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ANALYSIS OF CLASSROOM SPACE REQUIREMENTS FOR ELEMENTARY SCHOOLS BASED ON THE PROJECTION OF SCHOOL-AGE POPULATION GROWTH IN SURABAYA CITY

(STUDY ON EDUCATIONAL PLANNING USING THE SOCIAL DEMAND METHOD)

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ABSTRACT

This study aims to describe and analyze the classroom space requirements for elementary schools based on the projection of school-age population growth and to compare it with the School Minimum Service Standards (SPMP) and National Standards for Education (SNP). The research conducted is a descriptive qualitative study with projection calculations. This method is expected to yield actual data from several years ago and the present, which will then be estimated to predict trends for the coming years. In data collection, this study utilizes data on the number of school-age children (7-12 years) in Surabaya City. This data is obtained from demographic sources such as the Central Statistics Agency (BPS) and population projections based on age groups. The data collection technique employs secondary data sources through documentation studies. The data analysis technique involves data collection, data input, and data processing using projection methods with a mathematical equations approach. The results of the study indicate that the growth of the school-age population is a determining factor in the need for classroom space, which underscores the necessity for strategic planning in educational infrastructure to ensure that all children have access to adequate learning environments.

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1. INTRODUCTION

Education is one of the fundamental human rights and a basic necessity for developing countries (Talpur, Munir, Mary, & Hashim, 2014). Through education, the quality of life for citizens will improve, making education a fundamental right for every Indonesian citizen. Every Indonesian citizen has the right to receive quality education in accordance with their interests and talents, regardless of social status, economic status, ethnicity, religion, or gender (Perdana, 2015). A high-quality education serves as the foundation for creating superior and competitive human resources. Education is a conscious and planned effort to implement and realize the teaching and learning process in a sustainable manner, organized within a learning program.

Uneven human development remains a major challenge in producing quality human resources in Indonesia. Education is one of the important dimensions of human development (Arafat, Rindayati, & Sahara, 2018), and thus, educational disparities contribute to the widening gap in human development. Several educational indicators, such as participation rates and the percentage of qualified teachers, reflect patterns that correspond with the Human Development Index (HDI), revealing disparities between the eastern and western regions of Indonesia (Prasojo, 2024).

In Southeast Asia, Indonesia ranks third lowest in the Programme for International Student Assessment (PISA) scores, following the Philippines and Cambodia (OECD, 2023). In response to this situation, the government is committed to producing superior Indonesian human resources as part of the Indonesia Gold 2045 vision, prioritizing equitable quality education in line with the development direction outlined in the National Long-Term Development Plan 2025-2045 (Bappenas, 2023). To achieve this goal, it is essential to support it with data on the future school-age population. Therefore, providing projections for the school-age population becomes crucial. Education is influenced by several factors that can support its implementation in schools, one of which is the availability of adequate educational resources, such as the planning of educational facilities and infrastructure (Nasrudin & Maryadi, 2018).

According to Aref (2011), the availability of educational infrastructure is the primary factor of concern in socioeconomic development. In other words, equitable access to and improvement of education quality, one of which is the availability of adequate educational facilities, will enable Indonesian citizens to acquire life skills, thereby promoting the establishment of holistic human development and a civil and modern society rooted in the values of Pancasila, as mandated in Law No. 20 of 2003 on the National Education System.

The definitions of facilities and infrastructure are more clearly outlined in the Minister of Education Regulation No. 24 of 2007 regarding standards for facilities and infrastructure. Facilities refer to movable learning equipment, while infrastructure refers to the basic facilities necessary for the functioning of schools or madrasahs. According to Santoso (2012), educational infrastructure encompasses all types of tools, equipment, or items that can be used to facilitate (and make comfortable) the implementation of education, including classrooms. Syafaruddin (2015) states that

facilities are tools that directly support the achievement of educational goals, such as classrooms, libraries, laboratories, and so on. In contrast, infrastructure consists of tools that do not directly support the achievement of these goals, such as location, playgrounds, funding, and others. Educational facilities are all the equipment, materials, and furnishings used directly in the educational process at schools, while educational infrastructure includes all basic equipment or facilities that indirectly support the implementation of the educational process in schools.

According to Ananda and Banurea (2020) as cited in Nasution and Marpaung (2023), in line with Daryanto's definition, Mulyasa, as explained by Rusyidi and Oda, states that facilities are equipment and supplies such as buildings, classrooms, tables, chairs, and teaching tools and media that are directly used to support the educational process, particularly the teaching process. In contrast, infrastructure refers to facilities that indirectly support the educational or teaching process, such as schoolyards, gardens, or school parks. However, schoolyards, gardens, or school parks are considered educational facilities when they are directly used for teaching.

According to Sa'ud and Makmun (2013), the fulfillment of infrastructure is an important part of educational planning activities. Educational planning is the process of looking to the future in terms of determining policies, priorities, and educational costs while considering the existing realities in various economic, social, and political fields to develop the country's education system and the students served by that system. Planning is the first element and function of management, as stated by various administration experts. This aligns with Adams' opinion (Nuranti, 2017): "Planning is an almost ubiquitous activity, engaged in by individuals, organizations, communities, and nations. It is pursued for a variety of purposes in a variety of ways, depending on what is being planned,who is doing the planning, and what assumptions are being made about the context and constraints of planning".

Along with population growth, particularly among the elementary school-age population, the demand for classrooms continues to rise. Inadequate classroom availability can negatively impact the teaching and learning process, leading to issues such as overcrowded classrooms, ineffective learning hours, and a decline in overall education quality.

Planning in education is related to many aspects, one of which is planning for classroom needs. Planning for the needs of teachers and classrooms plays a crucial and strategic role in national education. Managing teachers and classroom needs without proper planning can have a significant impact on the quality of education. An imbalance between the number of teachers and classrooms and the number of students can lead to disparities in education quality. Planning for classroom needs is essential to ensure a balanced ratio of teachers to students and classrooms, thereby maintaining education quality and ultimately achieving national education goals.

In the context of basic education planning, classroom space planning is part of the social demand approach or the social needs approach. This approach prioritizes the fulfillment of educational services as a basic necessity for society. The social demand approach involves the development of education by providing institutions and facilities to meet the pressures for school enrollment and to enable the fulfillment of community desires for education (Sa'ud & Makmun, 2011). Social

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demand is based on the current needs and demands of society. The planning of the social needs approach emphasizes the educational goal of liberating society from ignorance and poverty, which includes how to meet adequate educational needs. Its implementation is reflected in policies, one of which is the necessity of ensuring the availability of classroom space in basic education.

Planning for educational facilities and infrastructure is carried out through a needs analysis by assessing and evaluating what facilities and infrastructure are necessary to support the learning process both inside and outside the classroom.

One of the most common issues related to school facilities and infrastructure is that schools often face a shortage of classrooms because the number of learning groups exceeds the available classroom capacity. Additionally, existing classrooms have suffered moderate to severe damage due to aging buildings, natural disasters, and other forms of deterioration. Furthermore, changes in the age demographics of the elementary school population will also impact the number of new students entering elementary schools. This will inevitably affect the number of classrooms that need to be available.

Based on preliminary studies, this research applies a social demand approach to planning educational infrastructure, focusing on the city of Surabaya. Data from the Surabaya Central Statistics Agency (BPS) for 2024 indicates that the number of school-age children changes each year, with a total of 265,003 individuals. This necessitates planning and analysis based on the school-age population to project the number of new students, which will impact the number of learning groups and the number of classrooms needed over the next five years.

The gap between the number of existing classrooms and the number of learning groups each year is significant. In the 2023-2024 academic year, there are 8,332 learning groups, while only 8,390 classrooms are available. Among these, 6,597 classrooms are in good physical condition, 1,453 are slightly damaged, 223 are moderately damaged, and 59 are severely damaged. Based on this data, the city of Surabaya still faces a shortage of 1,132 new classrooms (Kemdikbud, 2025). Moreover, when compared to the standards set by both the Minimum Service Standards (SPM) and the National Education Standards (SNP), which require a classroom-to-learning group ratio of 1:1 with a maximum of 28 students per classroom, and SPM with a ratio of 1:32, meaning 32 students per classroom/learning group, the situation is even more concerning. This issue will persist if appropriate planning is not implemented to address it. From the discussion and data, it is clear that changes in the school-age population will also affect the number of new students enrolling in elementary schools, which will impact the number of classrooms that need to be renovated or constructed, as well as the funding required per classroom unit that must be provided by the local government of Surabaya. By making accurate predictions, the Education Office can develop strategic plans to meet the SPM and achieve the SNP, positively impacting the quality of educational services provided to all segments of society.

2. RESEARCH METHODS

In this research, the research carried out was descriptive qualitative research with projection calculations. With this method, it is hoped that actual data will be obtained from several years ago and now to then estimate/predict trends for the next few years.

In collecting data, this research uses data on the number of residents of elementary school age (7-12 years) in the city of Surabaya. This data is obtained from population sources such as the Central Statistics Agency (BPS) as well as population projections based on age groups.

To process the data in this research, a mathematical equation approach was used using the Sprague Multiplier Method. The Sprague Multiplier is a multiplier coefficient table that is used to break down the population grouped five years into a single age population (unit). In the field of education, the Sprague Multiplier is used to determine the number of school age population from the total population grouped five years with the aim of ensuring that the community receives adequate educational services (Santosa & Rahmawati, 2018,).

Table 1. Sprague Multiplier

Age	F-2	F-1	F0	F+1	F+2	F+3
Tabel 1 *Age Range*						
Age 0 Years			+0,3616	-0,2768	+0,1488	-0,0336
Age 1 Year			+0,2640	-0,0960	+0,0400	-0,0080
Age 2 Years			+0,1840	+0,0400	-0,0320	+0,0080
Age 3 Years			+0,1206	+0,1360	-0,0720	+0,0160
Age 4 Years			+0,0704	+0,1968	-0,0848	+0,0176
Tabel 2 *Age Range*						
Age 5 Years		+0,0336	+0,2272	-0,0752	+0,0144	
Age 6 Years		+0,0080	+0,2380	-0,0480	+0,0080	
Age 7 Years		-0,0080	+0,2160	-0,0080	+0,0000	
Age 8 Years		-0,0160	+0,1840	+0,0400	-0,0080	
Age 9 Years		-0,0176	+0,1408	+0,0912	-0,0144	
Tabel 3 *Age Range*						
Ages 10, 15, 20, 25 etc	-0,0128	+0,0848	+0,1504	-0,0240	+0,0016	
Ages 11, 16, 21, 26 etc	-0,0016	+0,0144	+0,2224	-0,0416	+0,0064	
Ages 12, 17, 22, 27 etc	+0,0064	-0,0336	+0,2544	-0,0336	+0,0064	

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Ages 13, 18, 23, 28 etc	+0,0064	-0,0416	+0,2224	+0,0144	-0,0016	
Ages 14, 19, 24, 29 etc	+0,0016	-0,0240	+0,1504	+0,0848	-0,0128	

In the table above there are several symbols. These include the symbols F-2, F-1, F0, F+1, F+2 and F+3. The symbol F shows Fraction, namely the population grouped five years. F-2 is the population grouped five years, the previous two years, which is measured from the fraction of the population whose single age is being calculated.

F-1 is the population grouped five years, one year ago measured from the fraction of the population that is being calculated for the single age population. F0 is the number of residents whose single age population is being calculated. F+1 is the population one year later, measured from the fraction of the population whose single-age population is being calculated. And F+2, namely the population two years later, is measured from the five-year population fraction that is being calculated for the single-age population.

The data processing steps using the sprague multiplier method in this research are as follows:

1. Determination of Age Group
    a. Age groups are categorized based on the age range 0-4 years, 5-9 years, 10-14 years, and so on.
    b. Data on the population of primary school age (7-12 years) is calculated based on interpolation from available population data.
2. Application of the Sprague Coefficient
    a. Using the Sprague coefficient to interpolate the population in each year of age within a predetermined range.
    b. The Sprague coefficient used is as follows:

YEAR POSITION	COEFFICIENT
F-2	-0.0128
F-1	0.0848
F0	0.1504
F+1	-0.024
F+2	0.0016

    c. Calculation of the population in each year of age is carried out by multiplying the coefficient value by the population of the related age group.
3. Calculation Process

Interpolation calculations are carried out using formulas:

$$P_t = (F - 2 \text{ x } C_{-2}) + (F - 1 \text{ x } C_{-1}) + (F_0 \text{ x } C_0) + (F + 1 \text{ x } C_{+1}) + (F + 2 \text{ x } C_{+2})$$

meaning :

- Pt is the estimated population at a certain age year.
- C is the number of residents in the appropriate age group.
- F is the Sprague coefficient factor.

After interpolation was carried out for ages 7-12 years, the projection results for the population of elementary school age were obtained.

4. Calculating Classroom Needs

Based on the results of projections for the number of primary school age population:

- The standard number of students in one study group (rombel) is determined (for example 28 or 32 students per class according to National Education Standards/SNP).
- The total number of groups required is calculated by:

$$Rombel = \frac{Jumlah\ Penduduk\ Usia\ Sekolah}{Standar\ Jumlah\ Siswa\ per\ Kelas}$$

- The need for the number of elementary schools (SD) is calculated based on the average ratio of groups per school.
- Comparisons with the number of existing schools are made to determine classroom shortages and new schools needed.

With this method, the need for elementary school classrooms in the city of Surabaya can be estimated based on projected growth in the school-age population.

3. RESULTS AND DISCUSSION

RESULT

1. Population of Surabaya City based on Population Projections

Table 2. SP 2020 Population Projections According to Surabaya City Age Groups (2020-2025) Mid-Year Population (People)

Age's Group	Man			Woman			Total		
	2023	2024	2025	2023	2024	2025	2023	2024	2025
0-4	97649	95447	93461	94070	91953	89831	191719	187400	183292
5-9	109260	106742	104242	104730	102360	100216	213990	209102	204458
10-14	115316	114443	113231	109505	109050	108190	224821	223493	221421
15-19	114531	114643	114653	108162	108256	108348	222693	222899	223001
20-24	110739	111159	111551	106079	106192	106357	216818	217351	217908
25-29	109585	108497	107802	108246	106437	105074	217831	214934	212876

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30-34	111485	110846	109980	112512	111929	110915	223997	222775	220895
35-39	112981	111437	110138	113414	112260	111319	226395	223697	221457
40-44	114898	114434	113625	116515	115588	114542	231413	230022	228167
45-49	108244	109548	110497	112201	113600	114457	220445	223148	224954
50-54	95448	97300	99120	99559	101573	103573	195007	198873	202693
55-59	79225	81872	84330	85337	87793	90160	164562	169665	174490
60-64	61919	63824	65912	69847	72097	74403	131766	135921	140315
65-69	47149	48696	50260	55681	57350	59132	102830	106046	109392
70-74	30303	32523	34415	37767	41003	43750	68070	73526	78165
75+	23050	24894	27076	36026	38250	41051	59076	63144	68127
Total	**1441782**	**1446305**	**1450293**	**1469651**	**1475691**	**1481318**	**2911433**	**2921996**	**2931611**

2. Calculation Results of Primary School Age Population Projections

Based on the Sprague Multiplier method, interpolation was carried out on the number of residents aged 7-12 years in the city of Surabaya. This projection data was obtained through calculations by applying the Sprague coefficient to the available age groups. This projection is the basis for planning basic education facility needs.

Table 3. Surabaya City Multi Player Sprague Multiplier Table

No.	Age Group	Population
1	0 - 4 tahun	191719
2	5 - 9 tahun	213990
3	10 - 14 tahun	224821
4	15 - 19 tahun	222693
5	20 - 24 tahun	216818
6	24 - 29 tahun	217831

The data is divided into several age groups, ranging from 0 to 29 years. The relevant age groups for projecting the primary school age population are the 5-9 years and 10-14 years groups.

From the 5-9 years group, we can estimate that children aged 7-9 years fall within this group. From the 10-14 years group, children aged 10-12 years fall within this group. Thus, the projection for children aged 7-12 will encompass part of both of these groups.

This projection data is crucial for planning the needs for basic educational facilities. By knowing the number of school-age children, the government and stakeholders can plan the number of schools, classrooms, and other resources needed to meet educational demands.

From the available data, it is evident that the population in the 10-14 years age group (224,821 individuals) is higher than that in the 5-9 years age

group (213,990 individuals). This may indicate a trend of population growth that needs to be considered in long-term planning.

Overall, this data provides a clear picture of the distribution of the school-age population in Surabaya and serves as a strong foundation for better educational planning.

No.	Age's	F0	F+1	F+2	F+3	Total
		191719	**213990**	**224821**	**222693**	
1	0 years	0,3616	-0,2768	0,1488	-0,0336	**36064**
		69325,5904	-59232,432	33453,3648	-7482,4848	
2	1 year	0,264	-0,096	0,04	-0,008	**37282**
		50613,816	-20543,04	8992,84	-1781,544	
3	2 years	0,184	0,04	-0,032	0,008	**38423**
		35276,296	8559,6	-7194,272	1781,544	
4	3 years	0,12	0,136	-0,072	0,016	**39485**
		23006,28	29102,64	-16187,112	3563,088	
5	4 years	0,0704	0,1968	-0,0848	0,0176	**40465**
		13497,0176	42113,232	-19064,8208	3919,3968	
Total						**191719**

The data is organized by age, starting from 0 years up to 4 years. Each age group has associated values for F0 (the current population), F+1, F+2, and F+3, which likely represent projected populations for the next three years.

The total population for the age group of 0 years is 191,719, which serves as the baseline for the projections. The total figures for each age group are essential for understanding the overall demographic trends and planning for future needs.

This data provides insights into the population dynamics of young children in the specified age groups. The projections can help inform policymakers and planners about potential changes in the population, which is crucial for planning educational facilities, healthcare services, and other community resources. The fluctuations in the projections highlight the

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importance of continuous monitoring and adjustment of strategies to accommodate changing demographic trends.

No.	Age's	F-1	F0	F+1	F+2	Total
		191719	**213990**	**224821**	**222693**	
1	5 years	0,0336	0,2272	-0,0752	0,0144	**41361**
		6441,7584	48618,528	-16906,5392	3206,7792	
2	6 years	0,008	0,232	-0,048	0,008	**42170**
		1533,752	49645,68	-10791,408	1781,544	
3	7 years	-0,008	0,216	-0,008	0	**42890**
		-1533,752	46221,84	-1798,568	0	
4	8 years	-0,016	0,184	0,04	-0,008	**43518**
		-3067,504	39374,16	8992,84	-1781,544	
5	9 years	-0,0176	0,1408	0,0912	-0,0144	**44052**
		-3374,2544	30129,792	20503,6752	-3206,7792	
Total						**213990**

The projections for each age group show variations, with some years indicating growth (positive values) and others indicating decline (negative values).

For example, the population for 5 years shows a significant increase in the first year (F+1) but a decrease in the second year (F+2).

The 6-year age group also shows a similar trend, with a notable increase in the first year but a decline in the following year.

The total population for the age group of 5 years is 213,990, which serves as the baseline for the projections. The total figures for each age group are essential for understanding the overall demographic trends and planning for future needs.

This data provides insights into the population dynamics of children aged 5 to 9 years. The projections can help inform policymakers and planners about potential changes in the population, which is crucial for planning educational facilities, healthcare services, and other community resources. The fluctuations in the projections highlight the importance of continuous monitoring and adjustment of strategies to accommodate changing demographic trends.

No.	Age's	F-2	F-1	F0	F+1	F+2	Total
		191719	**213990**	**224821**	**222693**	**216818**	
1	10 years	-0,0128	0,0848	0,1504	-0,024	0,0016	**44508**
		-2454,0032	18146,352	33813,0784	-5344,632	346,9088	
2	11 years	-0,0016	0,0144	0,2224	-0,0416	0,0064	**44899**
		-306,7504	3081,456	50000,1904	-9264,0288	1387,6352	
3	12 years	0,0064	-0,0336	0,2544	-0,0336	0,0064	**45137**
		1227,0016	-7190,064	57194,4624	-7482,4848	1387,6352	
4	13 years	0,0064	-0,0416	0,2224	0,0144	-0,0016	**45185**
		1227,0016	-8901,984	50000,1904	3206,7792	-346,9088	
5	14 years	0,0016	-0,024	0,1504	0,0848	-0,0128	**45093**
		306,7504	-5135,76	33813,0784	18884,3664	-2775,2704	
Total							**224821**

Total of Primary School Age Population 7-12 years 265.003

DISCUSSION

The calculation results show that the population of elementary school age in the city of Surabaya is projected to reach 265,003 people. This figure is obtained by applying the Sprague coefficient value to the population in the appropriate age group. This data is the main basis for determining classroom and elementary school needs in the city of Surabaya.

3. Analysis of Classroom Needs

To identify classroom needs, an analysis is carried out based on two standards commonly used in educational planning, namely National Education Standards (SNP) and Minimum Service Standards (SPM).

a. SNP Standard (28 Students per class)

If each class is filled with 28 students, then the number of study groups (rombel) needed the result obtained 9.464 study groups (rombel) .

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Assuming that each school has an average of 6 groups, then the basic school needs that must be provided are 1.557 Elementary school.the ideal number of schools to accommodate all elementary school students in the city of Surabaya is 1,577 schools.

b. SPM Standard (32 Students per class)

If the number of students per class is 32 students, then the number of study groups (rombel) needed the result 8.281 study groups.

Assuming that each school has an average of 6 groups, the number of elementary schools needed is 1.380 School

Thus, the ideal number of schools to accommodate all elementary school students in the city of Surabaya is 1,380 schools.

4. CONCLUSION

Based on the data provided, analysis of the availability of elementary schools in the city of Surabaya can be carried out by considering two different standards, namely National Education Standards (SNP) and Minimum Service Standards (SPM). The following is an analysis for each standard: Based on the data provided, analysis of the availability of elementary schools in the city of Surabaya can be carried out by considering two different standards, namely National Education Standards (SNP) and Minimum Service Standards (SPM). The following is an analysis for each standard:

1. By SNP standards, the ideal number of elementary schools to accommodate all elementary school students in the city of Surabaya is 1,577 schools.
2. Using SPM standards, the ideal number of elementary schools to accommodate all elementary school students in the city of Surabaya is 1,380 schools.
3. Based on SNP Standards: 1,577 schools are needed to accommodate 265,003 students with 28 students per class.
4. Based on SPM Standards: 1,380 schools are needed to accommodate 265,003 students with 32 students per class.

With the analysis results showing the ideal needs of 1,577 schools based on SNP Standards and 1,380 schools based on SPM Standards, local governments must formulate clear policies for building new schools. This includes determining strategic locations that are accessible to students, especially in densely populated areas. With different SNP and SPM standards, educational planning must consider the ratio of students per class. Reducing the number of students per class can improve the quality of learning and the attention given to each student.

The implications for education planning in the city of Surabaya are very important to ensure that all children have adequate access to quality education. By considering the need for the number of schools, resource management, quality of education, and community involvement, education planning can be carried out more effectively and sustainably. This will contribute to improving the quality of education

in the city of Surabaya and support the development of quality human resources in the future.

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