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Discovering public preferences for school location in Surabaya

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Abstract

Public school in Surabaya became the major choice for Surabaya citizen in schooling their children. Their zero tuition fee, good quality, and good facilities are the strong attraction. However, the school's location is not well spread in whole city location, especially the secondary level and high level schools. Some analysis to improve this spread has been conducted and good new school location has been noted. Nevertheless, whether this new school location is accepted by the public, moreover, the good school spread is important or not for the public have not been discovered. This research uses Public Participatory GIS concept to discover public preferences in choosing school location. Using web base application at <http://participatorygis.net>, an online survey has been run about a year. By analyzing the collected data with some programming and spatial analysis tools, it can be seen the preferences level of a whole area in the city. This preferences level area will explain the public acceptance of current condition or the proposed new school location.

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1. Introduction

1.1. Background

Surabaya is one of the most education focused cities in Indonesia as reflected in its educational sector budget which more than 30%. The most prominent action taken by Surabaya city government is removing the school cost in public schools. Surabaya has 492,495 school aged citizens with 270,076 citizens at the elementary school age, 114,733 at secondary school age, and 107,686 at high school age. There are 1,622 schools at the elementary level, consisting of 564 public schools, and 1,058 private schools. At the secondary level, there are 42 public schools and 300 private for

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a total of 342 schools. At the high school level, there are 257 schools, of which 33 are public and 224 are private. Because of the high proportion of elementary school students, about five times of secondary school and seven times of high school, there are more schools built to accommodate these levels. Due to this fact, there exists a scarcity of educational institutions at the higher levels, making it common for students travelling much longer distances as they move to higher levels of study.

The Surabaya city government now trying to make quality of all public schools equally in order deliver the standardized service and provide the same facilities to citizens. However, public school service seems can not reach equally by citizens in term of accessibility. The spread of school, especially in secondary and high school level, does not divide the area of Surabaya city evenly. By performing simple spatial functions to the school point layer, how this spread's characteristic can be explained. The first function is by creating a Thiessen polygon of school location in each school level. At Primary school level, the minimum Thiessen area is 368 m², maximum is 15.321.375 m², and average is 787.514 m². At Secondary school level, the minimum Thiessen area is 366.061 m², maximum is 46.698.376 m², and average is 6.830.480 m². At High school level, the minimum Thiessen area is 117.781 m², maximum is 43.948.779 m², and average is 10.796.564 m². There is considerable margin between the minimum area, average, and the maximum area at all school levels. The second function is calculating the number of schools in the administrative area. Primary school calculates in sub-district boundary while Secondary and High school calculates in district boundary. This calculation result shows there are significant differences between administrative boundary in term of the number of schools which were there. Figure 1 shows the result of the above Thiessen function and calculating function.

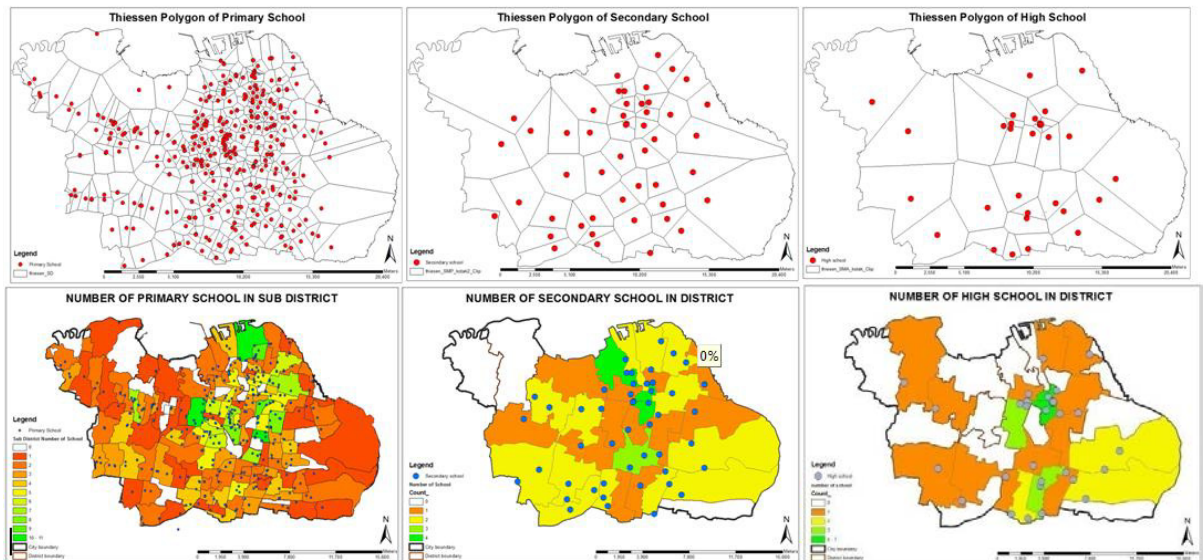


Fig. 1. Thiessen Polygon map and number of schools in administrative boundary, in three levels of school

Several spatial and statistical analysis have been conducted in order to find the best location. Those processes include some other layers like population, public transport accessibility, student flow pattern, and others layers which linked to the education sector. The result shows some areas in Surabaya cities. There are area with potential value and poor value. Areas with potential value can be recognized as places to build new schools. Areas with poor value can be used to evaluate the recent schools condition. However, are public have the same opinion with the result or not are not yet discovered. Are public really want that school's location spread evenly within the city are not well understood.

This research's aim is to discover public preferences of school location. This research uses web base application to collect user opinion. This web based application also provide interactive maps to inform what schools are suitable with their preferences. A public participation GIS concept is used in this application.

1.2. Public Participatory GIS

The use of a map in web based application can provide users with a more comprehensive understanding of location and environment. Using an interactive map provides the user with what-if analysis and changing input that collaborate with the system such as measures of area and distance. PPGIS can be used to: raise awareness, reduce the possibility of subjective judgment and speculation, and in the context of participation to: help reduce conflict, promote bonding, provide a more formal structure, assist in harmonizing viewpoints, promote discussion and equality, raise awareness of differences between participatory groups, and to offer greater legitimacy in the planning and decision-making process (Green, 2010). PPGIS may be implemented through a variety of tools, including stakeholder workshops or individual interview mail surveys with a mapping exercise or other methodologies where participants volunteer spatial information about important places (McCalla and Dunn 2012). In developing PPGIS, due to the using of Term Public and Participatory in it, an appropriate level of Public and level Participatory have to be defined. A Study by Marc Schlossberg and Elliot Shuford (Schlossberg and Shuford 2005) have made a clear matrix to adjust those levels. Figure 2 shows this matrix. This research is PPGIS with a personal survey with the user is random public. In Figure 2, this research position is in a cell colored with yellow.

		Domain of Public				
		Simple	Implement	Affected	Interested	Random
Domain of Participation	Participation Technology	Decision Makers	es	Individuals	Observers	Public
simple ↓ complex	Inform	Static Web				
	Educate	Interactive Web				
	Consult	Mail Survey				
	Define Issue	Personal Survey				
	Joint Planning	Public Meeting				
	Consensus	Charrettes				
	Partnership	Citizen Juries				
	Citizen Control	Collaboration				

Fig. 2. Matrix of Public and Participatory level, and position of this research in yellow cell

2. Methods

There are two big steps in this research. First is to collect public opinion, and the second is analyzing the collected data. For collecting the user preferences, this study makes a web based application that implements participatory GIS concept. The application isn't just collecting the user preferences, but also helping them in making a decision to choose current schools that suitable with their criteria. This application can be obtained at www.participatorygis.net. Information about this application shown in the online student report system (www.raporku.net). Therefore most user is student's parent that need to know which school that will be suited for their children whenever they finished their school level.

In the user side, this page is act like a tool to choose a school in the next school grade that suitable for their children. Figure 3 show the first page of this collecting public preferences website. In this page, a user has to choose an option that school level is suitable for their children. Is it primary school level (SD), secondary school level (SMP), or high school level (SMA and SMK). After the user chooses this option, the map will show schools in selected level. Then user then clicks next (Lanjut) button for going to the next pages. These pages will discover about:

- Where Sub-District of their home are
- How important is the distance between home to searched school
- If Home-to-School distance is important, what is the maximum distance that accepted
- Where Sub District are they working at
- How important is the distance between workplace to searched school
- If Workplace-to-school distance is important, what is the maximum distance that accepted
- Is it accepted that the school location is around the way from home to workplace
- How is the acceptance level of the home-to-workplace area.

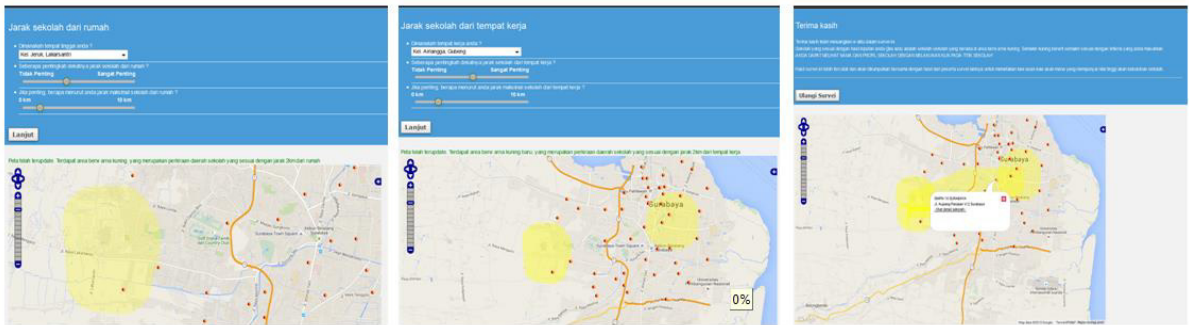


Fig. 3. Pages for collecting user preferences in PPGIS application

The users answer of above points has been saving in a tabular data which a few part of it shown in figure 4 below. There are several important fields for recording public input. Field SUBDIS_HOME and DISTRICT_HOME store sub-district and district of user home. Field W_DIST_HOME stores weight of near house preferences with value in a range from 0 to 1. Value 1 means they prefer it 100%, and 0 is not prefer it at all. Field MAX_DIST_HOME stores the maximal accepted distance of the school location with value also ranged from 0 to 1. With value 1 mean the maximum distance at 10 Km. SUBDIS_WORK, DISTRICT_WORK, W_DIST_WORK, and MAX_DIST_WORK applies the same action but for school location based on their workplace. The last field, W_HOME_WORK store the weight of preferences about school location lies between home and workplace. These fields then read and convert into shapefile with a custom desktop application build using Visual Basic 6.0.

LEVEL	SUBDIS_HOME	DISTRICT_HOME	W_DIST_HOME	MAX_DIST_HOME	SUBDIS_WORK	DISTRICT_WORK	W_DIST_WORK	MAX_DIST_WORK	W_HOME_WORK
SD	Rungkut Menanggal	Gunung Anyar	0.418333	0.0883333	Airlangga	Gubeng	0	0	0
SD	Airlangga	Gubeng	1	1	Airlangga	Gubeng	1	1	1
SD	Kejawen Putih Tam	Mulyorejo	1	0.0833333	Airlangga	Gubeng	1	0.126667	1
SD	Airlangga	Gubeng	0.985	0.0983333	Airlangga	Gubeng	1	0.165	1
SD	Benowo	Pakal	0.380417	1	Airlangga	Gubeng	0.640417	0.517083	0.577083
SD	Sukolilo	Bulak	0	1	Airlangga	Gubeng	1	1	0
SD	Airlangga	Gubeng	1	0.0495556	Airlangga	Gubeng	0	0	0
SD	Kedung Cowek	Bulak	0	1	Airlangga	Gubeng	0	0.99625	0

Fig. 4. Table structure to store

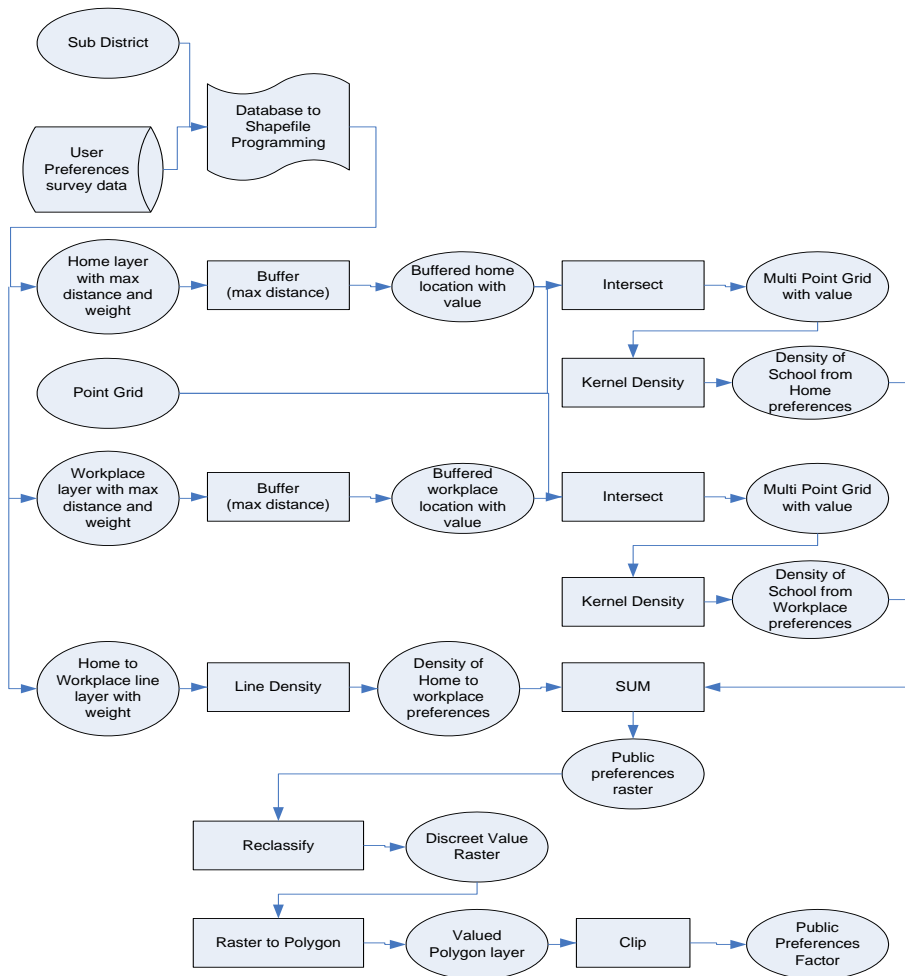


Fig. 5. Process Diagram to discover User Preferences Factor

The application read preference about home, workplace, and area between it separately. Each record for preference about home becomes a feature in point layer and also about the workplace. It use the sub-district of home and sub-district of the workplace and valued with the maximum distance and weight field. The rest, the ‘weight of area between’ field use to generate a feature in line layer, by creating a line from home to workplace and valued with this weight field. After converted into shapefile with Visual Basic 6.0 application, steps continue in ArcGIS 9.3. Figure 5 shows the process sequence for discovering user preferences factor.

There is 3 generated raster that will be summed to get the final map. The first raster is a raster with a value representing ‘near house’ area. The higher the value the most people choose those areas. The second raster is similar with the first one, but it represent ‘near workplace’. These two rasters use the same method. First, it needs to use The Join Function to join sub-district point layer and the survey table. Then it makes buffer from each center points of house’s (and workplace for the second raster) sub-district with distance taken from maximum distance field and valued with the weight field. There will be a lot of circles with different diameter and value as shown in Figure 6a. Next step is to discover in every city places how many public accept it place by summing up the value of circles in that place. It need point grid feature to get sample values to reflect all value in the city area. This sample will generate value in its neighborhood and make all city area covered by this public preferences value. The point grid will process

with Intersect function. By using this function, all point grid will join with all circles and will generate new point layer equipped with joined tabular data taken from circles including the weight field. Sometimes, in the same places there is two or more point with different weight value. Figure 6b illustrates calculated value of point features in generating new point layer. Numbers in this figure indicate the amount of circle area in that point position. The weight of each point is not shown in this illustration. This new weighted point layer then process with kernel density to generate raster public preferences ‘near home’ and ‘near workplace’ as shown in Figure 7a and Figure 7b respectively.

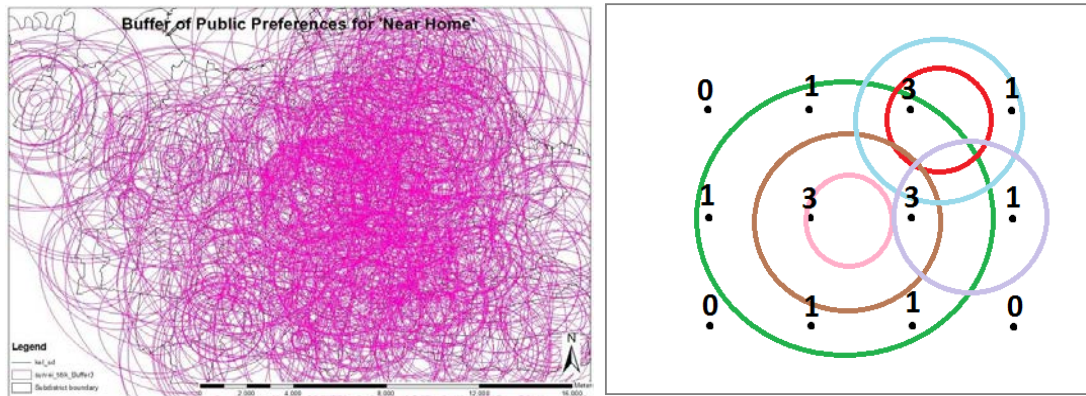


Fig. 6. (a)Generated circles. (b). Calculating circles area in sample points

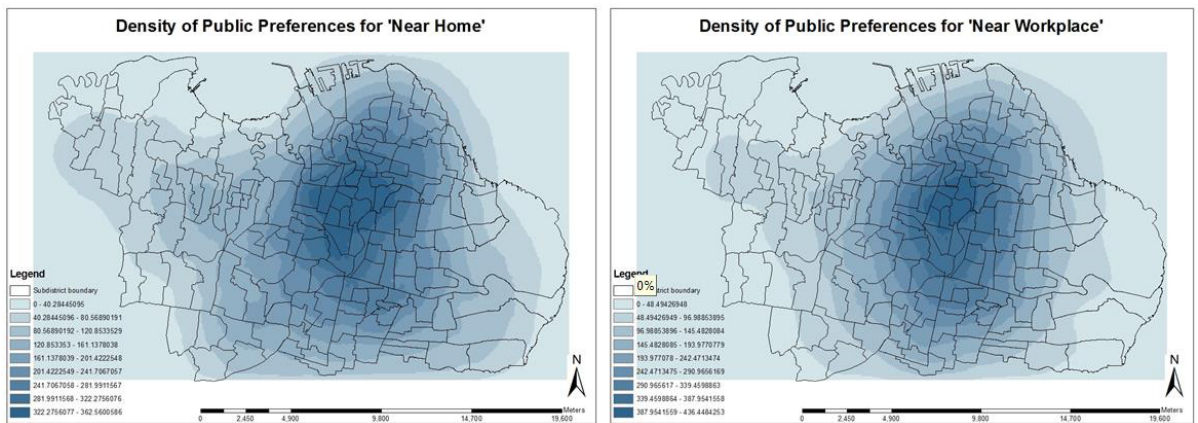


Fig. 7. (a) 'Near home' preferences density. (b) 'Near workplace' preferences density

The third raster is raster that represent the public preferences of area between house and workplace, whether is it accepted for school location or not. The visual basic application generates lines from house’s sub-district to workplace’s sub-district for each survey data. Those lines have a weighted value reflecting its accepted level of ‘home to workplace’ area. There will be a lot of lines and in the same line can be there are two or more features. Figure 8a shows lines features which represent public preferences for ‘home to workplace’ areas. It is colored with gradient color from green to red indicates low to high level of the weight. This line layer then used for input in Line Density functions to get all city area density raster. Figure 8b show the output of this function.

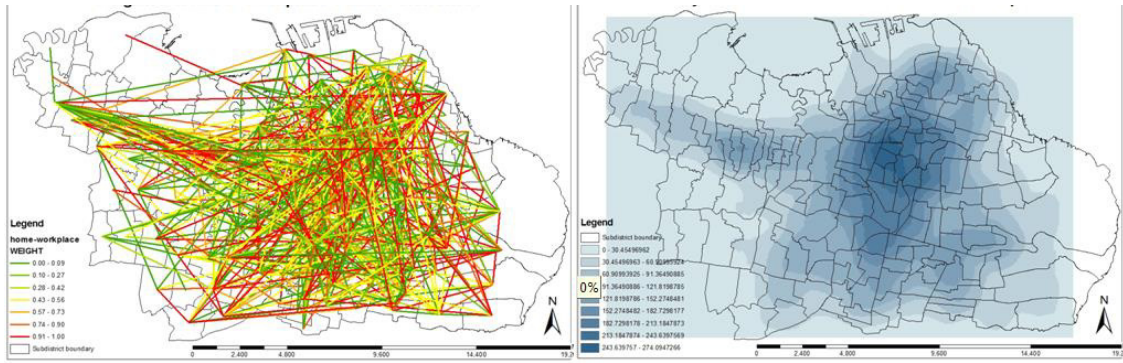


Fig.8. (a) generated home to workplace lines. (b). Density of home to workplace preferences

3. Result

The three rasters above need to be summed to get the final density raster that represent public preferences in school location. Figure 9a. show this summed raster. This raster then need to be reclassified, converted to polygon, and clipped to create the Public Preferences layer like shown in Figure 9b.

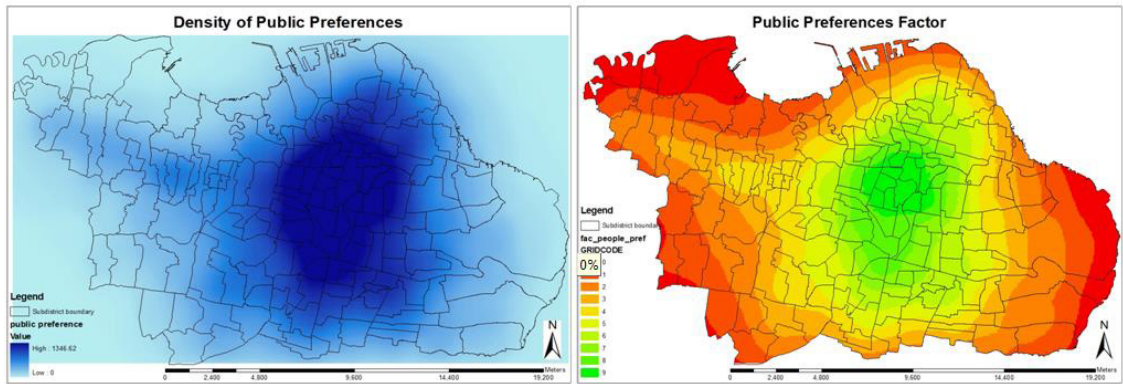


Fig. 9. (a) The summed result of 3 rasters. (b) Reclassed Public preferences map.

The final Public Preferences map then overlays with each school level layer. With Identity function value of Public Preference map in schools, the position can be grabbed. It generates school layer with a new field filled with public preferences value in its location. Figure 10 shows each school level overlaying the public preferences layer. The last step is counting the number of school per public preferences value. We group the values into three groups: high, moderate, low. High value is a value of 7,8, and 9. Moderate is 4, 5, and 6. Low is 3 or less. Figure 11 shows three different table for primary, secondary and high school respectively. In primary school level, 37.06% of school resides in high preferences value. 43.59% in moderate value, and 19.35 in low preferences value. In secondary level, 34.69% of school resides in high preferences value, 44.90% in moderate value, and 20.41 in low preferences value. In high school level, 45.16% in high preferences value, 32.26 in moderate value, and 22.58 in low preferences value.

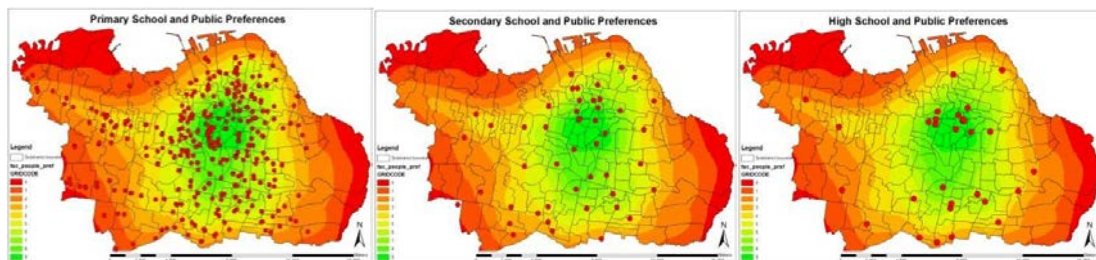


Fig.10. Public preferences layer and each school level layer

Primary School				Secondary School				High School			
VALUE	FREQ	TOTAL	%	VALUE	FREQ	TOTAL	%	VALUE	FREQ	TOTAL	%
0	4	83	19.35	0	1	10	20.41	0	0	7	22.58
1	15			1	0			1	0		
2	24			2	4			2	2		
3	40			3	5			3	5		
4	61	187	43.59	4	9	22	44.90	4	4	10	32.26
5	50			5	7			5	2		
6	76			6	6			6	4		
7	54			7	5			7	1		
8	60	159	37.06	8	7	17	34.69	8	4	14	45.16
9	45			9	5			9	9		

Fig. 11. Table of number of school in high, moderate, and low value

4. Conclusions

PPGIS can be used in wide-range of application. In this research has succeeded to use for collecting public preferences of school location. By combining PPGIS and Spatial analysis, a pattern of public preferences can be figured out as a Map Layer. The result of this research, like shown in Figure 10 and Figure 11, explain that public prefer most in city center area and gradually decrease in the edges. Current schools location is not to be worry because most of it already in the area that accepted by the public. This research collects opinion came from a random citizen whose home is also random. Next research may need to ensure that the citizen come from the whole area of Surabaya city evenly.

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