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AN INTEGER PROGRAMMING APPROACH FOR LOCATING PRESCHOOL OF CHILDREN WITH DISABILITY IN KUALA SELANGOR

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Abstract : Early childhood is the most rapid period of development in human's life. It is a period of great opportunity as it forms the basis of intelligence, personality, social behavior, and physical development. This made early childhood education crucial for all children whether the children with or without disability. However, there are many challenges faced by the disabled children to start their early education in mainstream preschools. It can caused by insufficient of disabled friendly facilities, inadequate well trained teachers and lack of social support. Therefore, the special school is needed to these disabled children to ease their learning process. The aim of this study is to locate the potential preschool areas according to the distance in between the mukims of Kuala Selangor. The expected outcome will supposedly suggest on how many preschool needed for children with disability in this province. An integer programming approach is used in constructing the numerical model and output created by LINGO software.

Keywords: Integer programming, Preschool of Disabled Children, Kuala Selangor.

1. INTRODUCTION

1.1 Background of Study

Children with disabilities have their right to obtain early education as non-disabled children. Regardless their individual strengths and weaknesses, some of them have hopes and expectations to achieve qualifications and skills in life. Therefore, quality early education programme really make a difference in the lives of young children with disabilities and their families (Gargiulo & Kilgo, 2014). Besides, having early special education will help them to gain confidence and control over their own lives**.** Special education during preschool or kindergartens for disabilities is believed to meet the developmental needs of the children especially those who are experiencing developmental delays.

According to Hallahan, Kauffman and Pullen (2009), early intervention is likely to provide support for the child and family that will help prevent the child from additional problems or disabilities. In similar manner, National Early Childhood Technical Assistance Centre (2011) come to an agreement that the brain is strengthened by positive early experiences especially safe environment, supportive relationship with the adult and healthy nutrition. Thus, it is undeniable that high quality early childhood education services can change a child's developmental trajectory and improves results for their families and communities. As related to high quality early childhood education programme, Robertson (2010) stated that there are six major goals that the teacher must have in mind. Among the goals are maximize the health status of the children, minimize risk to the well-being of the children and utilize education as a tool for health promotion.

Meanwhile, a goal of early intervention and early childhood special education efforts is to provide children with delays and disabilities with the best possible beginning.

1.2 Problem Statement

Early childhood special educators should be competent in handling the disable children and they should focus on the strength of each child instead of their limitations. Findings of Petra, Martina and Lenka (2014) shows that the pre-school children cannot be treated as a homogeneous group. It is because the wide range of disability experience, as well as the diversity of early childhood education and care services, makes it difficult to draw broad conclusions about early education of the disabled children. Children with special educational needs learn in different ways and different speeds. They also differ in their family backgrounds as therefore important not to make conclusions only on the basis of their belonging to the language, culture, social or ethnic origin. Therefore, the challenge is to develop models that allow the children with special needs receive services according to the individual needs of the preschoolers and their family.

In addition, the challenge can also cause by insufficient of disabled-friendly facilities, inadequate well trained teacher and lack of social support. Hence, the special school is needed to these disabled children to ease their learning process. Six preschools or kindergartens for disabled children have been introduced by the Malaysian government in closing ceremony of conference entitled 'Incheon Strategy 2013-2022: A New Decade for Persons with Disabilities in Malaysia' ("*Enam taska khas untuk OKU"*, 2013). As there is still a small number of the institution, choosing the right location of the preschool or kindergartens become a critical issue to the parents or guardians to ensure the benefits of affected household is optimized. Determination of where to locate potential preschools or kindergartens in a given area has been an important criterion to the strategic planning of development for a new school. In short, the aim for this study are

- to obtain better insight on the statistical data of the children with different categories of disabilities in the district of Kuala Selangor.
- to investigate the optimum number of this special preschool and its location, so that the benefits to the affected household is optimized.

This study employed secondary data obtained from *Jabatan Kebajikan Masyarakat (JKM)* to gather the relevant information on the details of disabled children in the district of Kuala Selangor. The data is then segregated by nine subdivisions (*mukim*) of Kuala Selangor and the distance between these subdivisions are determined. Several reasons why residents in Kuala Selangor are chosen in this research project. Since Unisel Bestari Jaya campus is located at this district area, it is beneficial to have information on this issue as it can generate the idea of proposing future community service based programme at the location near Unisel. As there is small number of private learning centre offered for children with disability in this province, the choice of getting the education for the children is smaller and harder especially for parents with a lower level of income. However, the research scope can be expanded to all districts in Selangor state or any other location in Malaysia for further research.

2. LITERATURE REVIEW

Child Act (2001) defines child as a person under the age of 18 years. Meanwhile, Malaysia's Person with Disabilities Act (2008) stated that persons with disabilities include those who have long term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society. Registration as disabled persons could falls under category of hearing, visual, speech, physical, learning difficulties, mental and various other disabilities which is not appropriate to be classified under the previous six categories. According to Gargiulo and Kilgo (2014), professionals referred disability as an inability of an individual to do something in a certain way. A disability may be thought of as an incapacity to perform as other children due to impairments in sensory, physical, cognitive, and other areas of functioning. Individuals with Disabilities Education Act (IDEA) was originally enacted by Congress in 1975 to ensure that children with disabilities have the opportunity to receive a free appropriate public education just like other children.

Children with special needs receive services in a variety of location such as childcare settings, child's home or neighborhood playgroup. However, this study focus on the preschool institution. Based on Education Act 1996, preschool defined as an institution that offered an education program for students aged from 4 to 6 years old. As the environmental arrangement are equally important in the education of young children with special needs, school buildings should be made accessible and disabled friendly, especially for students with physical impairment (Muhammad Nadhir Abdul Nasir & Alfa Nur Aini, 2016). Variables such as room arrangement, colour, lighting and room temperature are key dimensions of an effective learning environment. By some means, surplus of this special preschool might involve high setup and operational cost. Thus, locating preschool in an efficient manner should be considered in compromising the conflict.

A goal programming research proposed by the Trivedi and Singh (2016) states that four objectives were identified in locating establishments that included all the requisite metrics related to subjective weights, distances traversed, unmet demand and number of shelter sites. Furthermore, the relevant criteria mentioned in this study for selection of any potential location sites includes community infrastructure, safety and security, transportation capacity and proximity such as distance from main road and healthcare facility.

A multi objective model for locating fire station proposed by Badri and Alsayed (1998) could also be useful in applying goal programming technique for this research. The model attempts to determine the location of fire stations and the areas they are supposed to serve. The model considers multiple objectives that incorporate both travel times and travel distances from stations to demand sites. The results of the model indicate that the developed integer goal programming model seems an ideal technique that is applicable to the real location problem.

Facility location problems include the identification of locations such as emergency shelters, distribution centres, warehouses, fire stations, debris removal sites medical centres and many more. Deterministic facility location problems determine the place and input parameters such as the possible number of individuals affected, the location, shelter capacity, transportation costs, and fixed cost, with all parameters being known and constant over time. The problem selects or locates the

optimal facilities to be placed and seeks to minimize the total transport distance (including transport time or transport cost) between the demand points and selected facilities. Arabani and Farahani (2012) found that facility location problems are about space and time. The identification of potential facilities is based on the geography of the respective areas and divided into two: continuing facility location problems (facilities located in the planning areas) and discrete facility location problems (facilities located in candidate locations).

Selecting a proper site for a new facility requires a strategic decision making. It is important in order to ensure that profits costs are in the optimal level. Duarte A. E. (2014), in his study on facility location for biofuel plants, proposed an optimisation framework using a mixed-integer linear programming formulation to reduce the logistical and operating costs for biofuel plants. From his study, the experimental results indicated that placing a processing plant at Ibague city results in the best profitability. Meanwhile, a post-optimisation analysis indicated that even for a long period, the location decision remains the same.

Mohri et al. (2019) proposed a hybrid model for locating new emergency facilities to improve the coverage of road crash throughout the city. The proposed model takes into account the status and location of the emergency facilities in the network and identifies locations suitable for the construction of new facilities. In their study, Data Envelopment Analysis (DEA) and Maximum Coverage Location Problem (MCLP) are combined in a single model and a mixed integer programming model was developed in order to maximize the efficiency of services provided by emergency facilities across the city in response to the demand. The researchers used the average number of mortalities, injuries and property damage crashes in various regions of the city as well as the population density of each urban district as the input variables for the model. For the output variables of the model, the researchers included the coverage share of proposed emergency centres and hospitals equipped with ambulances. The results from their study showed that ten urban districts had efficiency problem in provision of emergency services. The recommendation was to add the location of some emergency centres and hospitals to the network.

In a classic covering facility problem, a customer is assumed to be covered if he or she is located within the critical distance zone around the facility and is otherwise not covered. Lee J.M. (2012) addressed the facility location problem that aims to optimize the location and scale of a new facility in consideration of customer restrictions, including customer preference and the minimum number of customers required to open the facility. This problem is caused by customer facility selection, which differs from the classic covering problem in which services are determined only by proximity. The researcher used a mixed integer programming formulation based on customer restrictions and also developed a heuristic solution procedure using Lagrangian relaxation.

3. METHODOLOGY

3.1 Data collection

There are several types of data needed to identify the number of preschool for special children which has a reasonable distance from the child's home. In this case, average 20 minutes of travelling time is chosen as it is the maximum time allocated by the Federal Department of Town and Country Planning, Ministry of Housing and Local Government in considering a development of new school. Since this travelling time also shows an equivalent distance in kilometres, therefore it will be the reference in developing the mathematical coding. Meanwhile, data for person with disability is provided by *Jabatan Kebajikan Masyarakat Kuala Selangor*. The details includes individual's address, date of birth, type of disability, date of disability card application and date of acceptance. From the given data, researchers form a statistics of disabled person with regards of their age, disability type, gender and living area. From the statistics, preschool students are identified and detail of these children is highlighted.

Several assumptions have been made in organizing data for this study. Among of the assumptions are as follows.

i. The number of person with disabilities is calculated based on the number of individual registered with JKM only. If there is other children known with disabilities not registered in this district area, they will not be counted in the figure shown.

ii. The statistics part involved person with disabilities registered for year 2013 to 2018 only. The reason why the study take into account the last five years data is because it is hoped that this data show the needs of this special preschool in recent situation. Therefore, the updated data hopefully helps the decision maker makes a right decision within a correct time frame.

3.2 Mathematical model formulation

The objective of present study is to select suitable locations for establishing preschool for children with disability in Kuala Selangor. The model tried to minimize the number of preschool as it helps to reduce economic burden incurred by the government. Besides that, an efficient location of the preschool should well address the following issues;

(a) It can shorten the distance between child's house and preschool to reduce the logistic burden of the children and their family members.

(b) It can reduce the overlap of services provided by the preschool.

The following variables represent the mukims in Kuala Selangor.

$$x_i = \begin{cases} 1 & \text{if location } i \text{ is selected} \\ 0 & \text{otherwise} \end{cases}$$

Table 1 The shortest distance from the i*th* mukim to j*th* mukim (in kilometers)

j \ *i*	1	2	3	4	5	6	7	8	9
1		21.8	31.3	15.4	6.0	18.7	20.0	14.0	33.1
2	21.8		7.0	26.9	20.3	19.8	32.6	27.5	11.2
3	15.9	7.6		22.0	21.7	26.4	39.2	29.7	17.8
4	9.1	25.0	25.7		15.0	27.8	29.2	23.0	36.2
5	7.1	20.3	34.6	17.5		13.3	14.6	8.5	31.5
6	19.5	19.7	40.5	29.8	12.7		20.7	11.9	23.7
7	21.3	32.6	38.7	31.7	14.6	18.1		7.9	36.5
8	14.8	21.9	28.0	25.1	8.0	6.5	11.5		25.8
9	32.9	11.2	17.4	38.1	32.4	28.7	36.5	31.4	

In this section, the shortest distances between mukims in Kuala Selangor are given in Table 1. The application of Batchgeo and Google Map are used in gathering the information. Nine mukims are considered in this study including Api-api, Bestari Jaya, Ijok, Jeram, Kuala Selangor, Pasangan, Tanjong Karang, Ujong Permatang and Ulu Tinggi. The travelling distances less than 20 kilometres are given in table 2 as follows.

Table 2 Summary of travelling distance between each mukims.

Mukim	**Variables**	**Travelling distance less than 20 kilometres**
Api-api	x_1	x_4, x_5, x_6, x_7, x_8
Bestari Jaya	x_2	x_3, x_5, x_6, x_9
Ijok	x_3	x_1, x_2, x_9
Jeram	x_4	x_1, x_5
Kuala Selangor	x_5	$x_1, x_2, x_4, x_6, x_7, x_8$
Pasangan	x_6	x_1, x_2, x_5, x_7, x_8
Tanjong Karang	x_7	x_5, x_6, x_8
Ujong Permatang	x_8	x_1, x_5, x_6, x_7
Ulu Tinggi	x_9	x_2, x_3

Hence, the above information can be summarized as follows;

$$\min z = x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9$$

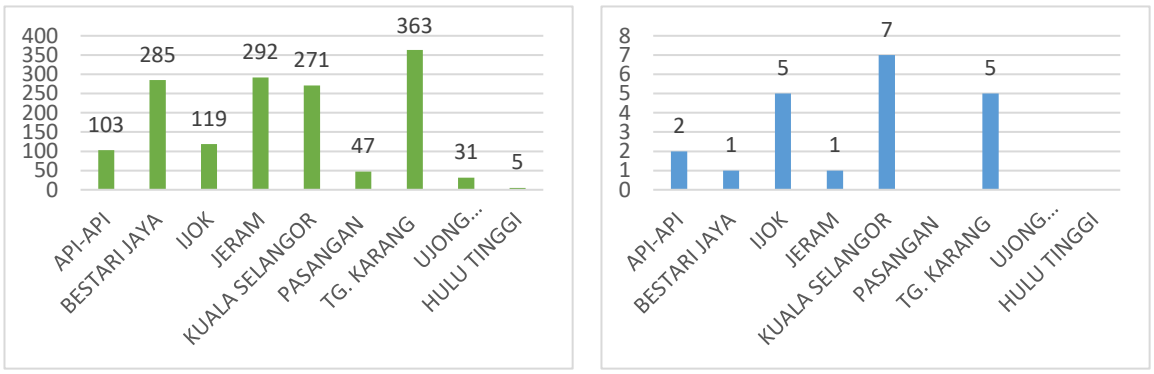
subject to

$$x_4 + x_5 + x_6 + x_7 + x_8 \geq 1 \quad \text{(mukim 1)}$$
$$x_3 + x_5 + x_6 + x_9 \geq 1 \quad \text{(mukim 2)}$$
$$x_1 + x_2 + x_9 \geq 1 \quad \text{(mukim 3)}$$
$$x_1 + x_5 \geq 1 \quad \text{(mukim 4)}$$
$$x_1 + x_2 + x_4 + x_6 + x_7 + x_8 \geq 1 \quad \text{(mukim 5)}$$
$$x_1 + x_2 + x_5 + x_7 + x_8 \geq 1 \quad \text{(mukim 6)}$$
$$x_5 + x_6 + x_8 \geq 1 \quad \text{(mukim 7)}$$
$$x_1 + x_5 + x_6 + x_7 \geq 1 \quad \text{(mukim 8)}$$
$$x_2 + x_3 \geq 1 \quad \text{(mukim 9)}$$

$$x_i = 0, 1$$

4. RESULT AND DISCUSSION

Based on the data collected from JKM, it is shown that mukim Kuala Selangor has the highest frequency of total disabled children aged four to six years old. The result is shown in the following Figure 1.



(A) (B)

Figure 1: Frequency of total disabled person (A) and disabled children aged 4 to 6 years old (B) according to mukim in Kuala Selangor.

Meanwhile, the results obtained by using integer programming method shows that two preschools for disabled children are needed in the district of Kuala Selangor. The locations indicated by the LINGO software are *mukim* Bestari Jaya (*X2*) and *mukim* Kuala Selangor (*X5*). It indicates that these preschools can serve disabled children at a maximum distance of 20 kilometres or equivalent travelling time of 20 minutes driving from their residential areas. Preschool in Bestari Jaya will probably give an early education opportunity for children with disability near its surrounding areas as well as children from *mukim* Ijok, Kuala Selangor, Pasangan and Ulu Tinggi. Meanwhile, preschool in Kuala Selangor will serve this special children nearby and neighborhood areas such as Api-api, Bestari Jaya, Jeram, Pasangan, Tanjong Karang and Ujong Permatang. In short, the output presented will cover the needs of all residents in every mukim of Kuala Selangor.

5. CONCLUSION

The statistical data should therefore raise awareness and contribute in the development of continuum service delivery option for disabled children. Consequently, it will improve the education system in promoting the right of every individual to enjoy access of education without discrimination or exclusion. This study is not limited only to the location of preschools, but also to other public facilities such as police station, fire station, fast food restaurant and others.

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