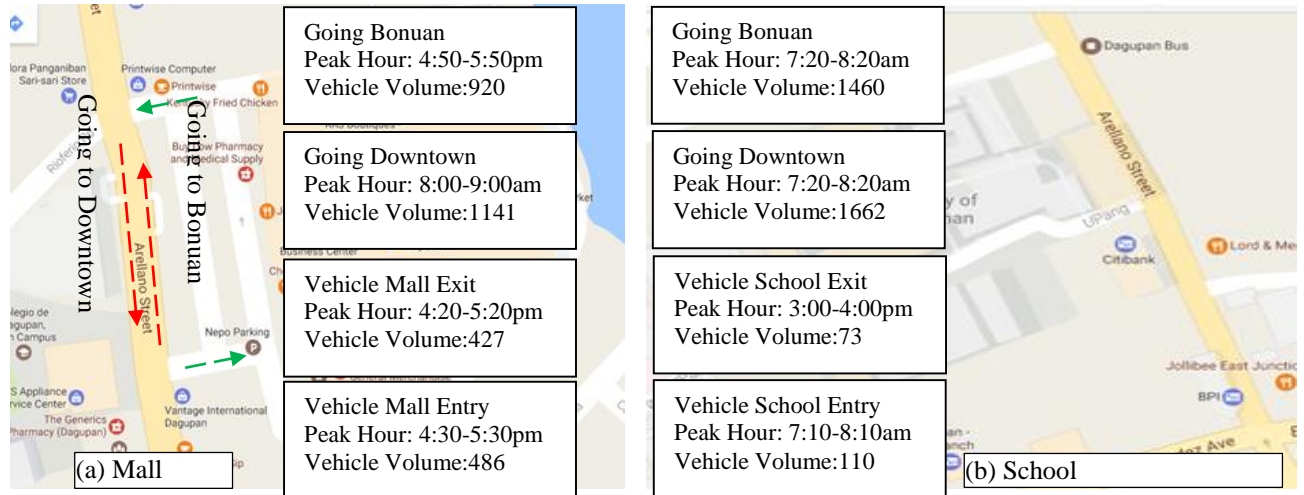Vehicle Volume:110

(b) School

Figure 4. Vehicle volume count of the mall and the school

As shown in the figure, mall trip attraction and school trip attraction have different peak hour periods. For the mall trips, the peak hour for vehicles in the direction of Bonuan is found at 4:50-5:50 PM with a total volume of 920, while the opposite direction which is going the downtown area is between 8:00-9:00 AM with total volume of 1141 which is higher than the Bonuan direction. This would mean that more trips are attracted to the center of the city than those going out of the city. The route going to downtown area will pass along the road section of the school and towards the central business district. This is implies that vehicles coming from this area will have significant impact on the volume of vehicles meeting at the central business district. Vehicles entering the mall on the hand show the peak period at 4:30 to 5:30 PM with vehicle volume of 486. Vehicles leaving the mall have almost similar peak period, 4:20-5:20 PM with total vehicle volume of 427.

The school revealed a different peak hour period for the direction going to Bonuan. This is found at 7:20 to 8:20 AM with a total vehicle volume of 1460. The peak period for the downtown direction is also at 7:20-8:20 AM with total vehicle volume of 1662. This is almost similar to the mall peak hour where their peak hours overlap from 8:00 to 8:20 AM. This implies that during these periods, volume of vehicles at the intersection near the school will have significant increase and may result to road congestion in these areas. The volume of vehicles entering the school on the other hand had a minimal count of 110 with peak hours at 7:10 to 8:10 AM for vehicle entry along Arellano street.

The pedestrian count for school and mall is shown in figure 5. The data reveals that during the one hour period of 11:50 to 12:50 PM, the mall had its peak period with total pedestrian count of 1,376. The main entrance of the school on the other hand had a total pedestrian count of 2,226 for the peak period of 7:10 to 8:10 AM. The peak period for exit of pedestrians from the mall is found during the 5:20-6:20 PM with total count of 1,481. The exit of pedestrians from the school however is at 11:40 t0 12:40 PM period with total volume count of 1,661.
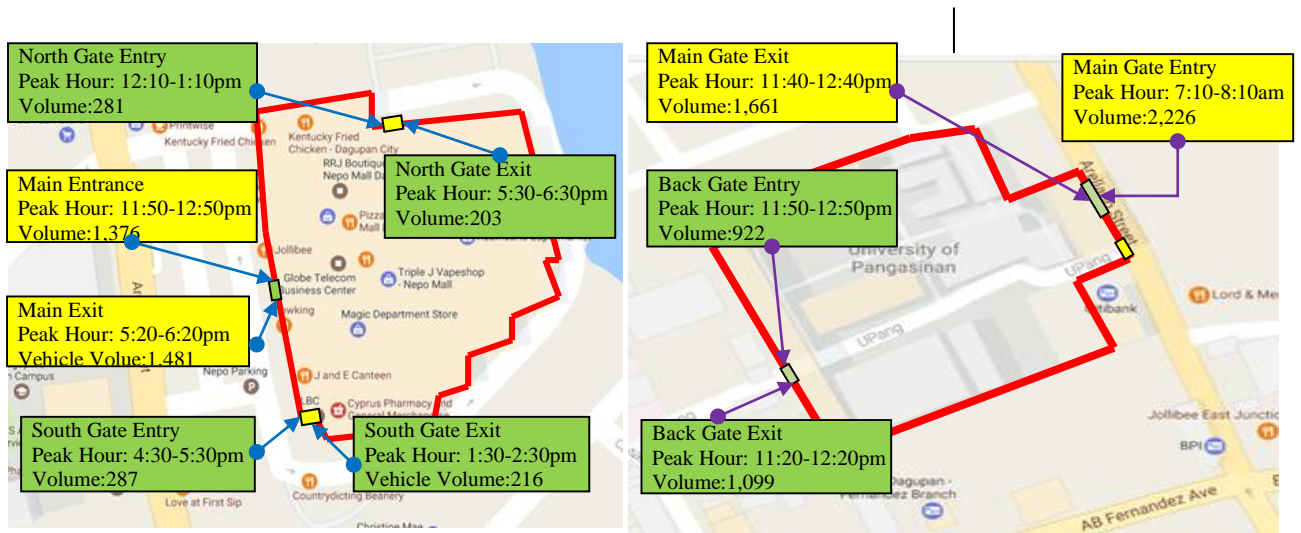
Figure 5. Pedestrian count on the mall and the school

The result shows that during the period of 11:50 to 12:50 PM, pedestrian count on the entry to the mall is at its peak while the pedestrian exit count of the school of 1,661 is on the period of 11:40 to 12:40pm. This implies that during these periods higher volume of vehicles going to the mall and leaving the school are expected which may contribute to road congestion in these areas.

5.1 Comparison of Trip Attraction Between a Mall and a School

Figure 6 shows the total vehicle count of the mall and the school in the directions going to Bonuan. The total vehicle volume includes all types of private and public modes of transportation. Comparing the trip attraction generated by the mall and the school, the data show that there are more vehicle volumes passing along the school area compared to the mall area. This implies that the school has more chances of generating traffic volumes that may lead to road congestion in the area.
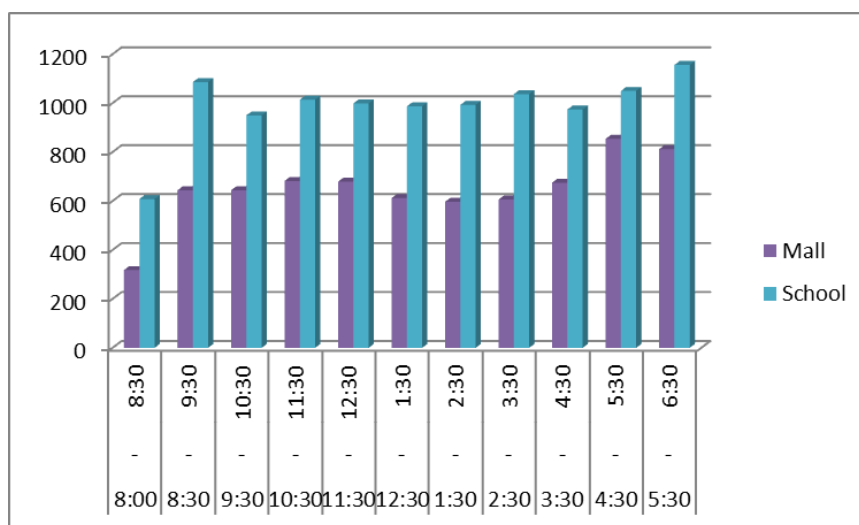

Figure 6. Comparison of total vehicle count at the
mall and school Bonuan direction

Figure 7 shows the same scenario for the opposite direction where there are more vehicle volumes along the school zone as compared to the mall zone. The vehicle volume generated by the school is almost double the vehicle volume generated by the mall. This implies that the school has more probability of generating traffic volumes along this area which may lead to road congestion.
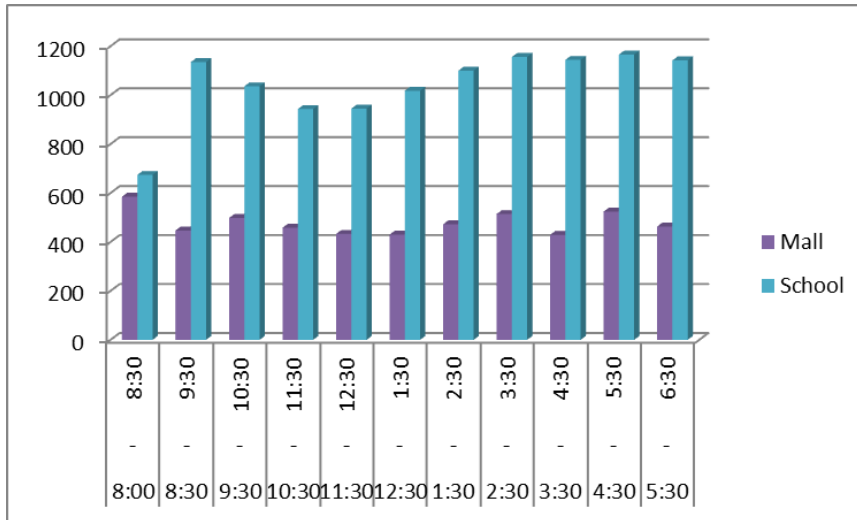

Figure 7. Comparison of total vehicle count at the
mall and school downtown direction

Figure 8 shows the comparison of vehicle count in terms of public and private type of transportation along the Bonuan direction. As shown in the figure, during the peak period of 7:30 to 8:30 AM, more private vehicles are passing along the school, while during the peak hour of 5:30 to 6:30 more private vehicles are passing along the Mall area. More public vehicle is observed during 10:30 to 11:30 period along the Mall area while more public vehicle is observed during the 7:30 to 8:30 period in the school area.
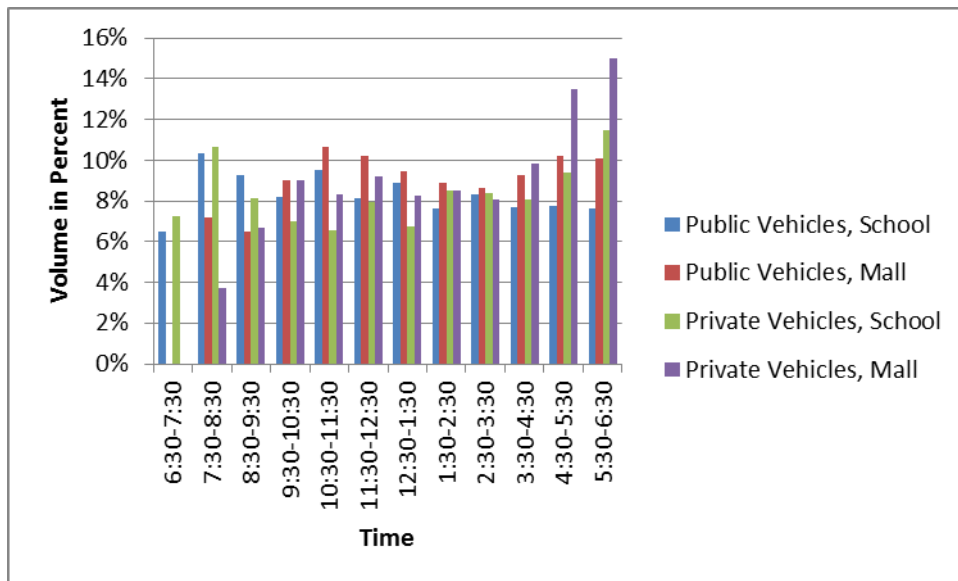

Figure 8. Comparison of public and private vehicle count at the
mall and school, Bonuan direction

Figure 9 shows the comparison of public and private vehicles in the downtown direction. As shown in the figure, more private vehicles are passing along the School area during 7:30 to 8:30 in the morning, while the Mall area has more private vehicle during 10:30 to 11:30 period. More public transportation along School area is observed during 1:30 to 2:30 in the afternoon, while more public transportation along Mall area is also observed at the same period.
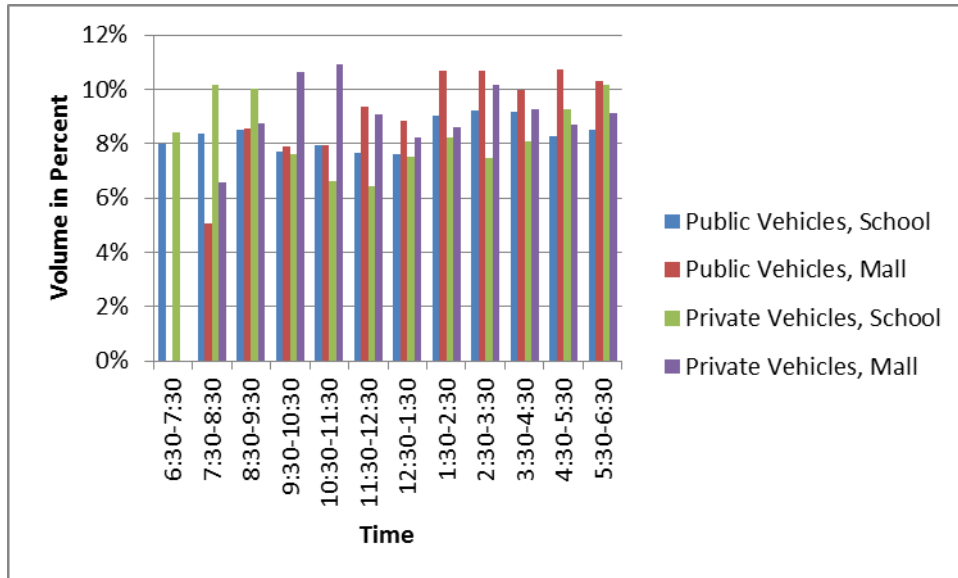

Figure 9. Comparison of public and private vehicle count at the
mall and school, Downtown direction

Figure 10 shows the comparison of total pedestrian count attracted to the mall and the school from 6:30 AM to 6:30 PM in the afternoon. It can be noticed that the school has its peak period during the 7:30 to 8:30 AM interval while the mall had its peak period at 11:30 to 12:30pm interval. This implies that the school generates higher pedestrian count during the period where classes usually start, while the mall had its period during lunch time. The peak period for the mall could be attributed to students and office workers who prefer to take their lunch at the mall. It should be noted also that minimum values are observed during the opening hours of the mall which starts at 10:00 AM in the morning.
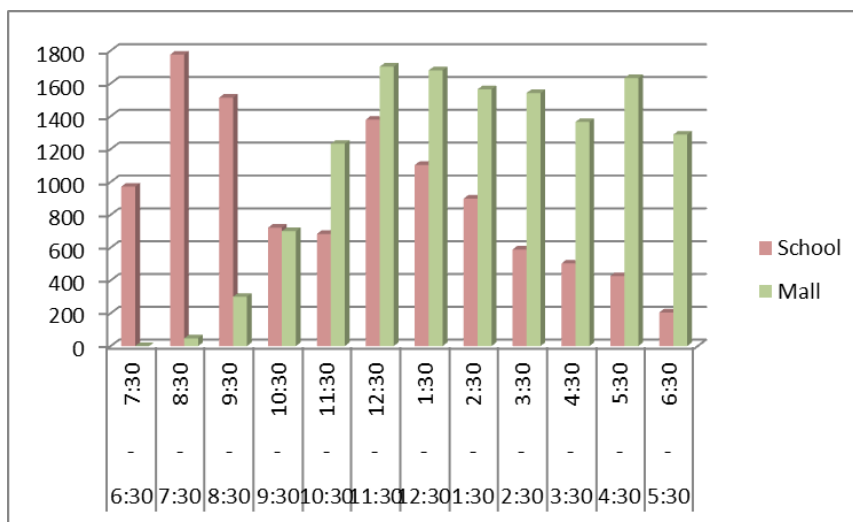

Figure 10. Comparison of total pedestrian count at the mall and school, main entrance

5.2 Descriptive Statistics of Respondents

To determine the personal and trip characteristics of respondents going to school and mall, a home interview survey is conducted. The survey questionnaires are given to the pedestrian entering the school and malls and were retrieved immediately. Table 1 shows the comparison of the personal and trip characteristics of respondents going to the mall and the school. The mean age of pedestrians going to malls is 23 with standard deviation of 8.17 while the mean age for the school is 21 with standard deviation of 7.70. The pedestrian count for the mall shows 56% of the mall goers are female while for the school, 51% are females.

Table 1. Descriptive statistics of respondents

Variables	Mall			School		
	N(%)	Mean	S.D.	N(%)	Mean	S.D.
Mean Age		23	8.17		21	7.70
Gender:						
Male	203(43.94)	-	-	-	258(48.96)	-
Female	259(56.06)	-	-	-	269(51.04)	-
Educational Attainment:						
Elementary	5(1.08)	-	-	0(0.00)	-	-
High School	110(23.81)	-	-	25(4.74)	-	-
Did Not Finish High School	10(2.16)	-	-	2(0.38	-	-
College Student	145(31.39)	-	-	420(79.70)	-	-
Did Not Finish College	75(16.23)	-	-	3(0.57)	-	-
College Graduate	112(24.24)	-	-	73(13.85)	-	-
Masters/PhD	5(1.08)	-	-	4(0.76)	-	-
Total	462(100)	-	-	527(100)	-	-
Income/Allowance per month		9,951.30	15,824.60		4,270.01	3243.22

On the educational attainment, 32% of the mall goers are college student and 24% are college graduate. Majority of the respondents in the school on the other hand are college students with a percentage of 79.7%. The average monthly income of respondents going to malls is 9,951.10 pesos which is higher than the average monthly allowances of respondents going to school which is only 4,270 pesos.

The type of transportation used by respondents going to school is shown in Table 2. The table shows that 46% of the respondents never use private car and a minimal of 6% always use this mode. The respondents are divided in terms of using the bus as 29% of the respondents claim they are using the bus, while 28% of the respondents never uses bus as the transport mode. Majority of the respondents on the other hand agree that they always use the jeepney type where there are 56% of the respondents who claimed they always use this type. The use of tricycle is also divided as 28% of the respondents claim they always use tricycle, but there are also 24% among the respondents who never uses tricycle. Few of the respondents are always using motorcycle type with a total number of 11% respondents, while

40% of the respondents claim they never use motorcycle. This implies that the respondents going to School prefer the "Jeepney" type as their mode of transportation.

Table 2 Type of Transportation Used by Respondents Going School

	P Car	Bus	Jeepney	Trike	Mcycle
Always	6%	29%	56%	28%	11%
Very Often	5%	10%	16%	14%	8%
Sometimes	18%	14%	12%	22%	20%
Rarely	24%	18%	6%	13%	21%
Never	46%	28%	10%	24%	40%
TOTAL	100%	100%	100%	100%	100%

The mode of transportation used by respondents going to the Mall is shown in Table 3. The table shows that the respondents sometimes use "Trike or Tricyle" as their mode of transportation going to the Mall, with 29% of the respondents claimed this. 59% of the respondents use "always" the "Jeepney" type. The respondents never use car, bus, motorcycle, and walking as their mode of transportation. This implies that respondents prefer Jeepney as their mode of transportation going to the Mall.

Table 3 Mode of Transportation Used by Mall Respondents

	Trike	Jeepney	Car	Bus	Mcycle	Walk
Always	25%	59%	9%	20%	10%	26%
Very Often	15%	20%	4%	8%	8%	10%
Sometimes	29%	11%	18%	14%	24%	13%
Rarely	10%	3%	18%	11%	13%	9%
Never	21%	6%	52%	46%	45%	42%
	100%	100%	100%	100%	100%	100%

6. CONCLUSIONS

The following conclusions could be drawn given the findings of this study:
1. Peak hour volume of vehicles passing the roads in the vicinity of the mall and the school happen at different time periods and directions of flow. Hence, should be considered when introducing traffic management schemes like the introduction of traffic intersection signalization in the city.
2. Similarly, the peak hour pedestrian flows entering and exiting the gates occur differently for the school and the mall. These are however predictable since this usually coincides with the starting time or dismissal of classes for the school and the opening of the mall.
3. Pedestrian volumes for the mall are greater than the pedestrian volumes going to school. In a day, more females enter the mall or the school than males.
4. The jeepney mode is the mode of choice of majority of those going to school and mall in the city.

7. RECOMMENDATIONS

Based from the result of the study, the following are hereby recommended:
1. To assign loading and unloading zone of Jeepney that is located strategically.
2. Total ban of tricycle entry within the central business district and perennial congested area.
3. Implementation of number coding.
4. Promote use of alternative mode of transportation such as bicycle and walking.

ACKNOWLEDGEMENT

REFERENCES:

Boltze, M. and Tuan, V.A. (2016). Approaches to Achieve Sustainability in Traffic Management. Sustainable Development of Civil, Urban and Transportation Engineering Conference. *Procedia Engineering,* 142 (2016) 205 – 212. . Retrieved from www.elsevier.com, September 1, 2016.

de Oliveira, E.L. et.al (2014). Determining critical links in a road network: vulnerability and congestion indicators. *Procedia - Social and Behavioral Sciences,* 162 (2014) 158 – 16.

Garber and Hoel (2012). *Traffic and Highway Engineering*. Cengage Learning Asia Pte Ltd: Pasig City, Philippines.

Jain, S. et. al. (2016). Predicting susceptibility to use demand responsive transport using demographic and trip characteristics of the population. *Travel Behaviour and Society* 6, 44–56. Retrieved August 7, 2016 from http://ac.els-cdn.com

Moran Toledo, C. A. (2011). Congestion Indicators and Congestion Impacts: A Study on the Relevance of Area-wide Indicators. *Procedia Social and Behavioral Sciences,* 16, 781–791. Retrieved August 15, 2016 from http://ac.els-cdn.com.

Nemchinov, D.M. (2016). The assessment of the required level of road and street network development in localities and conurbations (city agglomeration). *Transportation Research Procedia,* 14, 1699-1705. Retrieved August 15, 2016 from http://ac.els-cdn.com.

Takayam, Y. (2015). Bottleneck congestion and distribution of work start times: The economics of staggered work hours revisited. 21st International Symposium on Transportation and Traffic Theory. *Transportation Research Procedia* 7, 499 – 518. Retrieved from www.elsevier.com, September 1, 2016.

http://dagupan.gov.ph/ 2016/04/ dagupan-receives-award-as-among-the-top-ten-next-wave-cities-in-phl/

https://www.dagupan.gov.ph/about-dagupan/geography/