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Evaluating Creative Therapy Effectiveness on Children with Special Needs through Robust Clustering Techniques

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ABSTRACT

The study examined the progress of Children with Special Needs (CWSN) in the Center for Students with Special Needs (Pusat Layanan Peserta Didik Berkebutuhan Khusus, PLPDBK) Semarang through creative therapy methods. Based on the primary data collected from the observation of 56 children over eight sessions of therapy. The study employed the Robust Clustering Using Links (ROCK) clustering algorithm to evaluate children's social interaction and behavior development, fine motor skills, and cognitive capabilities. The clustering process revealed four distinct types of CWSN that, for the most part, were between the ages of 6 and 10 years old. The study found that although the stability of these development features was often seen, there was a possibility for improvements in certain categories. The study highlighted the potential of targeted interventions and modern treatments that regularly elevate children to "5" or the "very good" developmental category during the vital age range of 6 to 10 years. These findings call for greater inclusion in educational policy and therapies that can be designed to accommodate the various needs of children.

1. Introduction

Children with Special Needs (CWSN) comprise children that need special care and attention for optimal growth [1]. They face variety of challenges based on the needs they are facing, like hearing impairment, visual impairment, intellectual disability, and autism [2]. Various types of therapy may be offered including speech, occupational, physical, art, and behavioral therapies to aid their growth. Each therapy has an individual focus and strategy specifically tailored to the individual requirements of the kid [3], [4].

Occupational therapy seeks to assist CWSN in acquiring skills for daily living, thereby help them live independently, like eating, dressing and other tasks. Speech therapy is focused on improving communication skills including both nonverbal and verbal important for CWSN with speech or language problems [2]. Physical therapy is designed to enhance the gross motor abilities like running or walking, and typically is offered to children suffering from neurological or physical issues. The aim of behavioral therapy is to solve emotional and behavioral problems that often confront CWSN,

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such as problems with discipline or social interaction [5]. Art therapy, including the art of creative therapy, is one type of therapy which uses art practices like making music, painting, or creating to express emotion and develop social and cognitive capabilities [6], [7].

This study emphasized creative therapy, an aspect of art therapy in which 56 kids at Center for Students with Special Needs (Pusat Layanan Peserta Didik Berkebutuhan Khusus, PLPDBK) Semarang received direct observation over eight therapy sessions. The choice of creative therapy was made for its ability to enhance different aspects of development for children, such as behavior, social interaction, fine motor abilities, and cognitive skills [8]. Various studies have identified children's behavior and requirements within the context of therapeutic and educational [9]. The studies have identified patterns in developmental and behavioral needs through clustering techniques, which permit better-targeted intervention. Similar research methods have been used to study the development of children with special needs [10]. Clustering helps to overcome the challenges of monitoring and evaluating behavior and cognitive skills development.

Monitoring CWSN's growth when they engage in creativity therapy is often not easy due to regular evaluation and measurement. Lack of standardization in groups and proper data analysis frequently hinders therapists from determining the level of progress or issues faced by CWSN throughout the therapy process.

The study sought to address these issues by using the Robust Clustering Using Links (ROCK) method, which was specially developed to group categorical data. ROCK clustering is a sophisticated technique based on the usage of hyperlinks or the number of neighbors that share a common space, the data points to create clusters [11]. This technique is extremely useful when dealing with categorical information and data that cannot be categorized by similarity. Traditional methods of clustering may be unable to create meaningful groups. One of the significant benefits of ROCK clustering is its robustness in dealing with noise and outliers [12]. This makes it ideal for databases with intricate structure and different classifications.

Utilizing primary data gathered through direct observation of children who attend PL PDBK Semarang, this study examined the competence growth of CWSN through assessments made in eight therapy sessions. The subjects studied comprise CWSN profiles, profiles of therapists, and the competence development measurement of CWSN regarding behavior, social interaction, fine motor abilities, and cognitive capabilities.

By clustering, this research has a major impact on determining the difference between the amount of CWSN competence development during each therapeutic session. The findings of this research are not just helpful in assessing the effectiveness of therapy but will also offer suggestions for the design of more efficient therapeutic programs.

2. Method

2.1. Materials

The data used in this study came from first-hand data gathered through observations of CWSN undergoing therapy for creativity involving 56 children from the PL PDBK Semarang. This study comprised eight variables: age of CWSN (age), the gender of CWSN (gender), the type of diagnosis used for CWSN (diagnosis), the educational background of therapists (educational), assessment of the behavioral developmental development of CWSN (behavior), assessment of the development of social interaction of CWSN (interaction), assessment on the fine motor development of CWSN (finemotor), and assessment of the cognitive growth of CWSN (cognitive). Every assessment was recorded during eight consecutive sessions. The data description for each variable is shown in Table 1.

Table 1. Categorical Data Variables of CWSN

Number	Variables	Category	Explanation
1	Age	1	0-1 years old (Infant)

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Number	Variables	Category	Explanation
		2	1-5 years old (Toddler)
		3	5-6 years old (Preschooler)
		4	6-10 years old (Child)
		5	10-19 years old (Adolescent)
2	Gender	1	Boy
		2	Girl
3	Diagnosis	1	Hearing Impaired
		2	Intellectual Disability
		3	Autism
		4	Speech Delay
		5	ADHD
		6	Less satisfactory
		7	Celebral Palsy
4	Educational	1	Public Health (Bachelor)
		2	Management (Master)
5	Behavior	1	Very Poor
		2	Poor
		3	Fair
		4	Good
		5	Very Good
6	Interaction	1	Very Poor
		2	Poor
		3	Fair
		4	Good
		5	Very Good
7	Finemotor	1	Very Poor
		2	Poor
		3	Fair
		4	Good
		5	Very Good
8	Cognitive	1	Very Poor
		2	Poor
		3	Fair
		4	Good
		5	Very Good

2.2. Methods

Once the data had been collected, it was processed by R software with the assistance of the cab package. Descriptive statistics revealed information about the distribution of each column and illustrated differences between data categories with bar charts.

The data was organized in an array of tables, in which the rows were the names of CWSN at PL PDBK Semarang and the columns were the nine variables that were used. Clustering analysis using ROCK clustering was started by looking at the similarities. The next step was to determine the number of groups (n) using the proportion between SW (within-group standard deviation within the group) and SB (between-group standard deviation between groups). After that, the threshold (θ) was calculated to determine the link count. The clustering results were presented in the form of chart plots of clusters and bar charts. Fig. 1 shows the flowchart of research.

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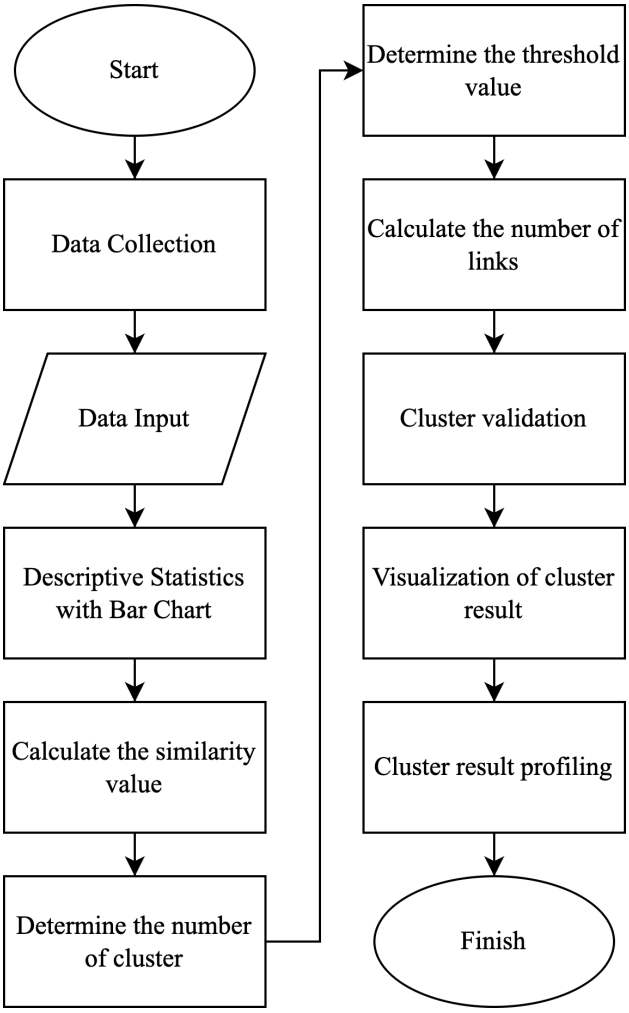

Fig. 1 Research flowchart.

2.3. ROCK Clustering

Analysis of categorical clustering usually involves measures of similarity specifically made for categorical data. The traditional hierarchical or nonhierarchical method of clustering is often considered insufficient for categorical data. Therefore, various techniques have been devised for the clustering of categorical data, one of which is the ROCK algorithm, which was used in this study [11], [13].

The ROCK method is an improvement of the hierarchical agglomerative technique, specifically adapted to categorical data. The method employs the notion of "links" (levels of connection) to determine similarities to make clusters [14]. The objects that have many links are placed within the same cluster. In contrast, objects with a smaller number of links are ejected from the group. The number of links between the observational objects is dependent on the threshold (θ) [15]. The value of (θ) is an indicator variable that indicates whether there are hyperlinks between two observations [11], [13].

a. Initialize objects into groups of one member for each.
b. Calculate similarity with the Jaccard coefficient formula. The Jaccard distance provides several benefits over other distance measurements across a variety of applications. Jaccard distance always outperforms other measures in the handling of massive amounts of information [16]. The similarity of the objects i and j is determined by using (1).

$$sim(X_i, X_j) = \frac{|X_i \cap X_j|}{|X_i \cup X_j|}, X_i \neq X_j \quad (1)$$

in which X_i is the categorical sets of the *i*th observation, while that X_j represents the categorical set of the *j*th observation. A categorical set is one that has members which comprise categorical data. The $|X_i \cap X_j|$ indicates the total number of members that are identical in X_i and X_j. $|X_i \cup X_j|$ symbol represents the total amount of members that are combined of X_i and X_j.

c. Find the cluster count (n) and then set the threshold (θ) to create the neighbor-matrix. The value (θ) represents an option parameter by the researcher to assess the degree of relationship between the observations. It indicates whether two pairs of observations are to be neighbors. The threshold value of (θ) is between 0 to 1.
d. Create the adjacency matrix A by calculating the value of θ. Matrix A can be described as a *n x n* matrix, where the number 1 indicates that both X_i and X_j have neighbors, and zero when X_i and X_j not neighbors.
e. Find the links between the pairs X_i and X_j. This is calculated by multiplying the X_i row and the X_j column the matrix A. Link can be calculated by using (2).

$$Link(X_i, X_j) = |T_{X_i} \cap T_{X_j}|, i \neq j \quad (2)$$

in which T_{X_i} is the set of neighbors of the *i*th observation, T_{X_j} is the set of neighbors of the *j*th observation, and $|T_{X_i} \cap T_{X_j}|$ is the number of common members in the set of neighbors between X_i and X_j.

f. Determine the goodness score when merging two clusters by using the (3) [17]:

$$g(C_i, C_j) = \frac{Link\ (C_i, C_j)}{({}_in + {}_jn)^{1+2f(\theta)} - {}_in^{1+2f(\theta)} - {}_jn^{1+2f(\theta)}} \quad (3)$$

in which $Link\ (C_i, C_j) = \sum_{X_i \in C_i, X_j \in C_j} Link\ (X_i, X_j)$, that represents the number of possible links pairs of objects that are in C_i and C_j, n_i and n_j indicate the total number of participants in the *i*th group and the *j*th group, respectively. The function $f(\theta)$ can be defined by the term $f(\theta) = \frac{1-\theta}{1+\theta}$.

g. After that, combine groups with the greatest goodness measure. Then, recalculate the links between groups, and change the goodness measurement values.
h. Perform steps and steps e and f till the required number of groups is reached.
i. Repeat steps from a up to g using different numbers of θ.
j. Calculate the ratio between S_w and S_B for every value of θ by with (12) and (13).
k. Compare the results of the step *i* for each number of θ to find the best θ using the criteria of having a smaller proportion of S_w and S_B 13 [12].

2.4. ROCK Clustering Validation

The key step in cluster analysis is to determine the optimal number of clusters and the optimal threshold. The process of validation for clusters is crucial for evaluating the efficiency of clustering outcomes. It is the method of objectively and qualitatively evaluating the effects of the cluster analysis. If a clustering strategy is properly executed, it can result in clusters with the highest degree of homogeneity between members within a cluster and significant heterogeneity among members from diverse clusters.

Variable n denotes observations and an n_k number represents the number of observations that fall within the category *k*th, where $k = 1, 2, 3, \ldots, K$ and $\sum_{k=1}^{K} n_{kc}^2 = n$. Thus, n_{kc} is the number of observations with category *k*th in group *c*th, where *c*=1,2, 3, …, represents the number of formed groups. Thus, $n_c = \sum_{k=1}^{k} n_{kc}$ represents the number of observers in the group *c*th. $n_k = \sum_{c=1}^{c} n_{kc}$ is the amount of observation in the category *k*th. The number of observations could be represented by this equation (4):

$$n = \sum_{c=1}^{C} n_c = \sum_{k=1}^{K} n_k = \sum_{k=1}^{K} \sum_{c=1}^{C} n_{kc} \quad (4)$$

a. Sum Square Total (SST)

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The SST for categorical variables in data can be calculated using the (5).

$$SST = \frac{n}{2} - \frac{1}{2n}\sum_{K=1}^{K} n_{k^2} \quad (5)$$

b. Sum Square Within (SSW)
The SSW for categorical variables in data can be calculated using the (6).

$$SSW = \sum_{c=1}^{C}\left(\frac{n_c}{2} - \frac{1}{2n_c}\sum_{K=1}^{K} n_{kc^2}\right) = \frac{n}{2} - \frac{1}{2}\sum_{c=1}^{C}\frac{1}{n_c}\sum_{K=1}^{K} n_{kc^2} \quad (6)$$

c. Sum Square Between (SSB)
The SSB for categorical variables in data can be calculated using the (7).

$$SSB = \frac{1}{2}\left(\sum_{c=1}^{C}\frac{1}{n_c}\sum_{K=1}^{K} n_{kc^2}\right) - \frac{1}{2n_c}\sum_{K=1}^{K} n_{k^2} \quad (7)$$

Then, (8), (9), and (10) are utilized to calculate for the Mean Square Total (MST), Mean Square Within (MSW), and Mean Square Between (MSB), respectively.

$$MST = \frac{SST}{(n-1)} \quad (8)$$

$$MSW = \frac{SSW}{(n-C)} \quad (9)$$

$$MSB = \frac{SSB}{(C-1)} \quad (10)$$

Following, the value that are S_W (within-group standard deviation within the group) along with S_B (between-group standard deviation between groups) in categorical data may be computed by using (11), (12), and (13).

$$S_W = \left[\frac{SSW}{n-c}\right]^{\frac{1}{2}} \quad (11)$$

$$S_B = \left[\frac{SSB}{c-1}\right]^{\frac{1}{2}} \quad (12)$$

$$R^2 = \frac{SSB}{SSB+SSW} \quad (13)$$

The lower the ratio values for S_W and S_B, and greater the R^2 value more efficient the results of the clustering technique applied.

3. Results and Discussion

3.1. Descriptive Statistics

Fig. 2 displays the proportional gender distribution (boys and girls) across various diagnoses and the percentage distribution for age groups over various diagnoses. A few points could be suggested based on this descriptive data. A key point to note is that the majority of children with Attention Deficit Hyperactivity Disorder (ADHD) and autism are boys (around 71.4%), which is consistent with a few studies that have shown those conditions are most often identified among males. This indicates that there is a need for gender-specific programs in PLPDBK Semarang, especially to help the academic and social development of the boys with ADHD and autism. Furthermore, most children with different diagnoses belong to the 6 to 10-year age bracket, including speech delay, hearing impairment, cerebral palsy, intellectual disability, ADHD, and autism. The educational and therapeutic programs offered at PLPDBK Semarang tend to be targeted at students in the elementary age group. It is crucial that the school continues developing methods for teaching appropriate to age, considering the challenges that CWSN face in their development. In addition, due to the large number of adolescents, particularly those with Down syndrome and cerebral palsy, schools may have to create programs that focus on the social and life skills of students and vocational education.

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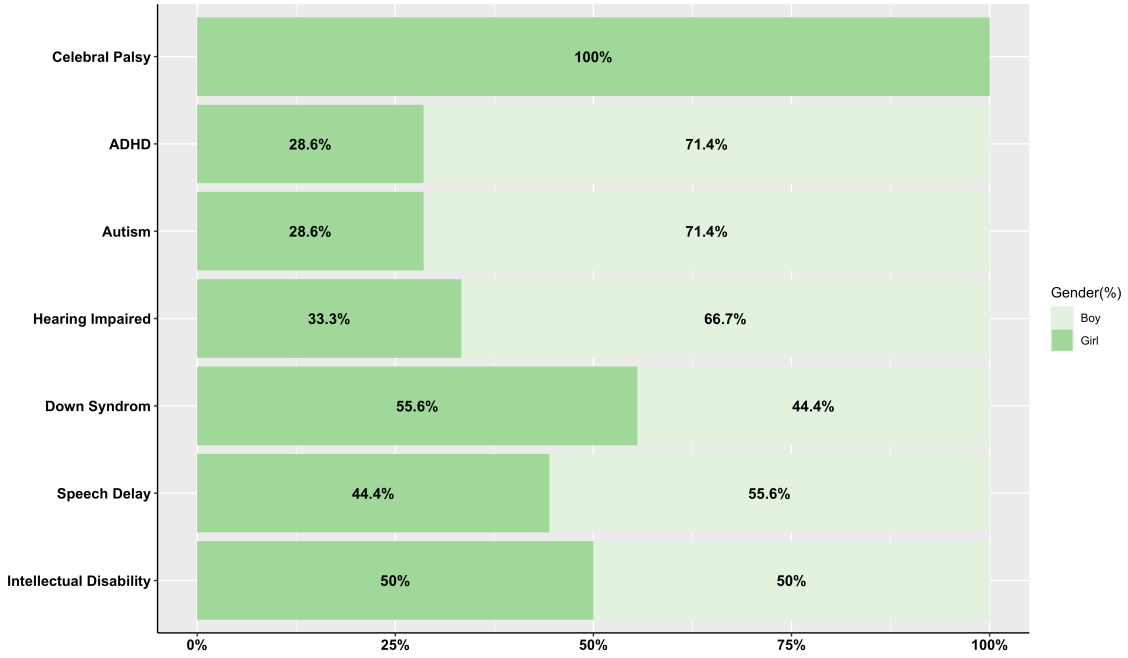
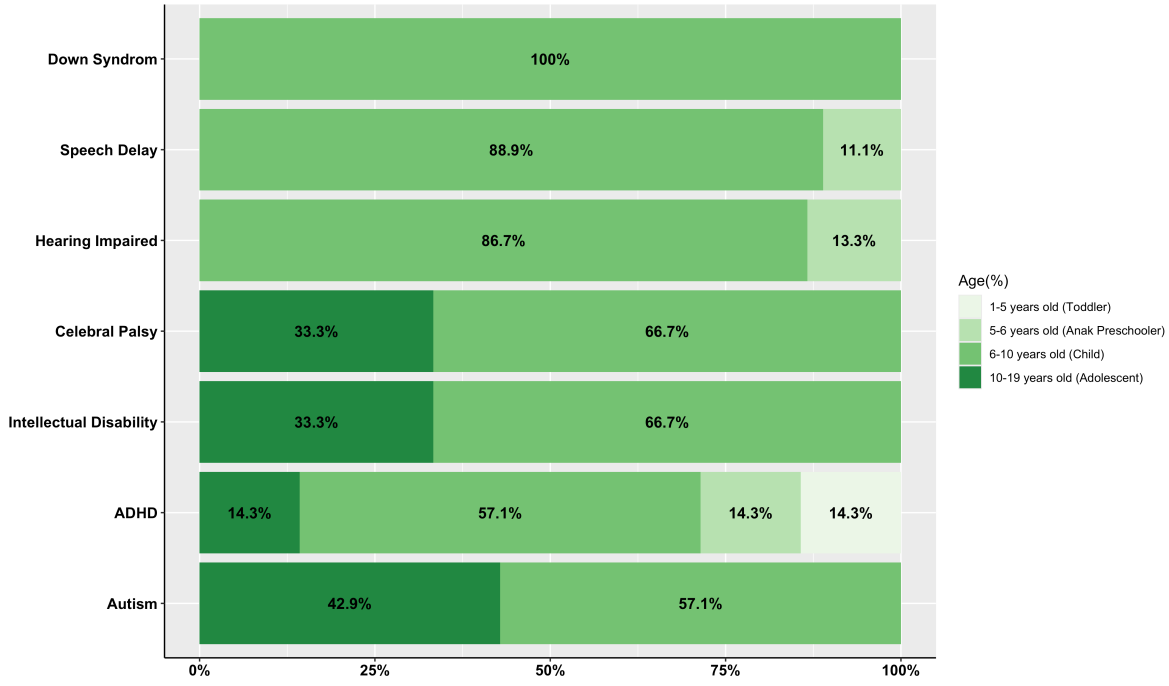


(a)



(b)

Fig. 2 Percentage distribution of diagnosis based on (a) gender and (b) age.

3.2. Clustering Analysis

The initial step of the ROCK clustering method is to treat each object as a cluster comprising a single component. Next, the inverse matrix of the object that can be used to determine the similarities between the objects must be created. The similarity matrix was calculated from 56 observed objects, which are displayed in the subsequent similarity matrix, which has a size of 56 × 56.

$$sim = \begin{bmatrix} 1 & 0.48 & 0.54 & & 0.14 & 0.61 & 0.61 \\ 0.48 & 1 & 0.64 & \cdots & 0.09 & 0.57 & 0.57 \\ 0.54 & 0.64 & 1 & & 0.06 & 0.54 & 0.54 \\ & \vdots & & \ddots & & \vdots & \\ 0.14 & 0.09 & 0.06 & & 1 & 0.04 & 0.04 \\ 0.61 & 0.57 & 0.54 & \cdots & 0.04 & 1 & 1 \\ 0.61 & 0.57 & 0.54 & & 0.04 & 1 & 1 \end{bmatrix}$$

A sim matrix can be described as a matrix that includes the similarity of any combination of objects observed. The diagonal of the matrix being an amount of one (representing the similarity from one object from its own). When determining the similarity between observation points, the next step is to establish the amount of θ that is the threshold used to identify neighbors. The information about the relation between objects observed is represented in matrix A. The matrix A measures 56 × 56 matrix, which has a value of 1 when the objects are neighboring or 0 if they are not neighbors.

$$A = \begin{bmatrix} 1 & 1 & 1 & & 0 & 1 & 1 \\ 1 & 1 & 1 & \cdots & 0 & 1 & 1 \\ 1 & 1 & 1 & & 0 & 1 & 1 \\ & \vdots & & \ddots & & \vdots & \\ 0 & 0 & 0 & & 1 & 0 & 0 \\ 1 & 1 & 1 & \cdots & 0 & 1 & 1 \\ 1 & 1 & 1 & & 0 & 1 & 1 \end{bmatrix}$$

In this case, the similarity between initial and second one was 0.54. Based on a value of θ = 0.23, both observations are neighbors. Therefore, the matrix A located in the third column and the column in the top row has an amount of 1.

Once the neighbor value for all possible combinations of observations, the next procedure was to determine the link count. Calculating the number of links was shown in a 56 × 56 matrix. As an example, the number on the third row and the column that is the initial row on the link matrix shows that the total number of links between the initial and second observation is 38.

$$link = \begin{bmatrix} 40 & 38 & 38 & & 11 & 38 & 38 \\ 38 & 42 & 41 & \cdots & 10 & 40 & 40 \\ 38 & 41 & 43 & & 9 & 39 & 39 \\ & \vdots & & \ddots & & \vdots & \\ 11 & 10 & 9 & & 22 & 11 & 11 \\ 38 & 40 & 39 & \cdots & 11 & 42 & 42 \\ 38 & 40 & 39 & & 11 & 42 & 42 \end{bmatrix}$$

In this study, various numbers of θ were utilized, including 0.01, 0.05, 0.07, 0.10, 0.15, 0.20, 0.21, 0.22, 0.23, 0.24, 0.25, 0.26, 0.27, 0.30, 0.35, 0.40, and 0.45. The values were determined by the researcher and were modified based on the similarity between observed objects and the expected result of the clustering. The expected results were group of objects that did not belong to a single group and there were none of the clusters containing one member. The verification of the highest (optimal) number of clusters could be determined by the ratio of S_W/S_B, which is the lowest, and by the highest R^2 number in one of the θ values. The initial findings revealed that optimal clustering was usually found between 3 and 5 clusters, researchers did not extend the spectrum of numbers of clusters. The S_W/S_B results and R^2 calculations for every θ are presented in Table 2.

Table 2. S_W/S_B and R^2 Values Based on the Cluster Size

Threshold (θ)	Cluster Size	S_W/S_B Ratio	R^2
0.01	3	0.15579194	0.6085742
0.05	3	0.06713019	0.8933188
0.07	3	0.05052305	0.9366424
0.10	3	0.04827645	0.9418313
0.15	3	0.04652191	0.9457574

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0.20	4	0.11995128	0.8003859
0.21	4	0.06689184	0.9280240
0.22	4	0.05152766	0.9560031
0.23	**4**	**0.03950447**	**0.9736620**
0.24	4	0.04760733	0.9621997
0.25	5	0.06223837	0.9529358
0.26	5	0.06373024	0.9507649
0.27	4	0.05783844	0.9451930
0.30	4	0.04284289	0.9691655
0.35	5	0.04613286	0.9735818
0.40	4	0.06106156	0.9392956
0.45	4	0.07450681	0.9122241

Table 2 shows that the threshold (θ) of 0.23 had the lowest S_W/S_B ratio of 0.03950447 and the highest R^2 value of 0.9736620 (97%) when compared with other threshold values. Thus, it can be concluded that the most optimal or best number of clusters can be created by when using this threshold (θ) value of 0.23 which results in four clusters.

As shown in Fig. 3, cluster 1 (cyan) comprises 9 CWSN, cluster 2 (yellow) comprises 10 CWSN, cluster 3 (red) comprises 15 CWSN, and cluster (blue) comprises 22 CWSN. Cluster 2 and cluster 4 exhibited a large overlap, especially within the middle of the axioms. This implies that the areas in both clusters might be similar in their characteristics. Cluster 1 and cluster 3 contained smaller circles, suggesting that members of these clusters are less homogeneous or similar.

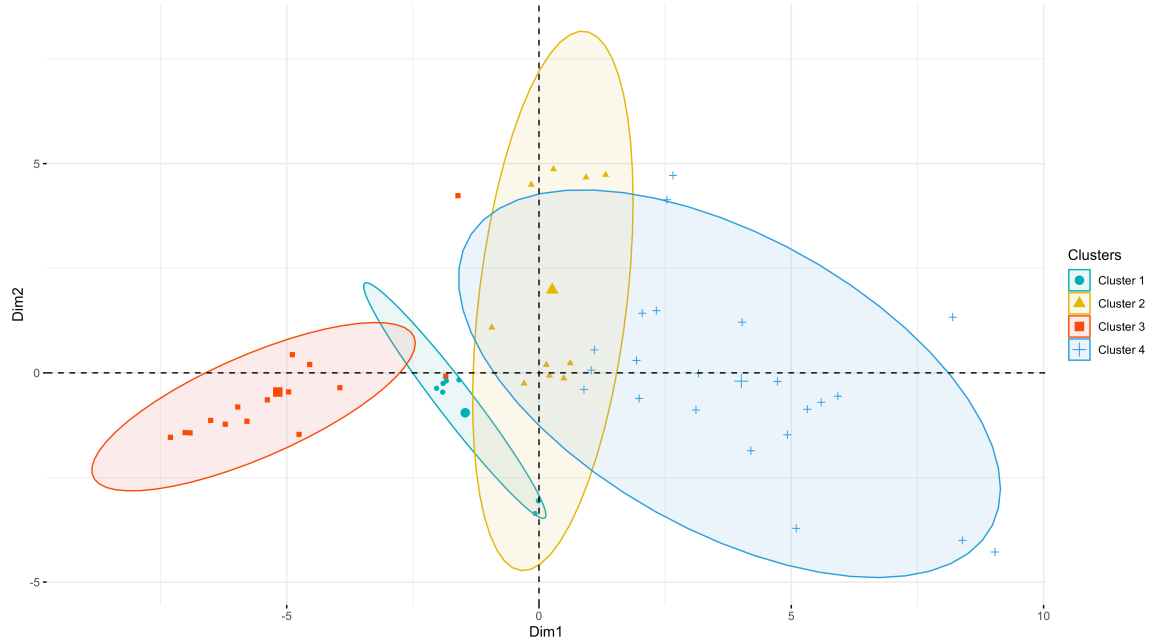

Fig. 3 Distribution of CWSN per cluster.

Fig. 4 illustrates the pattern of CWSN in each cluster, depending on age, gender, diagnosis, and educational background of therapists (educational). Based on Fig. 4, the 6–10-year-old age group (child) is the most dominant throughout all clusters, but particularly those in clusters 1, 3, and 4. The diagnosis of hearing impairment was the most prevalent diagnosis for clusters 1 and 3. Meanwhile, cerebral palsy and Down syndrome were prominent among cluster 4. The focus of the intervention provided through PLPDBK Semarang should be focused on children aged between 6 and 10 years. This group is the largest age group, particularly children with hearing impairments and cerebral palsy.

The experience and education of therapists play a critical influence on the nature of therapy. Therapists with a management background typically oversee the programs of CWSN within certain

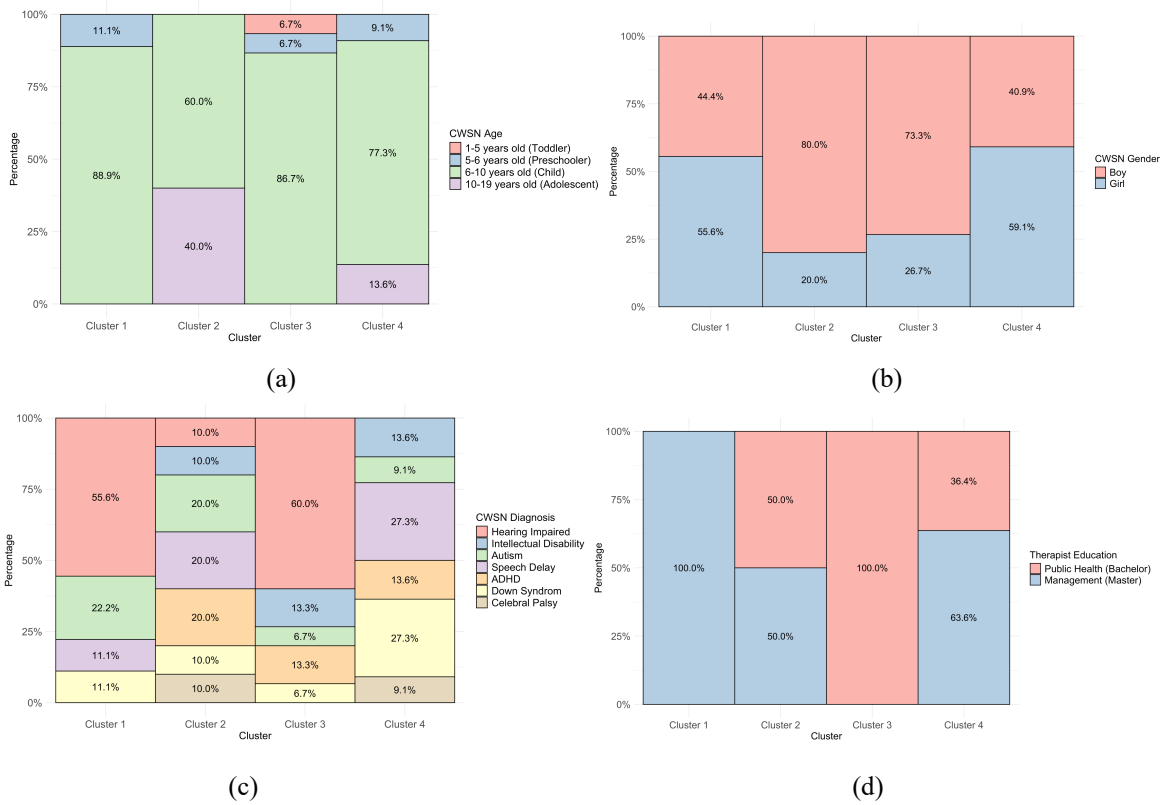

Fig. 4 Percentage distribution of clusters based on (a) age, (b) gender, (c) diagnosis, and (d) educational background.

groups, specifically clusters 1 and 4. While those who have an education in public health may concentrate more on a holistic wellbeing approach. Regarding gender, boys tended to be more prominent in the clusters 2 and 3. Meanwhile, clusters 1, 2 and 4 had a balanced mix with a slightly higher proportions of girls. The disparity in gender representation within specific clusters is a call for interventions that are gender sensitive, specifically to meet the specific needs of girls and boys within the various clusters.

Table 3 and Fig. 5 present the summary of characteristics or profiles of each cluster resulting from ROCK clustering, used to assess the behavioral development of CWSN (behavior), social interaction of CWSN (interaction), fine motor skills development of CWSN (finemotor), and cognitive development of CWSN (cognitive) between the 1st and 8th meetings. The profile of each cluster was also compared with the object profile, namely all CWSN of PLPDBK Semarang. Each assessment was measured using the following scale: 1 = very poor, 2 = poor, 3 = fair, 4 = good, and 5 = very good. The values shown in the table represent the mode of each column, providing an overview of the most frequently assigned rating for each aspect of the child's development in the respective cluster.

Table 3. Comparison of the Profile of Each Cluster and Every Object

Variable	All CWSN	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Behavior (1st meeting)	4	4	4	4	3
Behavior (2nd meeting)	4	4	4	5	3
Behavior (3rd meeting)	4	4	4	4	4
Behavior (4th meeting)	4	4	4	4	4
Behavior (5th meeting)	4	4	4	4	3
Behavior (6th meeting)	4	4	4	4	3

Variable	All CWSN	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Behavior (7th meeting)	4	4	4	5	3
Behavior (8th meeting)	4	4	4	5	3
Interaction (1st meeting)	4	4	4	4	4
Interaction (2nd meeting)	4	4	4	5	4
Interaction (3rd meeting)	4	4	4	5	4
Interaction (4th meeting)	4	4	4	5	3
Interaction (5th meeting)	4	4	4	5	3
Interaction (6th meeting)	4	4	4	5	3
Interaction (7th meeting)	4	4	4	5	3
Interaction (8th meeting)	4	4	4	5	3
Finemotor (1st meeting)	4	4	4	4	3
Finemotor (2nd meeting)	4	4	4	5	4
Finemotor (3rd meeting)	4	4	4	5	3
Finemotor (4th meeting)	4	4	4	5	3
Finemotor (5th meeting)	3	4	3	5	3
Finemotor (6th meeting)	3	4	3	5	3
Finemotor (7th meeting)	3	4	3	5	3
Finemotor (8th meeting)	4	4	3	5	3
Cognitive (1st meeting)	4	4	4	4	3
Cognitive (2nd meeting)	4	4	4	4	4
Cognitive (3rd meeting)	4	4	4	4	3
Cognitive (4th meeting)	4	4	4	4	3
Cognitive (5th meeting)	4	4	4	4	3
Cognitive (6th meeting)	4	4	4	4	3
Cognitive (7th meeting)	3	4	3	5	3
Cognitive (8th meeting)	4	4	3	5	3

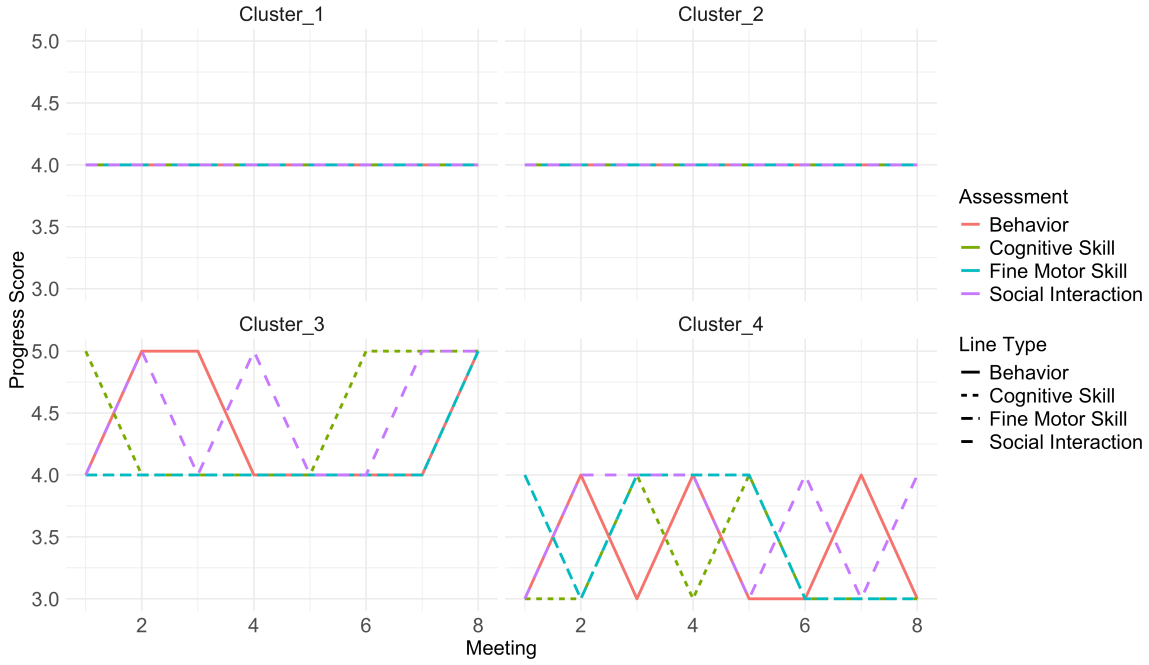

Fig. 5 CWSN progress from meeting 1 to 8.

Based on the Table 3 and Fig. 5, cluster 3 shows the best results. There was improvement in every aspect (behavior, social interaction, fine motor skills, and cognitive skills) particularly between the second and the eighth meeting. The programs offered to cluster 3 proved to be more efficient in helping the development of children. Cluster 1 and cluster 2 have shown steady progress across all areas, and consistently high scores during the meeting. Even though there were no notable

improvements in the behavior of other areas, the constant results of food (4) indicated that the majority of CWSN of these clusters may be considered to have high skills. Cluster 4 needs more focus, especially regarding the areas of fine motor skills, cognitive skills, and behavior. This is because this cluster has less results and less progress compared with other clusters.

In general, the division of CWSN by nine variables that define the child can be summarized by Table 4.

Table 4. Comparison of the Profile for Each Cluster, Including All Objects

Cluster	Characteristics of CWSN at PL PDBK Semarang	Number of Members
Cluster 1	The majority of CWSN are aged 6-10 years (child), more than half are female, the majority are diagnosed with Hearing Impaired followed by Autism. All CWSN are handled by therapists with an educational background in Master of Management, and the majority of CWSN show stability with a score of 4 or "Good" category in each meeting for all assessment aspects (behavior, interaction, fine motor, cognitive).	9
Cluster 2	60% of CWSN are aged 6-10 years (child), while the rest are CWSN aged 10–19 years (adolescents). The majority are boys. All diagnoses of CWSN fall within this cluster, with the most dominant being autism, speech delay, and ADHD. Some CWSN are handled by therapists with a Master of Management, while others are treated by graduates with a degree in Public Health. Most CWSN showed stability with a score of 4 or in the "Good" category during each session for the behavior and interaction aspects. However, for the fine motor and cognitive aspects, there was fluctuation, with a decrease to a score of 3 or in the "fairly good" category from the fifth to the eighth session, after previously being in the "good" category.	10
Cluster 3	The majority of CWSN are aged 6–10 years (child), with 13.4% of CWSN are aged between 1 to 6 years (toddler and preschooler). The majority are boys. All diagnoses of CWSN were within this cluster except for speech delay and cerebral palsy. The most dominant condition was hearing impairment (60%), followed by intellectual disability and ADHD. All CWSN are treated by therapists with a background in Public Health. Most CWSN showed fluctuating improvement in their assessment results, reaching a score of 5 or the "very good" category in the final meetings, such as the fifth, sixth, seventh, and eighth meetings, compared to earlier ones. This applies to all assessment aspects (behavior, interaction, fine motor skills, cognitive skills).	15
Cluster 4	The majority of CWSN are aged 6–10 years (child), followed by those aged 10–19 years (adolescent). More than half are girls, while 40.9% are boys. All CWSN diagnoses were included in this cluster except for hearing impaired. The most prevalent conditions were speech delay and Down syndrome. A total of 63.6% of CWSN are treated by therapists with an educational background in Master of Management. Most CWSN showed fluctuating downward progress in their assessment results during the initial meets for all assessment aspects (behavior, interaction, fine motor, cognitive), dropping from a score of 4 (categorized as "good") to a score of 3 or "fair." After that, from the next meet until the eighth meet, the scores tend to stabilize at 3 ("fair").	22

4. Conclusion

Based on the ROCK clustering study of CWSN in PLPDBK Semarang, four ideal clusters were identified using the threshold (θ) of 0.23. A threshold value of 0.23 was the lowest ratio of S_W/S_B at 0.03950447, which was 3.95%, and the largest R^2 ratio of 97.37% compared to other thresholds. The total number of participants in cluster 1 was 9 CWSN, cluster 2 was 10 CWSN, cluster 3 was 15 CWSN, and cluster 4 was 22 CWSN. The vast majority of across all clusters reside between the ages of 6–10. This indicates that this is crucial for the growth of children who have special needs. The right interventions could result in dramatic improvement in interactions with others and fine motor abilities and cognition.

Overall, the results from clustering demonstrate stability to be the most frequently achieved goal. However, there are also opportunities to develop further in a few clusters. PLPDBK Semarang can utilize the stability to serve as a base to boost the intensity of the therapy programs and implement more sophisticated therapies to ensure that children are able to reach their goal of being in the "very good" development category.

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