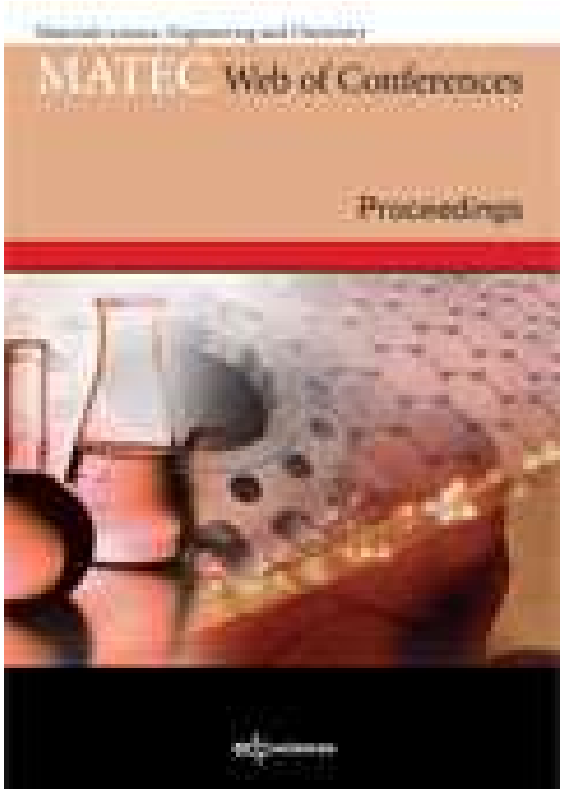

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Factors influencing the modal choice to access elementary school in supporting Surakarta as child friendly-city

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Abstract. Elementary school, as criteria of a friendly city, should be available inside a neighborhood unit (NU). There is only one out of 109 NU in Surakarta City that does not have an elementary school. However, 67% of the people of Surakarta choose elementary schools outside their NU. They use various modes of transportation because their school is out of reach for walking. Nevertheless, there are people who do not walk even though they are in their NU. This study aims to determine the factors that influence the modal choice in accessing schools in the city of Surakarta. This research used a quantitative research method with multinomial logistic regression analysis to analyze 14 factors obtained from the theoretical review. The result shows that there are six factors that influence the modal choice to access elementary school, i.e. family member; car ownership; householder occupation; time of trip made; road separator; and householder age.

1 Introduction

The city of Surakarta has been awarded as Child-friendly City since 2011. Until 2017, Surakarta still cannot reach the highest level of the child-friendly city in Indonesia. It becomes the basis for analyzing various aspects in supporting Surakarta City as Child-friendly City. Limitedness of children independent mobility is one of the basic factors that should be considered in planning the social infrastructure development, in order to support the friendly city concept [11]. Elementary School as children's social facilities should be available inside a Neighborhood Unit (NU), considering the distance of children walking capabilities [1, 2, 3, 7, 14, 15]. However, based on previous research [5], it is known that 67% of children in Surakarta attended elementary school outside their NU. It means that they use transportation modal to access the elementary school because of the distance that is too far to reach by walking.

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Besides going to school on foot, children in Surakarta use a variety of modals such as bicycles, pedicab, motorcycles, public transport, and cars to access elementary school [5]. However, it is not just happening to children who go to school outside their NU. There are children who do not walk even they attend elementary school inside their NU. Car use was perceived to be quicker, even though they also lived near the school [4]. In 2017, the use of motorizing vehicles still becomes the main modal used to go to elementary school [5]. It increases carbon dioxide emissions from the vehicles. The combustion of fossil fuel produces carbon dioxide emissions, which have a direct relationship with the global warming [16].

The modal choice that is not in line with the embodiment of a child-friendly city certainly brings up the problem. Therefore, it is necessary to mitigate in overcoming the anomaly. The modal choice anomaly becomes the basis for examining factors influencing the modal choice in accessing elementary school.

2 Methodology

The variables of factors influencing the modal choice to access elementary school were obtained from the elaboration of theories. The data of these factors were collected through 100 questionnaires distributed to elementary school students in each NU of Surakarta. The distribution of 109 NUs in Surakarta City [5] is presented in Figure 1.

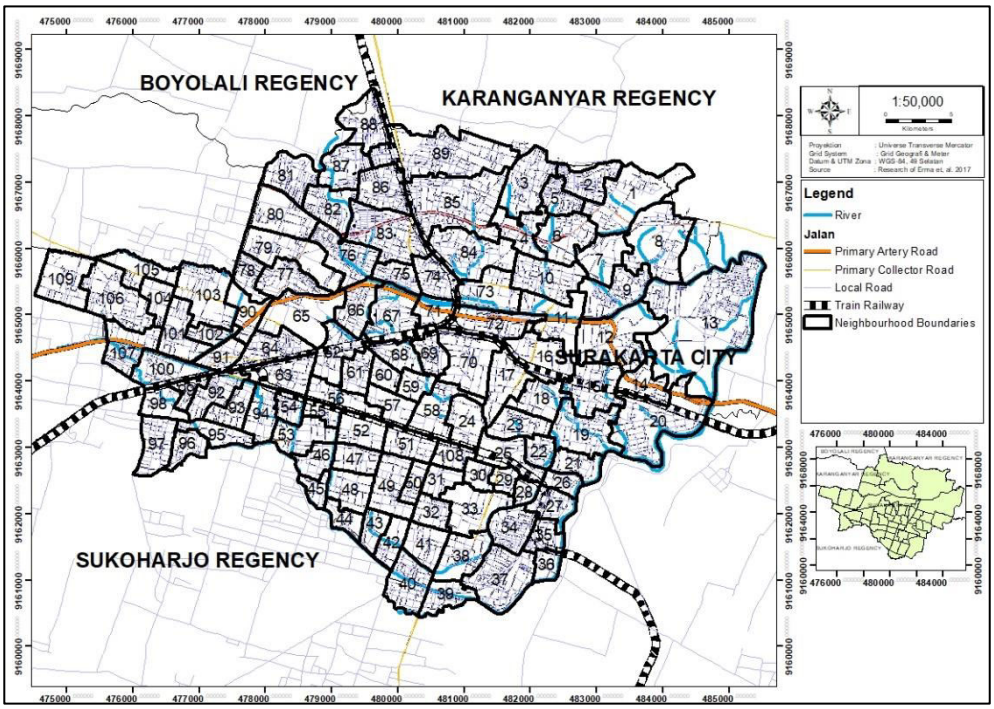


Fig. 1. The Division of Surakarta Neighbourhood Unit.

In the modal choice, there are four groups of influencing factors, which are Travel Characteristics, Traveller Characteristics, Transportation System Characteristics, and Special Characteristics Factors [6]. Travel characteristic factors include trip purpose [6], and time of trip made [6]. Since elementary school students are still dependent on their

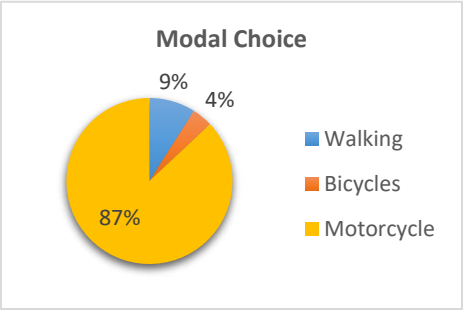
parents, the trip purpose in this paper is linked to parents of elementary school students, which is the purpose of the parent's trip and whether the trip to school coincides with the purpose of the parent's trip (to work, to shop, or others). Time of trip made is seen from the time the child left for school. Traveller Characteristics Factor consists of vehicle ownership [13, 6], and socio-economic character: structure [6] and family size (young couple, children, retirement or single, etc.) [6], age [6, 8], type of work [6], number of family members working [8], ownership of driving license [6]. Transportation System Characteristics Factor consists of accessibility [6].

Special Characteristics Factor is associated with the characteristics of elementary schools that should be in a neighborhood unit. The ideal neighborhood unit should ensure safety in the environment. It should be free from unwanted traffic across the roads [2]; has a separator between pedestrian and main street on local roads, collectors, and arteries [2, 4]; and safe for children to cross the street [2, 4].

3 Result and Discussion

3.1 The elementary school students' modal choice

Elementary school students in Surakarta goes to school by walking, bicycles, or motorcycle with their parents. Most of the elementary students go to school with their parents by motorcycle. Many parents prefer to take their children to school using the motorcycle because it is more efficient than walking. It is also because of their children school trip related to other parents' trip destinations, making it efficient for parents.



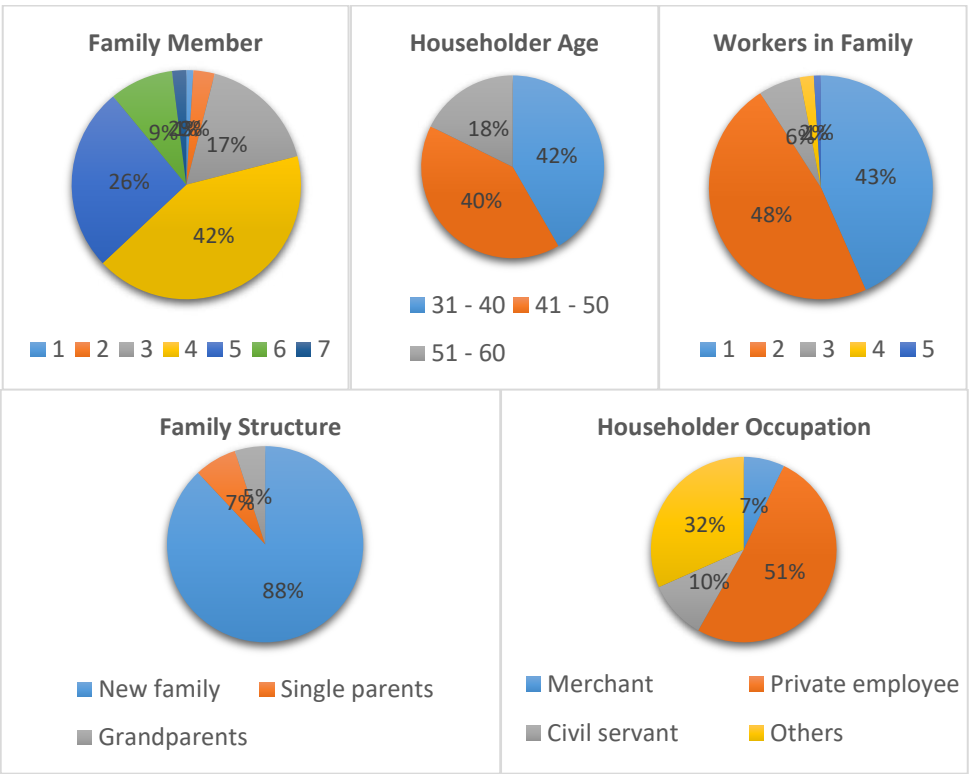
3.2 The factor characteristics influenced modal choice elementary school students

There are 14 factors that examined the modal choice to access elementary school. Judging from the aspect of their ability, the majority of parents had vehicle and driving license. This reflected that parents had an opportunity to drive children to go to school. It is in line with the study in Beijing, which found that car ownership is a major predictor of school modal choice [12].

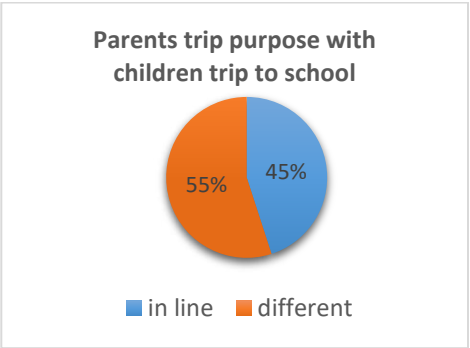
Table 1. Traveller Characteristics Factor

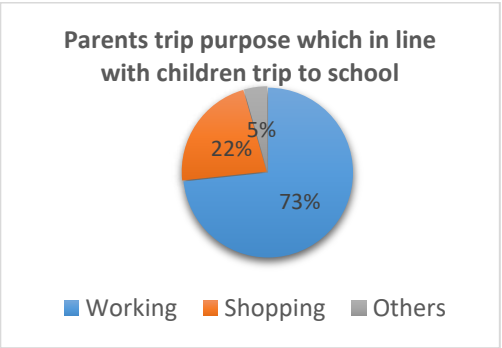
Factors	Yes	No
Vehicle Ownership	98%	2%
Driving License Ownership	84%	16%

Based on socio-economic aspects, there were factors related to the characteristics of elementary school children. The majority of children were in families with 4-5 family members and 2-3 of family members are working. As many as 88% of elementary students lived with their families who were a completely new family. Viewed from the parents' job, the majority of their family heads worked as a private employee.

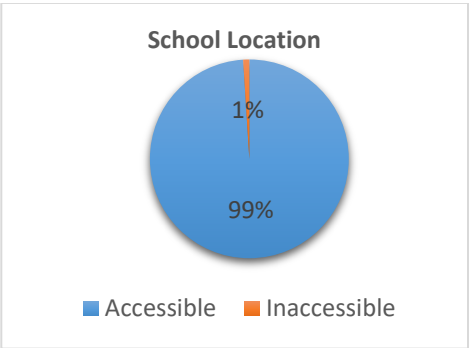


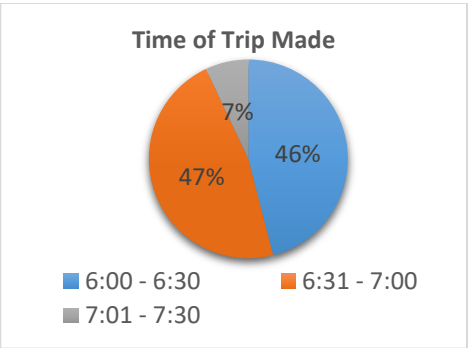
Childhood is an age of development that was still influenced by parents and school environment [10]. In traveling to school, children still needed to be accompanied by parents. There are 45% of the destination of parent travel was in line with the children's school. Thus, parents could take children to school on the way to their destination. The 73% of parents' accompanied their children to school was because their workplaces have the same direction as children's school. This finding also found in Taiwan [9] and Beijing [12], which is also said that parents drive their children to school on their way to work since the start times of schools for students are usually before or approximate the same time with parents depart for work.





However, children's travel time to school in the morning is different from parent's travel time to work. Therefore, the use of mode savings cannot be achieved because of such a mismatch of travel time between parent and children.





The majority of elementary schools in Surakarta are accessible to children. There were three factors related to child-friendly NU, namely the freedom of the road from unwanted traffic, the separation of the pedestrian path by road, and the safety of children in crossing the road. The majority of the roads in front of the elementary school were still not free of unwanted traffic, i.e., continuous traffic. The lack of a separation between pedestrian paths and roads also reduced the safety of children in walking. In addition, the safety of children in crossing the road was also still very low.

Table 2. Special Characteristics Factor

Factors	Yes	No
Unwanted traffic on the school road	62%	38%
Availability of road separator	24%	76%
Safety in crossing the road	34%	66%

3.2 Factor Analysis

The above factors were analyzed using multinomial logistic regression method. Based on the value of Pearson known that the whole model is suitable to use.

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	17.404	144	1.000
Deviance	17.298	144	1.000

Fig. 2. The Goodness-of-Fit result.

To determine the effect of 14 existing factors for modal choice to access elementary school, the first thing to do was to look at the simultaneous test result in Figure 3. A simultaneous test was used to see the influence of 14 independent variables, whether significant or not affecting the dependent variable.

Model Fitting Information

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	90.279			
Final	18.920	71.360	42	.003

Fig. 3. The model fits result.

The result of the analysis showed a significant value of 0.003, which meant smaller than the degree of freedom (0.05) so that in this test it could be said that there was an influence of independent variables on the chosen mode in accessing elementary school. To see which independent variables influenced the modal choice, so partial test was conducted.

Table 3. Partial test results

Variabels		Sig.	Interpretation
X1	Parents' mode ownership	0.011	Influence
X2	Parents' driving license	0.687	Do not influence
X3	The number of family members working	0.110	Do not influence
X4	The same parents' destination	-	Do not influence
X5	Purpose of parents' travel	0.992	Do not influence
X6	Accessibility level	0.998	Do not influence
X7	Head of family job	0.024	Influence
X8	Family structure	0.252	Do not influence
X9	Time of travel to school	0.017	Influence
X10	Continuous traffic	0.254	Do not influence
X11	Road separation between pedestrian and vehicle	0.000	Influence
X12	Children safety to cross the road	0.607	Do not influence
X13	The total member of the family	0.000	Influence
X14	Head of family age	0.000	Influence

From the partial test result above, it could be seen that the independent variables that affect the dependent variable (mode type) are only 6 variables, namely the parents' mode ownership, the type of head of family job, the time of travelling to school, road separation between pedestrian and vehicle, the number of family members, and the head of family age. It can be seen from the probability/significance of each independent variable whose value

was smaller than the degrees of freedom (0.05). Based on the value of significance, the factors that had the highest significance value were the number of family factor, road separation between pedestrian and vehicle, and the age of head of the family.

Pseudo R-Square

Cox and Snell	.521
Nagelkerke	.847
McFadden	.772

Fig. 4. The pseudo R-Square result.

In the goodness test model, the output of Nagelkerke value of 0.847 indicated that the data diversity of independent variables in this study was able to explain the diversity of the data of independent variable qualitative equal to 84,7%, where the rest 15,3% explained in other independent variables outside research model. In this study, the R-Square value of 0.847 was almost close to 1 because the independent variables used in this study amounted quite a lot. The more independent variables were analyzed, the higher the R-Square value.

The vehicle ownership factor that influences the modal choice in accessing elementary schools is related to the characteristics of the parents, which mostly have motorized vehicles. In addition, most of the time to go to the school that is different from their working time also allows them to accompany their children to go to school. The absence of pedestrian way's separation in most of the elementary school neighborhood is also a factor that can make parents feel unsafe to let their children go to school on foot.

4 Conclusion

Based on the results, six independent variables have a significant influence on the modal choice to access elementary school in supporting Surakarta as a child-friendly city. These factors are the number of family member, parents' vehicle ownership, householder occupation, time of the trip to school, road separation between pedestrian and vehicle, and the householder age. From those six factors, there are factors that are included in the aspect of child-friendly infrastructure, which is the separation of pedestrian paths. Given the concept of a child-friendly city that is ideally children go to school on foot or using non-motorize mode, these factors are very important. This can be a suggestion for the government to fulfill the infrastructure for the pedestrian to encourage people to choose the non-motorized mode that is more environmentally friendly. Providing pedestrian infrastructure hopefully can support Surakarta to be more child-friendly in all aspects.

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Factors influencing the modal choice to access elementary school in supporting Surakarta as child friendly-city

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Abstract. Elementary school, as criteria of a friendly city, should be available inside a neighborhood unit (NU). There is only one out of 109 NU in Surakarta City that does not have an elementary school. However, 67% of the people of Surakarta choose elementary schools outside their NU. They use various modes of transportation because their school is out of reach for walking. Nevertheless, there are people who do not walk even though they are in their NU. This study aims to determine the factors that influence the modal choice in accessing schools in the city of Surakarta. This research used a quantitative research method with multinomial logistic regression analysis to analyze 14 factors obtained from the theoretical review. The result shows that there are six factors that influence the modal choice to access elementary school, i.e. family member; car ownership; householder occupation; time of trip made; road separator; and householder age.

1 Introduction

The city of Surakarta has been awarded as Child-friendly City since 2011. Until 2017, Surakarta still cannot reach the highest level of the child-friendly city in Indonesia. It becomes the basis for analyzing various aspects in supporting Surakarta City as Child-friendly City. Limitedness of children independent mobility is one of the basic factors that should be considered in planning the social infrastructure development, in order to support the friendly city concept [11]. Elementary School as children's social facilities should be available inside a Neighborhood Unit (NU) considering the distance of children walking capabilities [1, 2, 3, 7, 14, 15]. However, based on previous research [5], it is known that 67% of children in Surakarta attended elementary school outside their NU. It means that they use transportation modal to access the elementary school because of the distance that is too far to reach by walking.

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Besides going to school on foot, children in Surakarta use a variety of modals such as bicycles, pedicab, motorcycles, public transport, and cars to access elementary school [5]. However, it is not just happening to children who go to school outside their NU. There are children who do not walk even they attend elementary school inside their NU. Car use was perceived to be quicker, even though they also lived near the school [4]. In 2017, the use of motorizing vehicles still becomes the main modal used to go to elementary school [5]. It increases carbon dioxide emissions from the vehicles. The combustion of fossil fuel produces carbon dioxide emissions, which have a direct relationship with the global warming [16].

The modal choice that is not in line with the embodiment of a child-friendly city certainly brings up the problem. Therefore, it is necessary to mitigate in overcoming the anomaly. The modal choice anomaly becomes the basis for examining factors influencing the modal choice in accessing elementary school.

2 Methodology

The variables of factors influencing the modal choice to access elementary school were obtained from the elaboration of theories. The data of these factors were collected through 100 questionnaires distributed to elementary school students in each NU of Surakarta. The distribution of 109 NUs in Surakarta City [5] is presented in Figure 1.

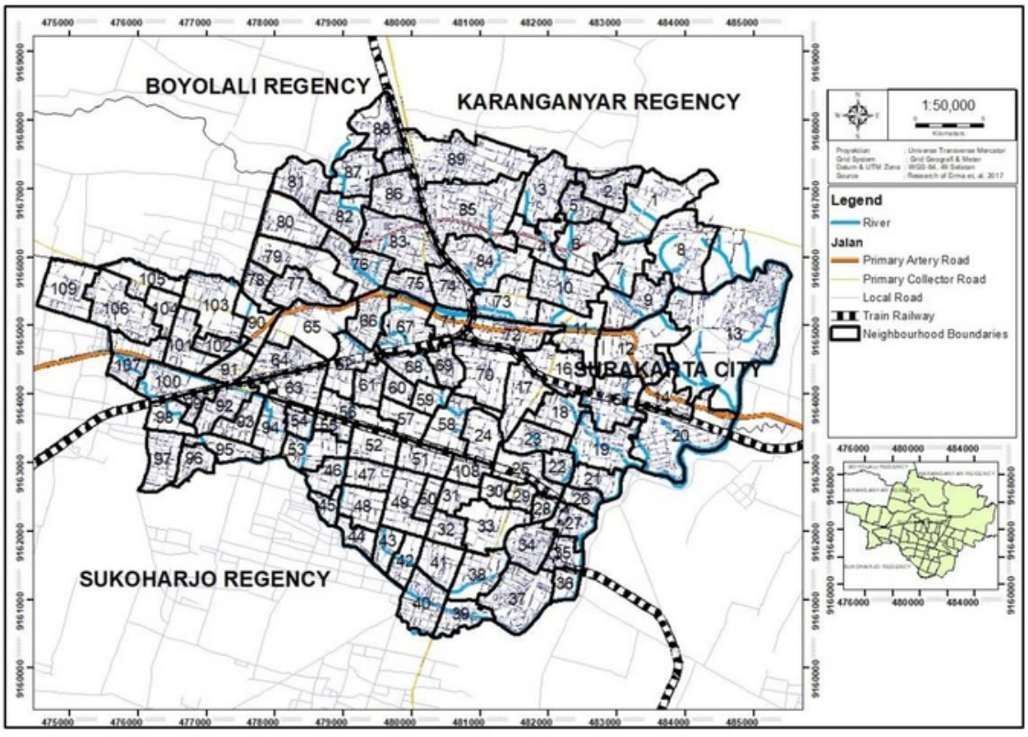


Fig. 1. The Division of Surakarta Neighbourhood Unit.

In the modal choice, there are four groups of influencing factors, which are Travel Characteristics, Traveller Characteristics, Transportation System Characteristics, and Special Characteristics Factors [6]. Travel characteristic factors include trip purpose [6], and time of trip made [6]. Since elementary school students are still dependent on their

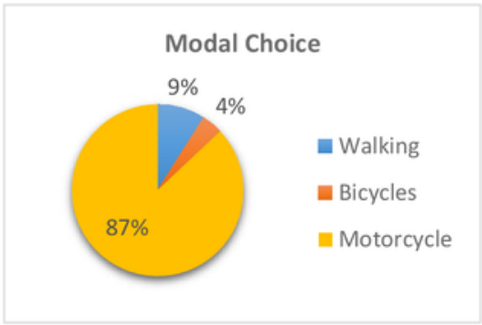
parents, the trip purpose in this paper is linked to parents of elementary school students, which is the purpose of the parent's trip and whether the trip to school coincides with the purpose of the parent's trip (to work, to shop, or others). Time of trip made is seen from the time the child left for school. Traveller Characteristics Factor consists of vehicle ownership [13, 6], and socio-economic character: structure [6] and family size (young couple, children, retirement or single, etc.) [6], age [6, 8], type of work [6], number of family members working [8], ownership of driving license [6]. Transportation System Characteristics Factor consists of accessibility [6].

Special Characteristics Factor is associated with the characteristics of elementary schools that should be in a neighborhood unit. The ideal neighborhood unit should ensure safety in the environment. It should be free from unwanted traffic across the roads [2]; has a separator between pedestrian and main street on local roads, collectors, and arteries [2, 4]; and safe for children to cross the street [2, 4].

3 Result and Discussion

3.1 The elementary school students' modal choice

Elementary school students in Surakarta goes to school by walking, bicycles, or motorcycle with their parents. Most of the elementary students go to school with their parents by motorcycle. Many parents prefer to take their children to school using the motorcycle because it is more efficient than walking. It is also because of their children school trip related to other parents' trip destinations, making it efficient for parents.



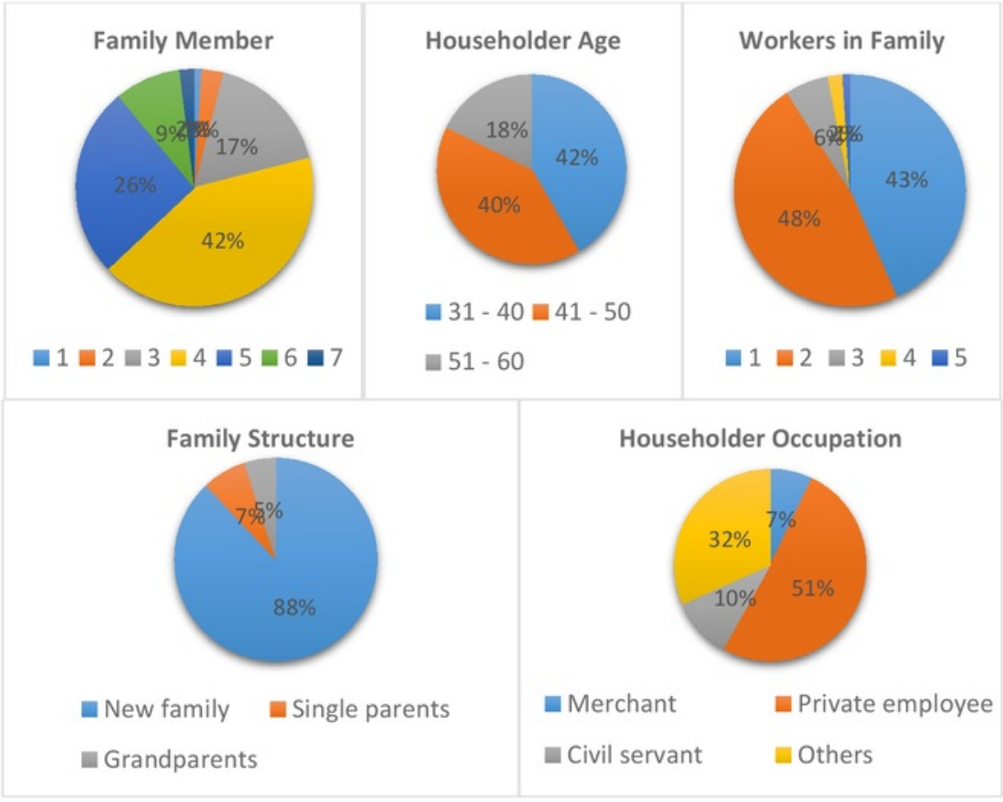
3.2 The factor characteristics influenced modal choice elementary school students

There are 14 factors that examined the modal choice to access elementary school. Judging from the aspect of their ability, the majority of parents had vehicle and driving license. This reflected that parents had an opportunity to drive children to go to school. It is in line with the study in Beijing, which found that car ownership is a major predictor of school modal choice [12].

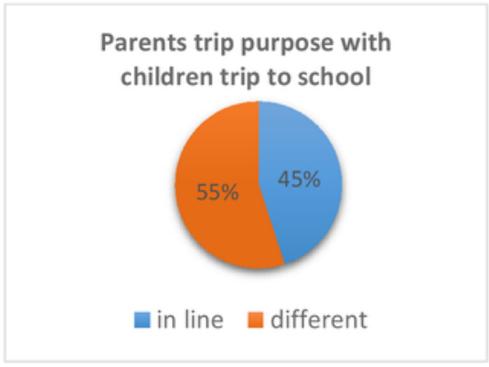
Table 1. Traveller Characteristics Factor

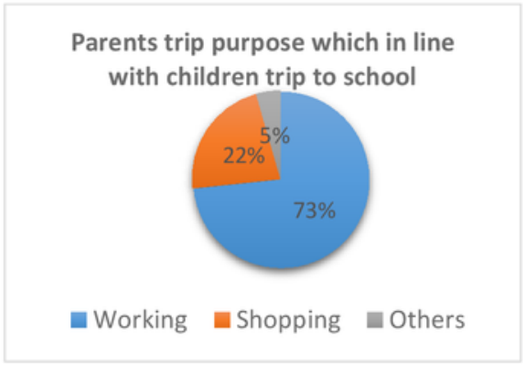
Factors	Yes	No
Vehicle Ownership	98%	2%
Driving License Ownership	84%	16%

Based on socio-economic aspects, there were factors related to the characteristics of elementary school children. The majority of children were in families with 4-5 family members and 2-3 of family members are working. As many as 88% of elementary students lived with their families who were a completely new family. Viewed from the parents' job, the majority of their family heads worked as a private employee.

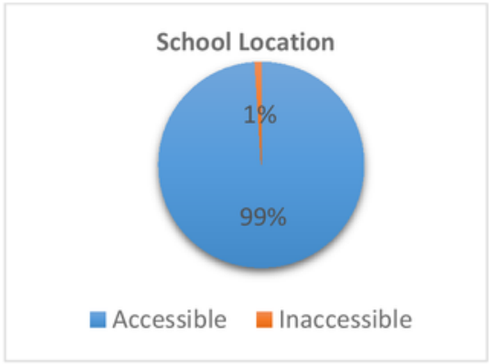


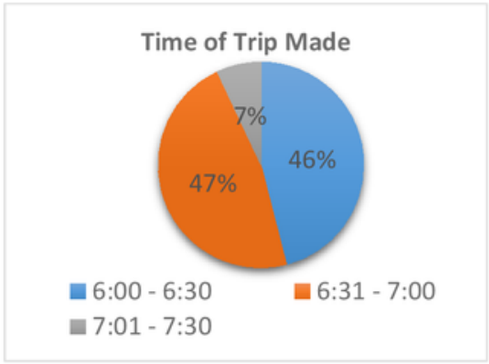
Childhood is an age of development that was still influenced by parents and school environment [10]. In traveling to school, children still needed to be accompanied by parents. There are 45% of the destination of parent travel was in line with the children's school. Thus, parents could take children to school on the way to their destination. The 73% of parents' accompanied their children to school was because their workplaces have the same direction as children's school. This finding also found in Taiwan [9] and Beijing [12], which is also said that parents drive their children to school on their way to work since the start times of schools for students are usually before or approximate the same time with parents depart for work.





However, children's travel time to school in the morning is different from parent's travel time to work. Therefore, the use of mode savings cannot be achieved because of such a mismatch of travel time between parent and children.





The majority of elementary schools in Surakarta are accessible to children. There were three factors related to child-friendly NU, namely the freedom of the road from unwanted traffic, the separation of the pedestrian path by road, and the safety of children in crossing the road. The majority of the roads in front of the elementary school were still not free of unwanted traffic, i.e., continuous traffic. The lack of a separation between pedestrian paths and roads also reduced the safety of children in walking. In addition, the safety of children in crossing the road was also still very low.

Table 2. Special Characteristics Factor

Factors	Yes	No
Unwanted traffic on the school road	62%	38%
Availability of road separator	24%	76%
Safety in crossing the road	34%	66%

3.2 Factor Analysis

The above factors were analyzed using multinomial logistic regression method. Based on the value of Pearson known that the whole model is suitable to use.

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	17.404	144	1.000
Deviance	17.298	144	1.000

Fig. 2. The Goodness-of-Fit result.

To determine the effect of 14 existing factors for modal choice to access elementary school, the first thing to do was to look at the simultaneous test result in Figure 3. A simultaneous test was used to see the influence of 14 independent variables, whether significant or not affecting the dependent variable.

Model Fitting Information

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	90.279			
Final	18.920	71.360	42	.003

Fig. 3. The model fits result.

The result of the analysis showed a significant value of 0.003, which meant smaller than the degree of freedom (0.05) so that in this test it could be said that there was an influence of independent variables on the chosen mode in accessing elementary school. To see which independent variables influenced the modal choice, so partial test was conducted.

Table 3. Partial test results

Variabels		Sig.	Interpretation
X1	Parents' mode ownership	0.011	Influence
X2	Parents' driving license	0.687	Do not influence
X3	The number of family members working	0.110	Do not influence
X4	The same parents' destination	-	Do not influence
X5	Purpose of parents' travel	0.992	Do not influence
X6	Accessibility level	0.998	Do not influence
X7	Head of family job	0.024	Influence
X8	Family structure	0.252	Do not influence
X9	Time of travel to school	0.017	Influence
X10	Continuous traffic	0.254	Do not influence
X11	Road separation between pedestrian and vehicle	0.000	Influence
X12	Children safety to cross the road	0.607	Do not influence
X13	The total member of the family	0.000	Influence
X14	Head of family age	0.000	Influence

From the partial test result above, it could be seen that the independent variables that affect the dependent variable (mode type) are only 6 variables, namely the parents' mode ownership, the type of head of family job, the time of travelling to school, road separation between pedestrian and vehicle, the number of family members, and the head of family age. It can be seen from the probability/significance of each independent variable whose value

was smaller than the degrees of freedom (0.05). Based on the value of significance, the factors that had the highest significance value were the number of family factor, road separation between pedestrian and vehicle, and the age of head of the family.

Pseudo R-Square

Cox and Snell	.521
Nagelkerke	.847
McFadden	.772

Fig. 4. The pseudo R-Square result.

In the goodness test model, the output of Nagelkerke value of 0.847 indicated that the data diversity of independent variables in this study was able to explain the diversity of the data of independent variable qualitative equal to 84,7%, where the rest 15,3% explained in other independent variables outside research model. In this study, the R-Square value of 0.847 was almost close to 1 because the independent variables used in this study amounted quite a lot. The more independent variables were analyzed, the higher the R-Square value.

The vehicle ownership factor that influences the modal choice in accessing elementary schools is related to the characteristics of the parents, which mostly have motorized vehicles. In addition, most of the time to go to the school that is different from their working time also allows them to accompany their children to go to school. The absence of pedestrian way's separation in most of the elementary school neighborhood is also a factor that can make parents feel unsafe to let their children go to school on foot.

4 Conclusion

Based on the results, six independent variables have a significant influence on the modal choice to access elementary school in supporting Surakarta as a child-friendly city. These factors are the number of family member, parents' vehicle ownership, householder occupation, time of the trip to school, road separation between pedestrian and vehicle, and the householder age. From those six factors, there are factors that are included in the aspect of child-friendly infrastructure, which is the separation of pedestrian paths. Given the concept of a child-friendly city that is ideally children go to school on foot or using non-motorize mode, these factors are very important. This can be a suggestion for the government to fulfill the infrastructure for the pedestrian to encourage people to choose the non-motorized mode that is more environmentally friendly. Providing pedestrian infrastructure hopefully can support Surakarta to be more child-friendly in all aspects.

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