Factors affecting junior high school students’ bike to school in Surakarta

Dewi Handayani\textsuperscript{1,a}, Widi Hartono\textsuperscript{1,b} and Alfin Wirawan Bagaskara\textsuperscript{1,c}

\textsuperscript{1} Department of Civil Engineering, Sebelas Maret University, 36A Ir. Sutami Street, Surakarta, Central of Java, Indonesia

\textsuperscript{a}dewi@ft.uns.ac.id
\textsuperscript{b}wieds_ts@ft.uns.ac.id
\textsuperscript{c}alfin.wirawanb@gmail.com

Abstract. Cycling to school is a Surakarta City government program to reduce the use of motorbikes by students. The development of facilities for cyclists by the City of Surakarta is still limited to certain areas. On the other hand, the traffic conditions when going to school and coming home from school are problems and considerations for students to cycle to school. This paper will examine the factors that influence junior high school students to cycle to school in Surakarta using the ANP (Analytic Network Process) method. There are four main factors and 16 sub-factors of each of the main factors used in this paper. The main factors are behaviour, physical condition, social conditions, and environmental conditions. The results of the study that the environmental conditions are the greatest factor students cycling to school. When reviewed as a whole, these factors are calculated simultaneously, and found the five most influential factors. The five factors are bike ownership, health, parent’s salary, gender and no cycling friends.

Keywords: bike to school, junior high school students, Analytic Network Process, Surakarta City

1. Introduction

Bicycles are a mode of transportation that is widely used for various purposes in Indonesia. The use of bicycles as a means of transportation can reduce congestion. Bicycles are also the most environmentally friendly means of transportation [1][2][3][4][5], provide health benefits [3][6][7]. The program to use bicycles to school has been socialized to attract school students, in this case junior high school students, to use bicycles to school. On the other hand, the facilities used for cycling are still incomplete, especially in Surakarta, this also happens in several other regions in Indonesia [1][2][8].

To provide safe and comfortable for users of non-engine vehicles such as bicycles and rickshaws, the Surakarta City Government provides bicycle stop space at a crossroads at the Gendengan intersection, Slamet Riyadi street. The Bicycle and Pedicab Advanced Stop Lines was made with a size of $2 \times 3$ meters, the Advanced Stop Lines was to prioritize cyclists and pedicabs to be able to walk first, after the traffic light turned green. The city of Surakarta has quite a long bike path, which is 27 km long with flat road contours. But not all of them can be used because they have quite severe damage like in
Ir. Sutami, Kol. Sutarto, Adi Sucipto street, and parts of Slamet Riyadi street in Purwosari to Kleco. On the other hand, low-speed lanes are widely used for parking and stalls. Parents' concerns about their children cycling to school are a matter of road safety and stress when cycling on the road [5][9]. Parents are worried because the conditions of the cycling facilities are still incomplete [1][2][8] and traffic conditions during school hours and after school [5]. The low student to use bikes because they use other modes of transportation [6][10][11][12], for reasons of safety, comfort, cost and time [5][11][12][13].

In this paper, we will study the factors that influence students to cycle in schools in Surakarta using the ANP (Analytic Network Process) method in junior high school students who are not yet allowed to use a moto biker.

2. Factors affecting cycling and respondents
To find out the factors that influence students cycling to school ANP method was analysed. The Super Decision Program is used to analysis models. It also uses a spreadsheet program to process data further. Data obtained by interviewing and giving respondents questionnaires consisting of several parties who understand about the problem of cycling. The respondents consisted of students (using bicycles to school) eight students, one sports teacher, two lecturers, two bicycle clubs, two bicycle activists and one regulator (Surakarta City Transportation Department). The distribution of respondents can be seen in Figure 1.

![Figure 1. Characteristics of respondents](image)

2.1. Factors That Affect Cycling to School
In this paper, the four main factors students use to go to school. These four factors are behavior, physical conditions, social conditions, and environmental conditions.

2.1.1. Behaviour
behaviour is based on the nature of the bicycle user in influencing the decision to use a bicycle or not. In the behavioural criteria, we can see that there is a can’t ride factor, this factor is interpreted as the respondent assumes that a person does not use a bicycle to school because he cannot ride a bicycle. Then they don’t want to go to school by bike factor [13] this factor is interpreted as a person who does not want to use a bicycle, but he can use a bicycle [13]. The factor cannot be "don't get permitted by parents” as someone who cannot get a parent's permission to use a bicycle to school [9][14]. The factor of having a friend is assumed that someone will use a bicycle if there are friends who use a bicycle too [14]. The like cycling factor is assumed that a person will use a bicycle because he likes or has a hobby of cycling [14].
2.1.2. Physical Condition
Physical Condition consists of several factors, namely gender, weight and health. Gender factors are assumed whether gender will influence students to cycle to school [5][6][10][11][15]. Then there is the weight factor which is assumed that whether weight affects the use of bicycles to school [7]. And the last is health factor [7][14] which is assumed that health is a driving factor for students cycling to school, because it can make the body become healthy and fit [7][14]. Besides students who have certain diseases such as asthma, heart disease, diabetes, which can affect the use of bicycles to school.

2.1.3. Social Condition
This criterion is a person's social condition will affect the use of bicycles to school. The parent salary factor is assumed to influence the use of bicycles to school or not, it can be assumed that parents have a lot or little income [11]. The factor of bicycle ownership is that bicycle ownership will influence someone in using a bicycle [10][11][16].

2.1.4. Environmental Condition
This criterion is intended whether a person's environmental conditions will affect the use of bicycles to school. Topographic factors are assumed that road surface factors in Surakarta will affect a person in using a bicycle to school. The distance factor [3][4][6][10][11] can be assumed that whether a distance or a distance will affect someone in using a bicycle. Weather factors [5] it is assumed that whether the weather is hot or rainy day someone will use a bicycle. The road pavement condition factor [5] is assumed that the road being passed by a bicycle user is damaged or will not affect someone using a bicycle. Factors of traffic conditions [5][14][16][13] it is assumed that someone who uses a bicycle will use a bicycle whether there is traffic or not. The secure parking factor is assumed that safe parking, when placed at school, will influence someone to use a bicycle to school [16][17].

| No | Criteria (Cluster) | Sub Criteria (Node) |
|----|--------------------|---------------------|
| 1  | Behavior           | Can’t ride bicycle [13]  |
|    |                    | Don’t want to go school by bike [13] |
|    |                    | Don’t get permission from parent [3][9][16] |
|    |                    | Have cycling friend [14] |
|    |                    | Likes to cycling [14] |
| 2  | Physical Condition | Gender [5][6][10][11][15] |
|    |                    | Weight [7] |
|    |                    | Health [7][14] |
| 3  | Social Condition   | Parent’s salary [11] |
|    | [14]               | Bike ownership [10][11][14][16] |
| 4  | Environmental Condition | Topography |
|    | [14]               | Distance [3][4][6][10][11] |
|    |                    | Weather [3][5] |
|    |                    | Road Pavement Conditions [5][13] |
|    |                    | Traffic conditions [5][13][14][16] |
|    |                    | Secure Parking [13][16][17] |

2.1.5. Hierarchy Model in ANP
The hierarchical model for evaluating the factors that influence students cycling to school consists of four clusters which are the main assessment factors in this paper. In each cluster there are sub criteria called nodes. In each cluster can consist of several nodes which is a more detailed explanation of the main criteria. The hierarchical model can be seen in Figure 2.
3. **Findings**
Calculations starting from level 1 in the hierarchical model, the data from the questionnaire are processed one by one with the Super Decision to get the value of each cluster. Data from all respondents are combined using a spreadsheet to get the total weight of each cluster. Results of the estimated cluster of all respondents can be seen in Table 2.

**Figure 2. Hierarchy Model in ANP**

| No | Criteria               | Weighted |
|----|------------------------|----------|
| 1  | Behaviour              | 0.2353   |
| 2  | Physical condition     | 0.2468   |
| 3  | Social conditions      | 0.2464   |
| 4  | Environmental conditions | 0.2715  |

Environmental conditions are the factors that most influence students cycling to school [14]. Environmental conditions consist of topographical, distance [10][11], weather [5], road pavement conditions [5], traffic conditions [5] and secure parking [16]. Then the physical condition factor becomes the second and third factor are the social condition [14] the following factors are affecting students riding bicycles to school.

3.1 **Behaviour**
The results of calculations for nodes in cluster behaviour can be seen in Table 3. The criterion "the existence of a cycling friend" is the biggest factor in cluster behaviour. This factor is a major consideration for students cycling to school. Students will be happy when going biking to school together with other friends [14]. Students will be happy, excited and enjoy a bicycle trip to school. Parents will feel safer if their child bikes to school with friends [5]. Furthermore, factors like cycling to be the next factor that affects students riding to school [14]. This becomes something interesting to study further, the joy of cycling can lead to a desire to go to school [14] Overall there is no significant difference between the factors contained in the behaviour cluster.
Table 3. Node Calculation Results for Cluster Behaviour

| No | Criteria | Weighted |
|----|----------|----------|
| 1  | Can't ride         | 0.1427   |
| 2  | Don't want to go biking | 0.1613   |
| 3  | Don't get permission | 0.1272   |
| 4  | No cycling friends  | 0.3011   |
| 5  | Likes to cycle     | 0.2678   |

3.2 Physical Condition

Physical condition factor consists of three nodes, namely gender, weight, and health. In the physical condition cluster analyzed from the three nodes which most influence students to school health factors become the main consideration for students cycling to school [7][14]. By cycling to school students feel they have a healthier and fitter body. The habit of biking to school is no longer a burden for students. In addition, there are other factors of health that is cycling affects stamina, so that is the main reason for students not cycling to school. Students who have been seriously ill, most likely will not use bicycles to go to school. Some students also do not feel fit when cycling to school, especially with the weather conditions and busy traffic conditions. The gender factor is the second factor that influences students to school [5][6][10][11][15]. Female students tend to be less enthusiastic about cycling to school compared to male students.

Table 4. Node Calculation Results for Cluster Physical Condition

| No | Criteria | Weighted |
|----|----------|----------|
| 1  | Gender   | 0.2878   |
| 2  | Weight   | 0.2265   |
| 3  | Health   | 0.4858   |

3.3 Social Condition

There are two criteria in the Social Condition cluster, namely parent’s salary and bike ownership. Bicycle ownership becomes the main factor influencing students to school [10][11][14][16] then the parent’s salary factor [11]. Ownership of bicycles affects students to like cycling to school so after that a cycling attitude will emerge. Cycling like attitude will encourage students to go to school by bike [14].

Table 5. Node Calculation Results for Cluster Social Condition

| No | Criteria            | Weighted |
|----|---------------------|----------|
| 1  | Parent's salary     | 0.3833   |
| 2  | Bike ownership      | 0.6167   |

3.4 Environmental Condition

This criterion is intended that a person's environmental conditions will affect the use of bicycles to school. The factor of distance from home to school is a major factor in the use of bicycles to school [6][3][4], the longer distance home to school, the more reluctant a student bikes to school. Weather factor [5][3] is the second factor in the use of bicycles to school, hot and rainy weather is an obstacle for students cycling to school. The heat during the day makes students reluctant to use bicycles to school, the sun's heat makes it uncomfortable during a bicycle trip. Rain makes students reluctant to use bicycles to school, especially rain in the morning when students go to school.

Table 6. Node Calculation Results for Cluster Environmental Condition

| No | Criteria       | Weighted |
|----|----------------|----------|
| 1  | Topography     | 0.1462   |
| 2  | Distance       | 0.2308   |
| 3  | Weather        | 0.2022   |
3.5 **Overall factor**

For the assessment of factors affecting students cycling to school at each node, it has been explained before. The following results of the analysis of the overall effect on factors affecting students who are cycling to school.

The five biggest factors influencing students to go to school are bicycle ownership, health, parent’s salary, gender and no cycling friends (see table 7). The bike ownership factor encourages students to go biking to school [14][10][11][16], bicycle ownership will encourage students' preference for cycling [14]. Bicycle ownership is influenced by the salary factor of parents and the community [14]. Bicycles being a necessity for transportation become commonly used being the main influence of bicycle ownership [14].

The next factor is health, where cycling activities to school will improve students' health [7][14]. The health condition of students cycling to school becomes healthier with ideal body weight [7]. Health factors also have to do with the condition of students who are already sick, so it is not possible to use bicycles to school.

Then there is the parent's salary factor, gender and no cycling friends to be the next factor that affects students cycling to school. Parents with high salaries tend to drive their children by vehicle rather than encouraging their children to go to school [11]. Male students have a desire to go to school more than girls [5][10][11][6][15]. The general condition of the surrounding community using bicycles will increase the influence of students cycling to school, where cycling friends will create enthusiasm for biking to school [14].

**Table 7. Overall Calculation Results of Factors Students Go to School**

| No | Criteria                                | Weighted |
|----|-----------------------------------------|----------|
| 1  | Bike ownership                          | 0.1520   |
| 2  | Health                                  | 0.1199   |
| 3  | Parent's salary                         | 0.0945   |
| 4  | Gender                                  | 0.0710   |
| 5  | No cycling friends                      | 0.0708   |
| 6  | Likes to cycle                          | 0.0630   |
| 7  | Distance                                | 0.0627   |
| 8  | Weight                                  | 0.0559   |
| 9  | Weather                                 | 0.0549   |
| 10 | Traffic conditions                      | 0.0449   |
| 11 | Topography                              | 0.0397   |
| 12 | Don't want to go biking                 | 0.0379   |
| 13 | Secure parking                          | 0.0356   |
| 14 | Road pavement conditions                | 0.0338   |
| 15 | Can't ride                              | 0.0336   |
| 16 | Don't get permission                    | 0.0299   |

4. **Conclusion**

Analysis of the factors that affect students cycling to school which is divided into four clusters namely behaviour, physical, social, and environmental conditions, with a total of 16 nodes, found that environmental conditions, such as: topography, distance, weather, road pavement conditions, and traffic conditions are the main factor. Distance is a major factor in environmental conditions that affect students cycling to school.
Overall the bicycle ownership factor is the main factor influencing students to go to school, where the bicycle ownership factor will trigger students to like cycling. The next factor is health, parent's salary, gender, and no cycling friends.

5. References

[1] D. Sulistyo, B. Triana, and N. Winarsih, “Upaya Penggunaan Sepeda Sebagai moda transportasi di kota surabaya,” in Proceeding PESAT (Psikologi, Ekonomi, Sastra, Arsitektur & Sipil), 2011, pp. 46–50.

[2] Artiningah, “Jalur Sepeda Sebagai Bagian Dari Sistem Transportasi Kota Yang Berwawasan Lingkungan,” J. Tata Loka, vol. 13, no. 1, pp. 27–41, 2011.

[3] O. Stewart, A. Vernez, and C. Claybrooke, “Common ground : Eight factors that influence walking and biking to school,” Transp. Policy, vol. 24, pp. 240–248, 2012.

[4] Y. Cao and D. Shen, “Contribution of shared bikes to carbon dioxide emission reduction and the economy in Beijing,” Sustain. Cities Soc., vol. 51, no. August, p. 101749, 2019.

[5] R. L. Knoblauch and R. F. Seifert, “The Pedestrian and Bicyclist Highway Safety Problem As It Relates to the Hispanic Population in the United States FINAL REPORT,” Virginia, United States, 2004.

[6] Y. Chen, “Neighborhood form and residents ’ walking and biking distance to food markets : Evidence from Beijing , China,” Transp. Policy, vol. 81, no. August 2017, pp. 340–349, 2019.

[7] R. Larouche, M. Stone, R. N. Buliung, and G. Faulkner, “I ’ d rather bike to school ! ” : Profiling children who would prefer to cycle to school,” J. Transp. Heal., vol. 3, no. 3, pp. 377–385, 2016.

[8] L. Indriyaningrum, A. Narendra, and Arfitriyani, “Analisis Pola Permintaan Sepeda Kampus Bagi Mahasiswa Universitas Negeri Semarang,” J. Tek. Sipil Perenc., vol. 14, no. 1, pp. 61–70, 2012.

[9] K. Ralph and L. A. Von Hagen, “Will parents let their children bike on “ low stress ” streets? Validating level of traffic stress for biking,” Transp. Res. Part F Psychol. Behav., vol. 65, no. Part F, pp. 280–291, 2019.

[10] Y. Arisandi and Y. A. C. S., “Pemilihan Moda Transportasi Untuk Sekolah,” J. Penelit. Transp. Darat, vol. 8, no. 3, pp. 205–218, 2016.

[11] D. W. Primasari, J. Ernawati, and A. D. W, “Pemilihan Moda Transportasi ke Kampus oleh Mahasiswa Universitas Brawijaya,” Indones. Green Technol. J., vol. 2, no. 2, pp. 84–93, 2013.

[12] D. I. Firdawati, “Pemilihan Moda Transportasi Pelajar Sekolah Di Kawasan Ir. H. Juanda Samarinda,” eJournal Tek. Sipil, vol. 1, no. 1, pp. 151–162, 2016.

[13] J. Acton et al., “How do we get students cycling more at universities and colleges in Edinburgh ?,” 2015.

[14] S. Handy and Y. Xing, “Factors associated with bicycle ownership and use : A study of six small U . S . cities,” 2010.

[15] K. Wang and G. Akar, “Gender gap generators for bike share ridership : Evidence from City Bike system in New York City,” J. Transp. Geogr., vol. 76, no. February, pp. 1–9, 2019.

[16] I. Helena, “Studi Konsep Rencana Dan Strategi Program Bike To School Di Kota Bandung,” J. Perenc. Wil. dan Kota, vol. 15, no. 1, pp. 10–19, 2015.

[17] N. C. Mcdonald, Y. Yang, S. M. Abbott, and A. N. Bullock, “Impact of the Safe Routes to School program on walking and biking : Eugene , Oregon study,” Transp. Policy, vol. 29, no. September, pp. 243–248, 2013.