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DETERMINING THE MAXIMUM SPEED LIMIT IN URBAN ROAD TO INCREASE TRAFFIC SAFETY

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Graphical abstract
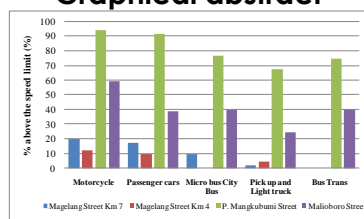
Abstract

Speed is one of the main risk factors in road traffic safety and become a traffic problem in developing countries. Three factors that cause accidents are human factor, vehicle, and environment. Speeding is one of the main cause factors in traffic accident. Traffic speed must be limited adjust with the activities in the street and potential accident. The aim of this research is to determine the maximum speed limit in urban road to increase traffic safety and to analyze the percentage of vehicle exceeding speed limit. The method to determine maximum speed limits using 85th percentile. Based on the analysis result, the proposed maximum speed limit on urban road for arterial road type 4/2-UD residential and 4/2-UD CBD is 60 km/h for motorcycle and passenger car, 55 km/h for pick up and light truck, and 50 km/h for bus and truck. Proposed maximum speed limit for collector road type 2/1-UD office area is 45 km/h for motorcycle and 40 km/h for four-wheeled vehicles or more while for collector road type 2/1-UD CBD is 40 km/h for motorcycle and 35 km/h for four-wheeled vehicles or more. The installation of speed limit sign is less effective to reduce the vehicle speed, the speed only reduce 2.9-5.5 km/h (5.6-10.1%). More than 46.5% of motorcycle users ride exceeding speed limit followed by the passenger cars users (39.43%), microbus/city bus at 31.63%, bus Trans at 28.75%, pick up and light truck at 24.69%. The maximum speed limit in school safety zone on hours/after school is 30 km/h with the consideration that the pedestrian fatality rate on 30 km/h has probability of death 10%.

Keywords: Speed limit, traffic safety, speeding, traffic accident, pedestrian safety

1.0 INTRODUCTION

Speed is one of the main risk factors in traffic safety [1]. It is difficult to examine the role of speed [2], higher speeds are proven to increase the likelihood of getting involved in a crash. Not only an increased chance of getting involved in crash, but the severity of crash also increases with speed, as the degree of kinetic energy at the time of the collision is higher [3]. Speed limits were introduced with the primary aim of reducing incidence, severity of casualty crashes [4], and reduces generalized cost [5]. This countermeasure was brought in with the aim of revealed that up to 30% of casualty crashes occur on residential streets [6]. Speed management is an important strategy to improve road safety [7, 8]. Speed limits enforcement is the main measure to control operating speeds [7], the speed acceptable to drivers [9]. TRL in 1994, found a relationship between speed and injury accidents- the higher speed, more accidents-indicating that 5%

change in accidents was associated with a 1 mph change in average speed [10].

The determination of the speed limit should consider the road conditions and areas along roadsides. About 20% of urban streets within Great Britain were designated 20 mph limits, and many other authorities planned to introduce low speed limits into their urban areas. The drivers of these policies may vary from city to city [11]. Australia lowered the speed limit for urban areas from 60 to 50 km/h have been shown to reduce the risk from accidents, revealed significant reductions in both fatal and serious injury crashes, and substantial overall social cost savings. Crash reductions in 50 km/h zones, relative to changes observed in crash frequency in all speed zones remaining 60 km/h in South East Queensland for various crash severity levels. On average, statistically significant yearly estimated reductions of 22% for all reported crashes, 20% for all property damage crashes, 23% for all casualty crashes, 24% for serious casualty crashes, and 88% for fatal crashes [4].

Traffic safety is a social problem that handling must be done comprehensively. Traffic speed must be limited adjust with the activities in the street and potential accident. Speeding-which encompasses excessive speed or inappropriate speed, is dangerous. Speed is an aggravating factor in the severity of all accidents [3]. Speeding was the main human error that contributed 57% to the crashes. In Thailand, cases involving vehicle hitting trees be the most serious and resulting 48 fatalities [12]. If the terms of the performance of traffic, the higher speed will improve traffic performance, opposite from the aspect of traffic safety, speed will decrease the degree of safety because of the risk of accidents becomes greater. Lowered speed limit reduces the risk from accident; reduce the externality cost like accident cost [13]. The cost of accidents can be decreased by reducing the frequency of accidents and severity of injury [14]. Total accident cost in Purbalingga Regency, Central Java, Indonesia was estimated 0.38% of the gross domestic product [15]. It is necessary for the determination of the maximum speed limit of vehicle as mandated in Indonesian Law No. 22 of 2009 on different types of road function, the type of terrain, and types of land use and the level of activity [16].

Research related to the speed limit and the risk of accidents concluded that lowered the speed limit will reduce the average driving speed, the number of accidents and the severity. The study of Roads and Traffic Authority (RTA) in New South Wales, after implementation speed limit, found that on 50 km/h streets there was a 25.3% reduction crashes and mean travelling speeds drop 0.94 km/h (RTA, 2000 in [17]). In Queensland, reductions 8% in casualties overall, 18% in fatalities, and mean travelling speeds dropping by 5 km/h (Walsh and Smith, 1999 in [17]). The establishment of speed limits in urban areas in Victoria reduced traffic accidents by 12% [4]. In Queensland, default of speed limits at 50 km/h, the relationship between the speeds with risk of injury due to accidents concluded that overall changes in average speed for every 1

km/h will change the risk of accidents about 3%. Andersson and Nilsson (1997) concluded that severity of injuries and fatalities changed along with changes in average speed [4]. According to the initial speed limit, through the application of two models an exponential function and power model, slightly higher support was given to the exponential function, which showed an increase of 1.58 in the number of fatal crashes if speed increased with 1 km/h from an initial speed of 85 km/h. The number of injury crashes was estimated to increase with 1.21. Starting from an initial speed of 75 km/h an increase of 0.79 fatal crashes with an increase by 1 km/h was found, for the injury crashes this was 0.86 [18].

Increasing vehicle speed affect to the increased reaction time and distance it takes to stop and increased likelihood of errors that can be carried by the driver. Pedestrians, incur a risk of about 80% of being killed at a collision speed of 50 km/h. Wearing seat-belts and using well-designed cars for car occupants generally can provide protection to a maximum of 70 km/h in frontal impacts, and 50 km/h in most side impacts (Tingvall *et al.*, 1999 in [19]. Probability of fatal injury for a pedestrian colliding with a vehicle shown in Figure 1.

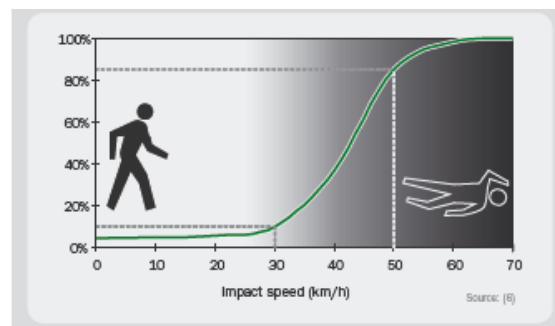**Figure 1** Probability of fatal injury for a pedestrian colliding with a vehicle [3]

High speeds increase the risk of accidents. Australian Transport Safety Bureau stated that the reaction time can be as little as 1 second but mostly ranged from 1.5 up to 4 seconds [19]. Illustration stopping distances in an emergency braking is shown in Figure 2.
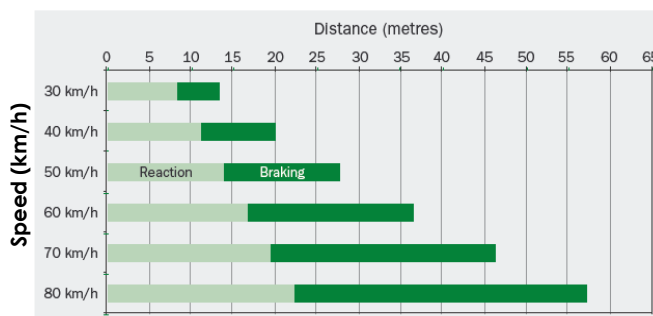

Figure 2 Illustration stopping distance in an emergency braking [19]

Based on the procedure traffic handbook was issued by Directorate General of Land Transportation, Minister of Transportation Republic of Indonesia in 2005, the risk of driving at high speeds raise the risk involved in a traffic accident [20]. At a speed of 50 km/h the car will be needed 41 m to stop, but at a speed of 60 km/h takes a distance of 58 m to stop. This makes the difference is quite noticeable on the opportunities accidents involved motorists. Traffic accident locations have an effect on the severity [21].

The aim of this study is to determine the maximum speed limit of vehicles on urban roads and to analyze the application trial of maximum speed limit to know the percentage of vehicle that exceeding the speed limit and its impact on pedestrian safety.

2.0 METHODOLOGY

2.1 Study Location

The study location is in Special Region of Yogyakarta Province, Indonesia. Study location in four streets: Magelang Street km 7 and Magelang Street km 4 is an arterial road in urban area; Pangeran Mangkubumi Street and Malioboro Street is collector road. The location of study can be seen in Figure 3.
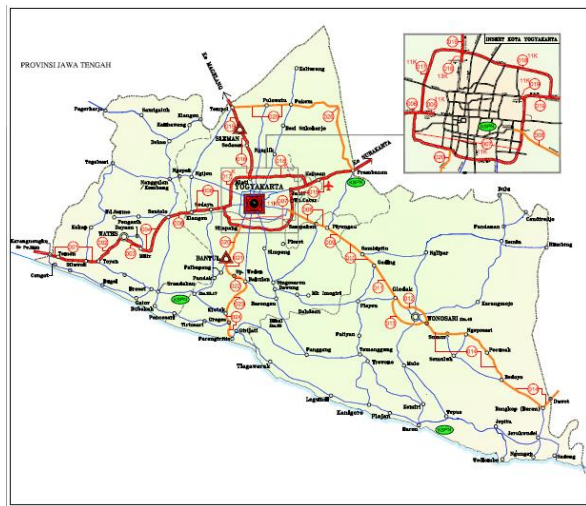

Figure 3 Location of study in Special Region of Yogyakarta Province

2.2 Data Collection and Analysis

Maximum speed limit data in arterial and collector road obtained from Department of Transportation Special Region of Yogyakarta Province. Vehicle speed of motorcycle, passenger car, pick up and light truck, microbus, bus, TransJogja bus, truck, and trailer truck

obtained in the field using speed gun. The statistical analysis of vehicle speeds results, include the mean, mode, median, variance, standard deviation, the amount of data, and 15th, 50th, 85th, and 98th percentiles for each type of vehicles. The determination of the maximum speed limit based on vehicle speed at the 85th percentile is distinguished by the type of land use i.e.: school area, residential area, Central Business District (CBD), hotel, shop, market, and industrial district. The impact of reducing speed limit was analysis on vehicle percentage that violating the speed limit and impact in pedestrian safety.

3.0 RESULTS AND DISCUSSION

3.1 Analysis of Vehicle Speed

a. Vehicle Speed in Magelang Street km 7, Sleman

Magelang street km 7, Sleman is an arterial road, consists of 4 lanes 2 directions without median or undivided road (4/2 UD) with land use as a residential area, shops, and office. The wide of this road is 12.00 m with the road capacity is 4132 pcu/h. The maximum speed limit of vehicles in Magelang street km 7, Sleman is 60 km/h. The number of vehicles has taken as many as 643 vehicles, with an S-curve of vehicle speed as shown in Figure 4. The type of vehicles in the field was dominated by motorcycles (52.10%) followed by passenger cars (29.86%). Based on Figure 4, it can be seen that 17.25% of passenger cars users and 19.75% of motorcycle users exceed the maximum speed limit in the field is 60 km/h. In addition to passenger cars and motorcycles, the types of vehicles that exceed the maximum speed limit are bus (9.5%), pick-up and light truck with a percentage of approximately 2%. The statistical analysis of vehicle speeds results, include the mean, mode, median, variance, standard deviation, the amount of data, and 15th, 50th, 85th, and 98th percentiles for each type of vehicles in Table 1.

The average speed of motorcycle at 51 km/h, passenger car at 52 km/h, pick up and light truck at 45.4 km/h, microbus at 41.1 km/h, bus at 43.2 km/h, truck at 41.5 km/h, and trailer truck at 34.2 km/h. The average speed from 643 vehicles is 49.8 km/h. This value is smaller than the maximum speed limit in the field (60 km/h). The speed limit based on 85th percentile varied between 36.8 km/h for trailers truck up to 64 km/h for motorcycles. The speed limit value based on 85th percentile for motorcycle (64 km/h) and passenger car (62 km/h) is higher than the maximum speed limit in the field (60 km/h).
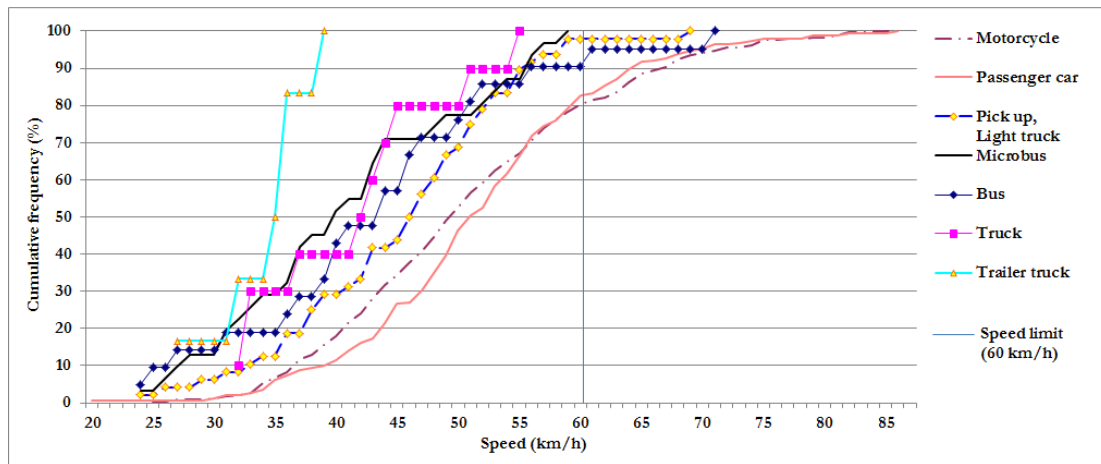
Figure 4 S-curve of vehicle speed in Magelang street km 7, Sleman

Table 1 Characteristics and statistical analysis of vehicle speed in Magelang street km. 7, Sleman

Statistical analysis		Motor cycle	Passenger car	Pick up, Light truck	Micro bus	Bus	Truck	Trailer truck	Total
Mean (km/h)		51.0	52.0	45.4	41.1	43.2	41.5	34.2	49.8
Modus (km/h)		49.0	50.0	43.0	37.0	40.0	33.0	36.0	49.0
Median (km/h)		50.0	51.0	46.5	40.0	44.0	42.5	35.5	49.0
Variance (km/h)		131.7	107.3	84.9	98.8	135.7	60.9	17.4	128.7
Standard deviation (SD)		11.5	10.4	9.2	9.9	11.6	7.8	4.2	11.3
Amount of data (n)		335	192	48	31	21	10	6	643
Percentile (km/h)	15	39.0	42.0	36.0	31.0	31.0	33.0	30.8	38.0
	50	50.0	51.0	46.5	40.0	44.0	42.5	35.5	49.0
	85	64.0	62.0	54.9	53.5	52.0	48.9	36.8	61.0
	98	77.6	75.7	59.6	57.8	67.0	54.3	38.7	75.0

b. Vehicle Speed in Magelang Street km 4, Yogyakarta

Magelang street km 4, Yogyakarta is an arterial road in urban area consists of 4 lanes 2 directions without median or undivided road (4/2 UD) with land use as a central business district, residential area, shops, and office with maximum speed limit of 60 km/h. The wide of this road is 14.00 m with the road capacity is 5712 pcu/h. The number of vehicles has taken as many as 717 vehicles, with an S-curve of vehicles speed as shown in Figure 5. The type of vehicles in the field was dominated by motorcycles (55.79%) followed by passenger cars (27.89%). The statistical analysis of vehicle speeds results, include the mean, mode, median, variance, standard deviation, the amount of data, and 15th, 50th, 85th, and 98th percentiles for

each type of vehicle in Table 2. The average speed of motorcycle at 48.3 km/h, passenger car at 48.3 km/h, pick up and light truck at 43.6 km/h, microbus at 33.1 km/h, and truck at 43.5 km/h. The average speed from 717 vehicles is 47.1 km/h. This value is smaller than maximum speed limit in the field (60 km/h). Standard deviation value varied between 8.7 for passenger car up to 10.8 for pick-up and light truck. The speed limit on 85th percentile varied between 41.8 km/h for microbus up to 59 km/h for motorcycle. Based on Figure 5, it can be seen that 10% of passenger cars users and 12.25% of motorcycle users exceed the maximum speed limit specified in the field is 60 km/h. In addition to passenger cars and motorcycles, the type of vehicles that exceed the maximum speed limit is pick-up and light truck with a percentage of approximately 4.75%.

Figure 5 S-curve of vehicle speed in Magelang street km. 4, Yogyakarta

Table 2 Characteristics and statistical analysis of vehicle speed in Magelang Street km. 4, Yogyakarta

Statistical analysis		Motor cycle	Passenger car	Pick up, Light truck	Microbus	Truck	Total
Mean (km/h)		48.3	48.3	43.6	33.1	43.5	47.1
Modus (km/h)		47.0	46.0	48.0	20.0	N/A	47.0
Median (km/h)		47.0	47.0	44.0	33.0	41.0	47.0
Variance (km/h)		105.8	75.2	116.9	79.8	91.7	107.4
Standard deviation (SD)		10.3	8.7	10.8	8.9	9.6	10.4
Amount of data (n)		400	200	84	29	4	717
Percentile (km/h)	15	38.0	40.0	35.0	26.0	36.8	37.0
	50	47.0	47.0	44.0	33.0	41.0	47.0
	85	59.0	58.0	53.6	41.8	50.7	58.0
	98	70.0	67.0	64.7	53.3	56.2	68.7

c. Vehicle Speed in Pangeran Mangkubumi Street, Yogyakarta

Pangeran Mangkubumi Street, Yogyakarta is a collector road in urban area with maximum speed limit of 30 km/h. This street consists of 2 lanes 1 direction without median or undivided road (2/1 UD) with land use as CBD, hotel, shops, and office. The wide of this road is 7.00 m with the road capacity is 2348 pcu/h. The number of vehicles has taken as many as 751 vehicles, with an S-curve of vehicle speed as shown in Figure 6. The type of vehicles in the field was dominated by motorcycles (55.92%) followed by passenger cars (31.96%).
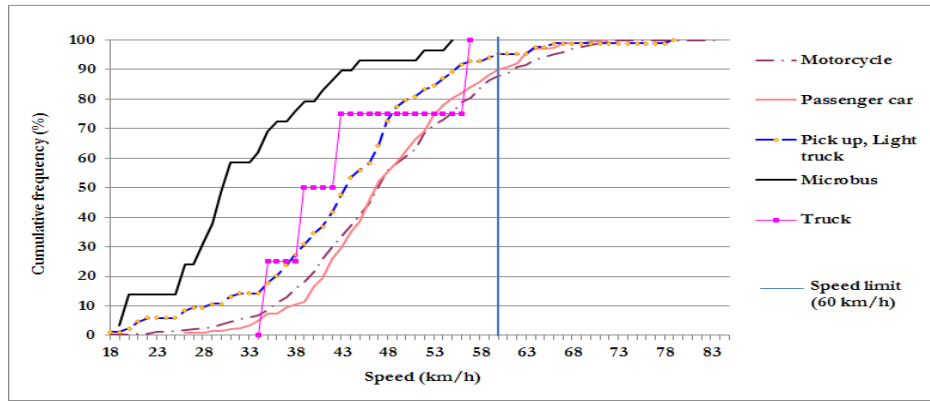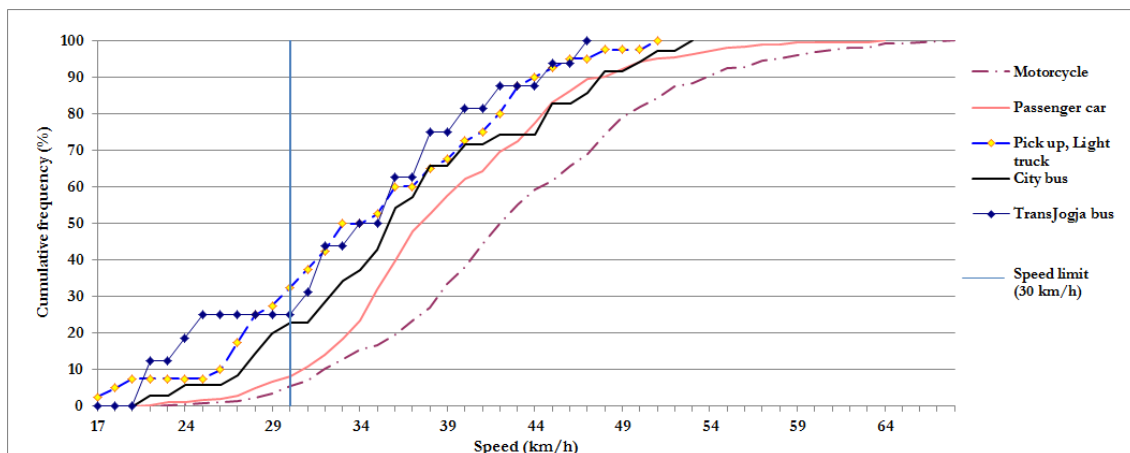

Figure 6 S-curve of vehicle speed in Pangeran Mangkubumi Street, Yogyakarta

Table 3 Characteristics and statistical analysis of vehicle speed in Pangeran Mangkubumi Street, Yogyakarta

Statistical analysis		Motor cycle	Passenger car	Pick up, Light truck	City bus	TransJogja	Total
Mean (km/h)		43.3	39.2	34.7	37.1	34.0	41.1
Modus (km/h)		39.0	35.0	27.0	36.0	22.0	36.0
Median (km/h)		42.5	38.0	34.0	36.0	35.0	40.0
Variance (km/h)		70.8	49.3	64.3	62.8	61.1	70.6
Standard deviation (SD)		8.4	7.0	8.0	7.9	7.8	8.4
Amount of data (n)		420	240	40	35	16	751
Percentile (km/h)	15	34.0	33.0	27.0	29.0	24.3	33.0
	50	42.5	38.0	34.0	36.0	35.0	40.0
	85	52.0	46.0	43.0	46.8	41.5	49.0
	98	62.6	55.2	48.7	51.6	46.4	60.0

Speed limit violations are very common. There are 67% to 94.5% of the drivers exceed the limit. Based on Figure 6, it can be seen that 94.5% of motorcycle users, 91.67% of passenger cars users, 77% of city bus, 75% of TransJogja bus, and 67.5% of pick up and light truck exceed the maximum speed limit specified in the field is 30 km/h. The statistical analysis of vehicle speeds results, include the mean, mode, median, variance, standard deviation, the amount of data, and 15th, 50th, 85th, and 98th percentiles for each type of vehicle shown in Table 3. The average speed of motorcycle at 43.3 km/h, passenger car at 39.2 km/h, pick up and light truck at 34.7 km/h, City bus at 37.1 km/h, and TransJogja bus 34 km/h. The average speed from 751 vehicles is 41.1 km/h. This value is greater than the maximum speed limit in the field (30 km/h). Standard deviation value varied between 7 for passenger car up to 8.4 for motorcycle. The speed limit on 85th percentile varied between 41.5 km/h for TransJogja bus up to 52 km/h for motorcycle.

d. Vehicle Speed in Malioboro Street, Yogyakarta

Malioboro Street, Yogyakarta is a collector road in urban area with maximum speed limit of 30 km/h. This street consists of 2 lanes 1 direction without median or undivided road (2/1 UD) with land use as a central business district, hotel, shops, market, and office. The wide of this road is 7.00 m with the road capacity is 1941 pcu/h. The number of vehicles has taken as many as 745 vehicles, with an S-curve of vehicle speed as shown in Figure 7. The type of vehicles in the field was dominated by motorcycles (53.69%) followed by passenger cars (33.56%). Speed limit violations are very common. Among 24-60% of the drivers exceed the limit. Based on Figure 7, it can be seen that 59.5% of motorcycle users, 38.8% of passenger cars users, 40% of city bus, 40% of TransJogja bus, and 24.5% of pick up and light truck exceed the maximum speed limit specified in the field is 30 km/h. The statistical analysis of vehicle speeds results, include the mean, mode, median, variance, standard deviation, the amount of data, and 15th, 50th, 85th, and 98th percentiles for each type of vehicle shown in Table 4.

The average speed of motorcycle at 33.1 km/h, passenger car at 28.5 km/h, pick up or light truck at 25.7 km/h, City bus at 28.1 km/h, and TransJogja bus at 29.5 km/h. The average speed from 745 vehicles is 30.8 km/h. This value is greater than the maximum speed limit in the field (30 km/h). Standard deviation value varied between 5.6 for TransJogja up to 8 for motorcycle. The speed limit on 85th percentile varied between 33 km/h for pick up or light truck up to 41 km/h for motorcycle.
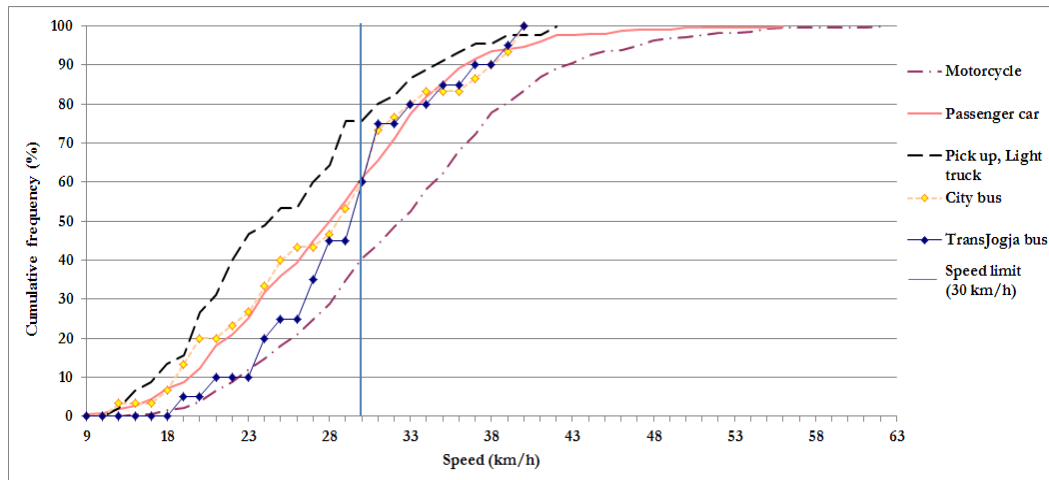
Figure 7 S-curve of vehicle speed in Malioboro Street, Yogyakarta

Table 4 Characteristics and statistical analysis of vehicle speed in Malioboro Street, Yogyakarta

Statistical analysis		Motor cycle	Passenger car	Pick up, Light truck	City bus	TransJogja	Total
Mean (km/h)		33.1	28.5	25.7	28.1	29.5	30.8
Modus (km/h)		29.0	24.0	20.0	31.0	30.0	29.0
Median (km/h)		33.0	28.5	25.0	29.0	30.0	30.0
Variance (km/h)		63.5	50.5	44.4	48.8	30.9	62.9
Standard deviation (SD)		8.0	7.1	6.7	7.0	5.6	7.9
Amount of data (n)		400	250	45	30	20	745
Percentile (km/h)	15	25.0	21.0	19.6	20.0	24.0	22.0
	50	33.0	28.5	25.0	29.0	30.0	30.0
	85	41.0	35.0	33.0	36.0	35.3	38.0
	98	52.0	44.0	39.4	40.0	39.6	49.1

3.2 Determining Maximum Speed Limit

In the 1960s speed limits in Sweden were set using the 85[22]. The 85th percentile speed of vehicles passing a given point is the speed at or below which 85 percent of the vehicles passing the point are traveling [23]. Speed limits are set in accordance with the road design standards. Based on road function, there are three types of road i.e: arterial road, collector road, and local road. The determination of maximum speed limit based on vehicle speed at the 85th percentile is distinguished by the type of land use i.e. residential area, office, and central business district. The maximum speed limit is distinguished by the type of vehicles that pass through in these roads are motorcycles, passenger cars, pick up or light trucks, microbus, bus, city bus,

trucks, and trailers truck. Proposed maximum speed limit value based on the 85th percentile speed of vehicles on urban road for arterial and collector road is presented in Table 5. Proposed maximum speed limit value based on the 85th percentile speed of vehicles for arterial road type 4/2-UD residential and 4/2-UD CBD, the speed for motorcycle and passenger car at 60 km/h, for pick up and light truck at 55 km/h, for microbus, bus, city bus, truck at 50 km/h. Proposed maximum speed limit value for collector road type 2/1-UD office area, 45 km/h for motorcycle and 40 km/h for four-wheeled vehicles or more. While for collector road type 2/1-UD CBD, 40 km/h for motorcycle and 35 km/h for four-wheeled vehicles or more.

Table 5 Proposed maximum speed limit of vehicles based on 85th percentile in urban road

Road function (type of road)	Type of area	Speed limit (km/h)	Maximum speed limit (km/h)							
			Motor cycle	Passenger car	Pick up, Light truck	Microbus	City bus	Bus	Truck	Trailer Truck
Arterial (4/2-UD)	Residential	60	60	60	55	50	50	50	50	45
Arterial (4/2-UD)	CBD	60	60	60	55	50	50	50	50	N/A
Collector (2/1-UD)	Office	30	45	40	40	40	40	40	40	N/A
Collector (2/1-UD)	CBD	30	40	35	35	35	35	35	35	N/A

3.3 The Impact of Reducing Speed Limit

Speed limit is commonly set at the 85th percentile speed which is the speed at which 85% of the traffic is travelling and in the USA is set 8 to 12 mph (13 to 19 km/h) below that speed [24]. Review of speed limits for Canada identified where speed limits had been increased and decreased changes in speeding, fatalities, injuries, and property damage [25]. Effect of reducing mean speed from 55 to 50 mph/h in rural roads accident frequency multiplied by 0.86 [10]. An increase in speed will lead more accidents and more serious accidents [26].

a. Impact on Proportion of Drivers Exceeding Speed Limit

The amount of violations on an individual road depends on many different local aspects, including maximum speed limit, road characteristics, road environment, traffic density, traffic composition, and the level of enforcement in this country. The proportion of drivers exceeding the speed limit in urban road by category of road users illustrates in Figure 8. Figure 8 shows the proportion of drivers in urban road that driving above the speed limit by category road users. For passenger car drivers, it shows that 17.25% of drivers exceed the speed limit in 4/2 UD-residential area and 91.67% in 2/1 UD-office area. For motorcycle users, it shows that 19.75% of road users exceed the speed limit in 4/2 UD residential area and 94.5% in 2/1 UD-office area. Motorcyclists represent the road user category with the highest rates of speeding with more than 46.5% of motorcycle users ride over the speed limits followed by the passenger cars users with more than 39.43% user exceeding speed limit, microbus or city bus at 31.63%, bus Trans at 28.75%, pick up and light truck at 24.69%.

Figure 8 Proportion of drivers exceeding speed limit

The analysis results of the maximum speed limit determination, before and after installing speed limit sign and proportion of drivers exceeding the speed limit was presented in Table 6 for the speed limit 30 km/h; in Table 7 for the speed limit 40 km/h; and was presented in Table 8 for the speed limit 60 km/h.

Impact of reducing speed limit in urban road can be seen in Table 6 to Table 9. If the maximum speed limit is 30 km/h, the average speed of all vehicles decrease from 52.6 to 47.5 km/h (5.1 km/h or 9.7%) and the proportion of motorcycles ride exceeding speed limit reduce 6%, passenger cars reduce 3.13%, pick up reduce 6.06%, microbus reduce 11.11%, and trucks reduce 7.9% up to 14.29%. For maximum speed limit 40 km/h, average speed of all vehicles decrease from 52.1 to 49.3 km/h (2.9 km/h or 5.6%). The proportion of motorcycle exceeding speed limit reduce 7.17%, passenger cars reduce 5.4%, pick up reduce 22.07%, microbus increase 6.25%, and truck reduce 19.17 up to 31.82%. If the maximum speed limit is 60 km/h, the average speed of all vehicles decrease from 54.9 to 49.4 km/h (5.5 km/h or 10.1%) and the proportion of motorcycles ride exceeding speed limit reduce 7.5%, passenger cars reduce 16.61%, pick up reduce 2%, microbus reduce 9.5%, and trucks reduce 4.75%.

Table 6 Speed and proportion of drivers exceeding the speed limit 30 km/h

No.	Type of vehicle	Speed limit based on 85th percentile (km/h)		Δ Speed limit (km/h) and (%)	Proportion of drivers exceeding the speed limit (%)		Δ driver exceeding speed limit (%)
		Before installing speed sign	After installing speed sign		Before installing speed sign	After installing speed sign	
1.	Motorcycle	68.0	61.0	-7 km/h (10.3%)	96.96%	90.96%	-6.00%
2.	Passenger car	62.0	61.0	-1 km/h (1.6%)	99.22%	96.09%	-3.13%
3.	Pick up	58.7	57.0	-1.7 km/h (2.9%)	100%	93.94%	-6.06%
4.	Microbus	54.6	53.8	-0.8 km/h (1.5%)	100%	88.89%	-11.11%
5.	Bus	63.5	55.0	-8.5 km/h (13.4%)	100%	78.57%	-21.43%
6.	Light truck	57.0	55.5	-1.5 km/h (2.6%)	97.37%	89.47%	-7.90%
7.	Truck	53.0	51.0	-2 km/h (3.8%)	100%	85.71%	-14.29%
	Average all veh.	52.6	47.5	-5.1 km/h (9.7%)	99.08%	89.09%	-9.99%

Table 7 Speed and proportion of drivers exceeding the speed limit 40 km/h

No.	Type of vehicle	Speed limit based on 85th percentile (km/h)		Δ Speed limit (km/h) and (%)	Proportion of drivers exceeding the speed limit (%)		Δ driver exceeding speed limit (%)
		Before installing speed sign	After installing speed sign		Before installing speed sign	After installing speed sign	
1.	Motorcycle	63.0	59.8	-3.2 km/h (5.1%)	80.47%	73.30%	-7.17%
2.	Passenger car	65.0	61.0	-4 km/h (6.2%)	87.96%	82.56%	-5.40%
3.	Pick up	62.0	57.9	-4.1 km/h (6.6%)	85.71%	63.64%	-22.07%
4.	Microbus	50.8	56.7	+5.9 km/h (11.6%)	75.00%	81.25%	+6.25%
5.	Bus	58.0	62.8	+4.8 km/h (8.3%)	100%	100%	0%
6.	Light truck	58.1	54.8	-3.3 km/h (5.7%)	79.17%	60.00%	-19.17%
7.	Truck	53.5	48.0	-5.5 km/h (10.3%)	81.82%	50.00%	-31.82%
	Average all veh.	52.1	49.3	-2.9 km/h (5.6%)	84.30%	72.96%	-11.34%

Table 8 Speed and proportion of drivers exceeding the speed limit 60 km/h

No.	Type of vehicle	Speed limit based on 85th percentile (km/h)		Δ Speed limit (km/h) and (%)	Proportion of drivers exceeding the speed limit (%)		Δ driver exceeding speed limit (%)
		Before installing speed sign	After installing speed sign		Before installing speed sign	After installing speed sign	
1.	Motorcycle	68.7	61.6	-7.1 km/h (10.3%)	19.75%	12.25%	-7.50%
2.	Passenger car	66.0	58.0	-8 km/h (12.1%)	17.25%	0.64%	-16,61%
3.	Pick up	58.0	57.9	-0.1 km/h (0.2%)	2.00%	0%	-2.00%
4.	Microbus	63.8	60.3	-3.5 km/h (5.5%)	9.50%	0%	-9.50%
5.	Bus	55.4	53.0	-2.4 km/h (4.3%)	9.50%	0%	-9.50%
6.	Light truck	58.1	57.6	-0.5 km/h (0.9%)	4.75%	0%	-4.75%
7.	Truck	56.7	53.2	-3.5 km/h (6.2%)	4.75%	0%	-4.75%
	Average all veh.	54.9	49.4	-5.5 km/h (10.1%)	9.64%	1.84%	-7.80%

Table 9 Impact of reducing speed limit

Maximum speed limit	Impact of changing the vehicle speed
30 km/h	Average speed of all vehicles decrease from 52.6 to 47.5 km/h (5.1 km/h or 9.7%).
40 km/h	Average speed of all vehicles decrease from 52.1 to 49.3 km/h (2.9 km/h or 5.6%).
60 km/h	Average speed of all vehicles decrease from 54.9 to 49.4 km/h (5.5 km/h or 10.1%)

Based on the analysis results obtained that the installation of speed limit signs on the highway is less effective to reduce vehicle speed. With the installation of speed limit sign, vehicle speed is reduced only about 2.9 to 5.5 km/h (5.6 to 10.1%). This result is similar with study Malkhamah et al (2012), installing the speed limit sign in arterial road only reduce the speed in rural road 5-10% [27]. The speed limit change was only communicated by adapting traffic signs. Parker [28] stated that "changing posted speed limits alone, without additional enforcement, educational programs or other engineering measures, only has a minor effect on driver behavior". Therefore in addition to the installation of speed limit signs also need to be coupled with the traffic management is most suitable for application in the field adjusted to the geometric roads and land use. There is a decrease in injury crashes in 62% of the

locations after lowering speed limit from 90 to 70 km/h. There was a decrease in crash rates at intersections at 43% of the locations and 70% at road sections. In the case of the fatal and serious injury crashes, a decrease is found at 67% of the locations. A distinction between road sections and intersections showed a decrease in severe crashes at 49% and 67% of the locations, respectively [1].

Lowering speed limit will not automatically lead to a change in travel speeds. The factors such as habits, non-acceptance of the new measure or inattentiveness might explain why the actual speed adaptation is lower than the required speed adaptation [29]. Furthermore the infrastructure of the road was not adapted, which makes it less appealing for drivers to adapt their behavior, whereas others will strictly follow the rules. This can lead to an increase in the variance in travel speeds, which is an important risk factor for the occurrence of crashes [30].

b. Impact on Pedestrian Safety

According to National Highway Traffic Safety Administration (NHTSA) [31] more than 30% of accidents related to speed that causes mortality and a high social cost. Based on Figure 2, up to a speed of 30 km/h, the speed impact on fatality rate of pedestrian is 10%, which means that if a pedestrian hit by a vehicle at a speed of 30 km/h, the probability of a pedestrian died was 10%. Along with the addition of speed, after a speed of 30 km/h, the pedestrian fatality rate will increase dramatically. For speed of 50 km/h, the impact speed on fatality rate of pedestrian to 85% and at speed of 70 km/h, the impact speed on fatality rate of pedestrians to 100% Walz et al (1983) and the Swedish Ministry of Transport 2002 in [3]. For that, at school safety zone on hours/after school proposed the maximum speed limit is 30 km/h. The spot speed and average speed of vehicles before school safety zone relatively lower speed, but larger than the maximum speed limit (20 or 25 km/h) which allowed. The average speed of vehicle at school safety zone in peak time period can be seen in Table 10.

Table 10 Speed of motorcycle and passenger car at school safety zone in peak time period

Location of school safety zone	Peak time	Motorcycle speed (km/h)		Passenger car speed (km/h)	
		Lane 1	Lane 2	Lane 1	Lane 2
SDN 1 Bobosan	morning	35.45	35.08	20.73	31.12
SDN 1 Bobosan	afternoon	39.78	41.74	35.29	38.34
SD 1 Al Irsyad	morning	24.65	20.23	17.89	22.38
SDN 4 Purwanegara	morning	36.01	39.47	28.21	31.30
SDN 4 Purwanegara	afternoon	38.51	36.58	36.05	31.30
Average of speed (km/h)		34.88	34.62	27.63	30.89

Based on Table 10, motorcycles speed at peak time (morning and afternoon) more than 30 km/h, only in SD 1 Al Irsyad has value lower than 30 km/h. The average of speed for motorcycle in lane 1 is 34.88 km/h and in lane 2 is 34.62 km/h. Average speed of passenger car at lane 1 is 27.63 km/h and in lane 2 is 30.89 km/h. The average of speed for passenger car is lower than motorcycle. The result is similar with study Sugiyanto *et al.*, (2016), average speed in school safety zone for motorcycle is 34.75 km/h and light vehicles is 29.26 km/h [32].

4.0 CONCLUSION

Based on the results, the following conclusion can be drawn: the proposed maximum speed limit based on the 85th percentile speed of vehicles in urban road for arterial road type 4/2-UD residential and 4/2-UD CBD is 60 km/h for motorcycle and passenger car, 55 km/h for pick up and light truck, and 50 km/h for bus and truck. Proposed maximum speed limit for collector road type 2/1-UD office area is 45 km/h for motorcycle and 40 km/h for four-wheeled vehicles or more while for collector road type 2/1-UD CBD is 40 km/h for motorcycle and 35 km/h for four-wheeled vehicles or more. Proposed maximum speed limit in school safety zone on hours/after school is 30 km/h. Installation of speed limit sign is less effective to reduce the vehicle speed; vehicle speed on the field is only reduced 2.9 to 5.5 km/h (5.6 to 10.1%). More than 46.5% of motorcycle users ride exceeding speed limits followed by the passenger cars users (39.43%), microbus or city bus at 31.63%, bus Trans at 28.75%, pick up and light truck at 24.69%.

Acknowledgement

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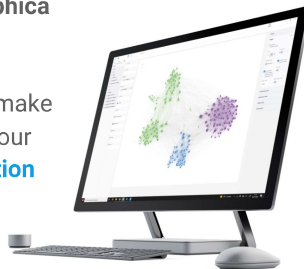
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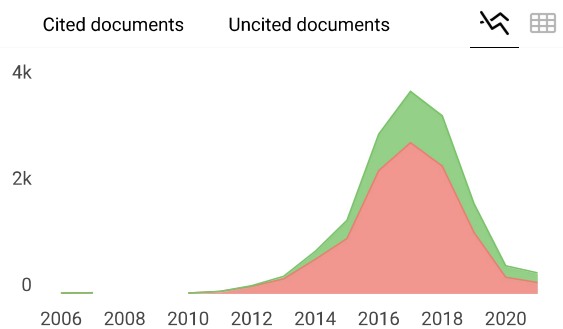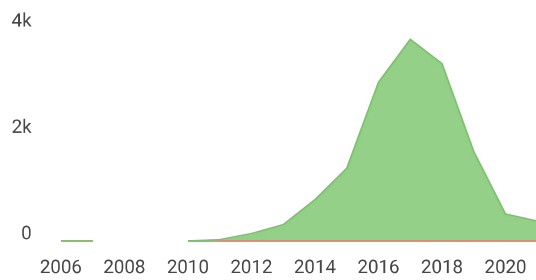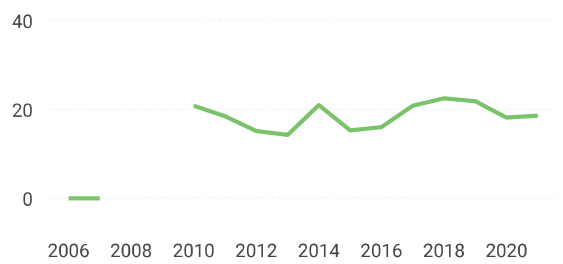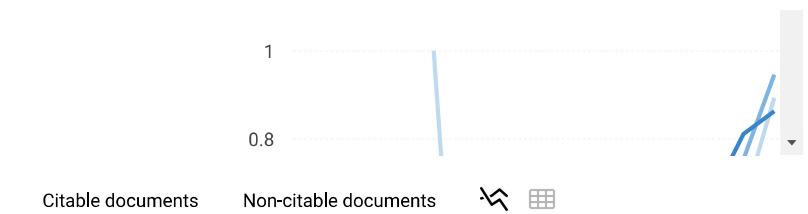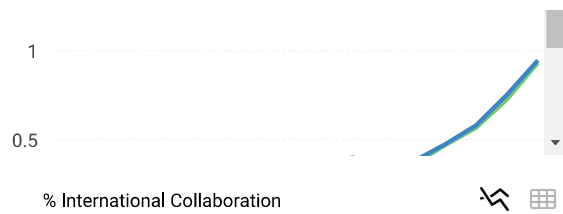
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Isa   1 day ago

I am really disappointed to have submitted my work to this j. They Ianruohave behaved very badly, in a way that is absolutely inconsistent with their rating. 9 months have passed since the

submission, during which they have never responded to any request for clarification about the long review process. The e-mails to the editor in chief bounce and there is no way to get clarification of any kind. The feeling is that of an absolute lack of professionalism. My co-authors and I are in the process of withdrawing the work. Treating in this way an article written by colleagues and that has required months and months of work is truly a sad, disrespectful and not worthy attitude of those involved in research. Never again

reply

S   **Syarifah Fazilah Yuhari**   2 years ago

Hello, I'm Syarifah, here I want to ask a favor questions about publication in term of:

-Scope of paper
-publication fee (2021)
-format

Thank you for your intention

reply

M   **majeed**   2 years ago

https://journals.utm.my/jurnalteknologi/about/submissions

SCImago Team

Melanie Ortiz   2 years ago

Dear Syarifah,
thank you for contacting us.
Unfortunately, we cannot help you with your request, we suggest you visit the journal's homepage or contact the journal's editorial staff , so they could inform you more deeply.
Best Regards, SCImago Team

eko supriyadi   2 years ago

I have a problem with this journal, for example, my manuscript is stored in the Turnitin repository and experienced rejection by this journal.. Other authors may consider using this journal to submit his manuscript. hopefully, the editor of a technology journal considers this issue..thx

reply

SCImago Team

Melanie Ortiz   2 years ago

Dear Eko, thanks for your participation! Best Regards, SCImago Team

A   **Aramesh**   2 years ago

Dear Madam/Sir,

I have been reviewer for this journal and I am writing to you to request a letter that confirmed it and mentioned how many paper I evaluated.

Best regards,
Dr.Seif

reply

SCImago Team

Melanie Ortiz   2 years ago

Dear Aramesh,
thank you for contacting us.
We are sorry to tell you that SCImago Journal & Country Rank is not a journal. SJR is a portal with scientometric indicators of journals indexed in Elsevier/Scopus.
Unfortunately, we cannot help you with your request, we suggest you contact the journal's editorial staff , so they could inform you more deeply.
Best Regards, SCImago Team

K   **Kharimatul Fachriah**   2 years ago

World you like to give me the price for manuscript?

reply

SCImago Team

Melanie Ortiz   2 years ago

Dear Kharimatul,
thank you for contacting us.
We are sorry to tell you that SCImago Journal & Country Rank is not a journal. SJR is a portal with scientometric indicators of journals indexed in Elsevier/Scopus.
Unfortunately, we cannot help you with your request, we suggest you visit the journal's homepage or contact the journal's editorial staff , so they could inform you more deeply.
Best Regards, SCImago Team

R   **Rakhman Sarwono**   2 years ago

Thanks

reply

R   **Rakhman Sarwono**   2 years ago

I want to ask about my paper
No. P: 14565

What is going on with my paper

Thank you

reply

SCImago Team

Melanie Ortiz   2 years ago

Dear Rakhman,
thank you for contacting us.
We are sorry to tell you that SCImago Journal & Country Rank is not a journal. SJR is a portal with scientometric indicators of journals indexed in Elsevier/Scopus. Unfortunately, we cannot help you with your request, we suggest you contact the journal's editorial staff , so they could inform you more deeply.
Best Regards, SCImago Team

F   **FAKHRUL ANUAR AZIZ**   2 years ago

Saya masih menunggu maklumat tentang kertas kerja yang dijanjikan untuk masuk ke JURNAL ini. Saya hantar ke ADVCIT 2015, KRABI. Sampai saat ini saya tak dapat info apa-apa dari jurnal ini. Harap pihak tuan bertindak segera. Sila hubungi saya melalui emel yang disertakan.

reply

SCImago Team

Melanie Ortiz   2 years ago

Dear Fakhrul,
thank you for contacting us.
We are sorry to tell you that SCImago Journal & Country Rank is not a journal. SJR is a portal with scientometric indicators of journals indexed in Elsevier/Scopus. Unfortunately, we cannot help you with your request, we suggest you contact the journal's editorial staff , so they could inform you more deeply.
Best Regards, SCImago Team

S   **S.A**   2 years ago

I am willing to submit a manuscript in "Journal Teknologi" but the website of the journal doesn't work properly.
I have tried several times to submit, but all the time I received an error message! Would you please kindly let me know how can I submit my manuscript in this journal?
Thank you very much. I remain

reply

B   **bimal patel**   2 years ago

Even I am getting same probem.I think one more journal with same name available but with different ISSN

Melanie Ortiz   2 years ago

Dear Sir/Madam,

thank you for contacting us.

Unfortunately, we cannot help you with your request, we suggest you contact the journal's editorial staff , so they could inform you more deeply.

Best Regards, SCImago Team

J   **Jasim Humadi Hassen**   2 years ago

I send two manuscripts for publication in this journal a year ago and the journal rejected them. We published them in other journals On doing plagiarism the report says that they submitted to your journal and show 90% plagiarism. They are still there on the database of the journal as archived. How to delete them. I wrote to the journal but no answer.

reply

Z   **Zeena**   1 month ago

Hi desr Sir

Can you please inform me the other journal adress to publish my paper

Thank you so much

M   **mosa**   2 years ago

It was the same case that has been commented in this page for 10 month ago. May be the scimago will help to contact the journal for solve the problem.

J   **Jasim Humadi Hassen**   2 years ago

Dear Melanie Ortiz

Please do not tell me to contact the journal, simply they do not answer. You should find a solution. What is your role if you can't solve a problem like this?

Regards

Melanie Ortiz   2 years ago

Dear Jasim,

SCImago Journal & Country Rank is a portal with scientometric indicators of journals indexed in Elsevier/Scopus. We always try to help our users regarding different issues, however, this is not our responsability. We are commited to help decision-making through scientometric indicators.

Best Regards, SCImago Team

Melanie Ortiz   2 years ago

Dear Jasim,

thank you for contacting us.

Unfortunately, we cannot help you with your request, we suggest you to contact another member of the editorial staff , so they could inform you more deeply.

Best Regards, SCImago Team

W   **wahyu budianto**   2 years ago

Is it for the Knowledge Management Evaluation Model journal system to improve the Performance of Case Study Employees at PT PLN (Persero)

reply

Melanie Ortiz   2 years ago

Dear Wahyu,

Could you please expand a little bit your comment? Best Regards, SCImago Team

B   **Bayu ardiansah**   3 years ago

Jurnal Teknologi provides online submission to every manuscript.

All activities should be done through online. After submission, you will get notification. Once submitted (during review process), authors will not be able to retract the paper (may be this is ethical), and not allowed to submit manuscript to other journals until review process has been done (got notification of acceptance/rejection/revision).

In my case (https://jurnalteknologi.utm.my/index.php/jurnalteknologi/article/view/13243) , all process need about 5 months waiting. And it no problems.

Probably, 1 month is very short to wait. Ans note that, this is journal from scientific community (by UTM), non provit organization, so they will do carefully, and may be, need longer review process.. Hope this explanation help.

reply

S   **Susilawati**   3 years ago

We submitted the manuscript on Jurnal Teknologi, however, after 1 month waiting, we did not get any notification. So, we withdraw the manuscript and send it to another journal. However, that another journal found that our similarity index was 97% since Jurnal Teknologi save our work on their Turnitin database as student paper of UTM Repository...What??? We are not even students from UTM!! So, another journal rejected our paper due to that occasion, they suggested us to remove our paper first from UTM database. However, Jurnal Teknologi does not want to delete it (maybe they forget the Turnitin ID of checking), even when we ask for the ID, and the funny things that UTM Turnitin operator also ask us to request the ID from Jurnal Teknologi UTM, still Jurnal Teknologi does not want to give the ID. We just want to get the ID and remove it!! It seems like we need to paraphrase everything......Therefore I report this here, so anyone who wants to submit to Jurnal Teknologi can consider my experience, and ask the editor first not to save the manuscript to their Turnitin Database.

reply

Jasim Humadi Hassen   2 years ago

I have the same problem. Did you find a solution?

Regards

hisham   3 years ago

there are much more good journal where you can submit your manuscript rather than submitting to this journal!!!!!

A Razali   3 years ago

Thank you for sharing the tips.

SCImago Team

Melanie Ortiz   3 years ago

Dear Razali, thanks for your participation! Best Regards, SCImago Team

Bayu ardiansah   3 years ago

Jurnal Teknologi provides online submission to every manuscript.
All activities should be done through online. After submission, you will get notification. Once submitted (during review process), authors will not be able to retract the paper (may be this is ethical), and not allowed to submit manuscript to other journals until review process has been done (got notification of acceptance/rejection/revision).

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Hope this explanation help.

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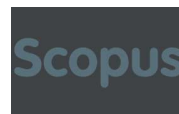
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