The International Conference on Natural Sciences, Mathematics, Application, and Technology (ICON-SMART) Proceedings
e-ISSN: 2963-3915

Vol. 2, December 2022
pp. 18-22

Characteristics of Education in Central Kalimantan Using Biplot Analysis

Fernando Dorothius Pongoh[1, a)]

[1]*Faculty of Teacher Training and Christian Education, IAKN Palangka Raya, Indonesia*

[a)] Corresponding author: fernando.pongoh@gmail.com

Abstract. Education is a conscious and planned effort to realize the learning atmosphere and learning process so that students actively develop their potential to have religious spiritual power, self-control, personality, intelligence, noble morals, as well as the necessary skills for themselves, society, nation, and state. The components of education are students, education personnel, educators, and the implementation place of the education. This research purposed to describe the mapping characteristics of the number of students (X1), the number of employees (X2), the number of teachers (X3), and the number of schools (X4) senior high schools in Central Kalimantan. The data used is the main data of education (data pokok pendidikan) from the Ministry of Education and Culture (KEMDIKBUD) for the 2021/2022 school year from 14 regencies/municipalities in Central Kalimantan Province. Biplot analysis of the main components is used to describe the data contained in the summary table into a two-dimensional graph. The results of the analysis 1) All variables have almost the same variances; 2) The number of students (X1) and the number of teachers (X2) have the closest positive correlation; 3) Palangka Raya city, East Kotawaringin Regency and Kapuas regency have the highest scores for the number of students (X1), the number of employees (X2), and the number of teachers (X3).

Keywords: Biplot analysis; education characteristics; Central Kalimantan.

INTRODUCTION

Education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual power, self-control, personality, intelligence, noble character, as well as the necessary skills for themselves, society, nation, and state. The components of the implementation of education are students, education staff, educators, and the place of implementation of the education.

Mapping high schools in South Minahasa Regency based on content standards, educators and education staff standards, graduated competency standards, and educational assessment standards using biplot analysis shows that SMAN 1 Tareran has an advantage in graduated competency standards and SMAN 1 Amurang has advantages in educators and education staff standards. Meanwhile, Suluun Christian High School and SMAN 1 Tatapaan have advantages in educational assessment standards [1]. Graduated competency standards, processes, education financing, and educational assessment of SMA and SMK mapped using biplot analysis in Southeast Minahasa Regency show that SMKN 1 Ratahan has advantages in process standards [2].

Biplot analysis was also used for mapping SD in Southeast Minahasa Regency based on indicators of national education standards, obtained by SD GMIM Ratahan to have the highest scores on graduated competency standards, content standards, and management standards. SDN 1 Mundung has the highest score on the content standard. SDN 2 Liwutung has the highest score on educators and education staff standards. Meanwhile, SDN 1 Tababo, SD GMIM Bunag, SDN 1 Tondanouw, and SDN 1 Tombatu have the highest scores for process standards, facilities, and infrastructure standards, education financing standards, and education assessment standards, respectively [3].

Central Kalimantan Province is the second largest province in Indonesia after Papua Province with an area of 153,564 Km². Central Kalimantan has 13 regencies and 1 city, with the provincial capital in Palangka Raya City [4]. The number of high school students in the 2021/2022 school year is 59,549 students while the number of teachers is 4,855 [5]. The mapping picture of the number of students and the number of teachers by regencies/ municipalities in Central Kalimantan has not been well published.

Biplot analysis is one of the multivariate analyses that can present simultaneously in the form of two-dimensional images of observed variables and regency/municipality. With Biplot analysis we can find out the description of each regency/municipality based on the observed variables.

Therefore, this research aims to describe the mapping of the characteristics of the number of students (X1), the number of employees (X2), the number of teachers (X3), and the number of schools (X4) of SMA in Central Kalimantan using biplot analysis.

METHODOLOGY

The data used is the main education data of the Ministry of Education and Culture (KEMDIKBUD) for the 2021/2022 school year from 14 regencies/municipalities in Central Kalimantan Province [5]. With the variables is,

X1: Number of students,
X2: Number of employees,
X3: Number of teachers, and
X4: Number of schools.

Fourteen regencies/municipalities in Central Kalimantan Province are,

1. Barito Selatan
2. Barito Timur
3. Barito Utara
4. Gunung Mas
5. Kapuas
6. Katingan
7. Kotawaringin Barat
8. Kotawaringin Timur
9. Lamandau
10. Murung Raya
11. Pulang Pisau
12. Seruyan
13. Sukamara
14. Palangka Raya

Data analysis in this research used descriptive statistical analysis and biplot analysis. Descriptive statistical analysis is an analysis to explain or describe the variables with the measures of center and measures of variation in the tables or graphs.

Biplots similarly provide plots of the n observations, but simultaneously they give plots of the relative positions of the p variables in two dimensions. Four important things can be obtained from biplot analysis, namely

1. Variances of the observed variables, used to see if there are any variables that have almost the same variance for each object. In biplots, variables that have a small variance are described as short vectors while variables with large variance are described as long vectors.
2. Correlation between variables is used to know how one variable affects another. Two variables that have a positive correlation will be described as two lines forming a narrow-angle (taper). Meanwhile, two changes that have a negative correlation will be described as two lines forming a wide angle (obtuse). Meanwhile, two uncorrelated variables will be described as two lines with an angle close to 90^0.
3. The variable values of an object, are used to see the advantages of each object. An object located in the direction of the variable vector is said to be that the object has a value above the average. But if the object is located in the opposite direction of the variable vector, then the object has a value below the mean. While an object that is almost in the middle means that the object has a value close to the average.
4. Proximity between observed objects, to find objects that are similar to other objects.

The plots are based on the singular value decomposition (SVD). This states that the ($n \times p$) matrix X of n observations on p variables measured about their sample means can be written

$$\mathbf{X} = \mathbf{U}\,\mathbf{L}\,\mathbf{A}'$$

where **U**, **A** are ($n \times r$), ($p \times r$) matrices respectively, each with orthonormal columns, **L** is an ($r \times r$) diagonal matrix with elements $l_1^{1/2} \geq l_2^{1/2} \geq \cdots l_r^{1/2}$, and r is the rank of **X**.
let $\mathbf{G} = \mathbf{U}\,\mathbf{L}^{\alpha}$, $\mathbf{H}' = \mathbf{L}^{1-\alpha}\,\mathbf{A}'$. Then

$$\mathbf{G}\,\mathbf{H}' = \mathbf{U}\,\mathbf{L}^{\alpha}\,\mathrm{L}^{1-\alpha}\,\mathbf{A}' = \mathbf{U}\,\mathbf{L}\,\mathbf{A}' = \mathbf{X}$$

and the (i, j)th element of **X** can be written

$$x_{ij} = g'_i\, h'_j$$

where g'_i, $i = 1,2,\ldots,n$ and h'_j , $j = 1,2,\ldots,p$ are the rows of **G** and **H**, respectively.

If $\alpha = 0$, then **G** = **U** and **H**' = **L** **A**' or **H** = **A** **L**.

Turning to the biplot with $\alpha = 1$, the properties relating to g_i and h_j separately are different from those for $\alpha = 0$. With $\alpha = 1$ we have

$$\mathbf{G} = \mathbf{U}\,\mathbf{L} \text{ and } \mathbf{H}' = \mathbf{A}' \quad [6]$$

RESULTS AND DISCUSSIONS

Descriptive Statistics

Descriptive statistics based on data from 14 regencies/municipalities in Central Kalimantan Province are sown in Table 1. The least number of students (X1) is 1232 students and at most 8420 students with a standard deviation score of 2070. The number of employees (X2) has the lowest value of 16 employees while the highest is 136 employees, with a standard deviation value of 36.95. The least number of teachers (X3) is 131 and 727 teachers in one district/city, with a standard deviation of 148.10. As for the lowest number of schools (X4), it is 5 schools and the highest is 27 schools, with a standard deviation score of 6.70.

Table 1. Descriptive statistics of the variables

Variable	Count	Mean	StDev	Min	Median	Max
Num of students	14	4254.00	2070.00	1232	3934.00	8420
Num of employees	14	72.29	36.95	16	67.50	136
Num of teachers	14	346.80	148.10	131	333.50	727
Num of schools	14	17.36	6.70	5	17.00	27

Based on Figure 1, Palangka Raya city has the highest value on both the variables number of students (X1), number of employees (X2), number of teachers (X3), and also number of schools (X4). Kotawaringin Timur Regency also has an above-average value on the variables. Kapuas Regency only has above-average values on the variables number of students (X1), number of employees (X2), and number of teachers (X3). The southern barito district has above average values on the variable number of employees (X2) and number of schools (X4).

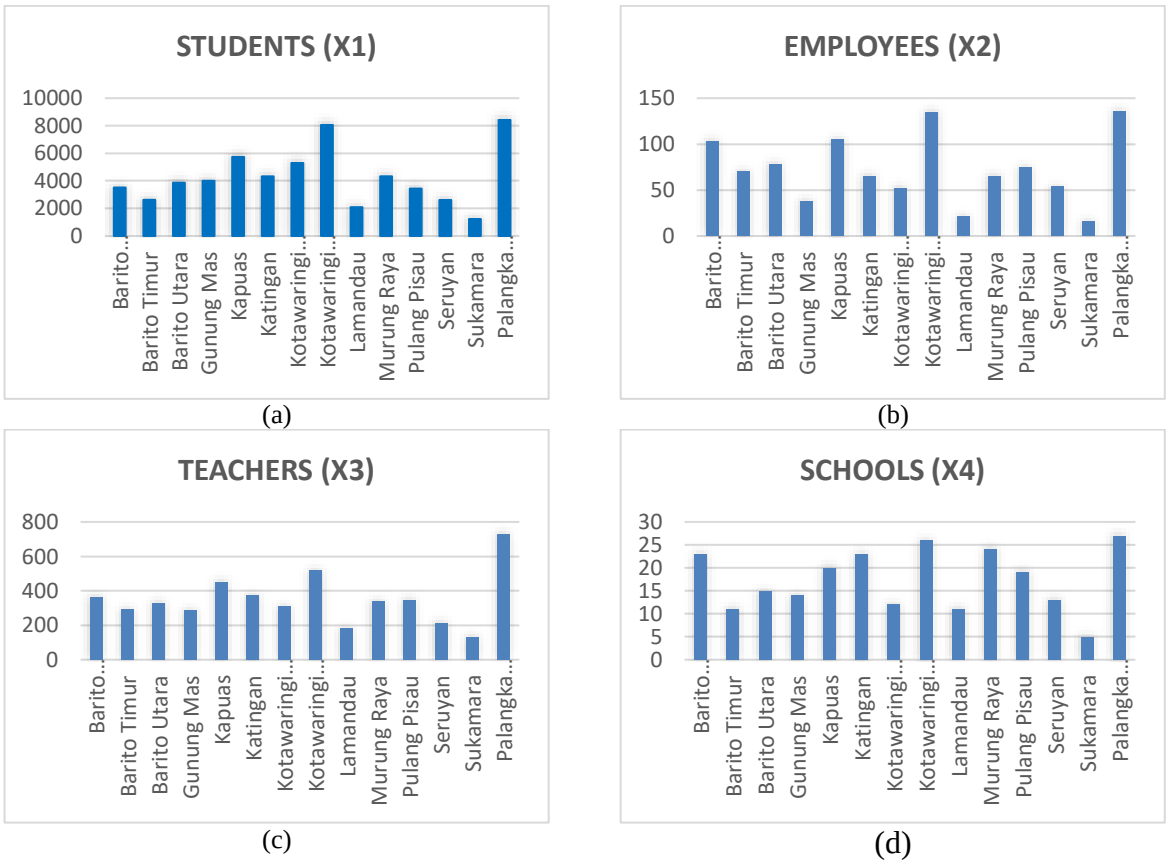

FIGURE 1. Graph of Number of students (a); Number of employees (b); Number of teachers (c), and Number of schools (d)

Biplot Analysis

The results of the biplot analysis are shown in Fig. 2. Based on this analysis, the variances of the number of students (X1), number of employees (X2), number of teachers (X3), and number of schools (X4) has almost the same value, this is indicated by similar vector lengths.

The number of students (X1), number of employees (X2), number of teachers (X3), and number of schools (X4) have a positive correlation relationship indicated by the formation of a taper angle between each variable. The variable number of students (X1) and the number of teachers (X3) have the closest correlation values.

The city of Palangka Raya, East Kotawaringin Regency has above-average scores for the number of students (X1), the number of employees (X2), the number of teachers (X3), and the number of schools (X4). Meanwhile, Sukamara Regency, Lamandau Regency, Seruyan Regency, East Barito Regency, Gunung mas regency, and Northern Barito Regency have similar characteristics where they have values below the average on all these variables. As for South Barito Regency, Murung Raya Regency, Katingan Regency, and Pulang Pisau Regency have characteristics similar to the variable number of schools (X4).

Palangka Raya City, East Kotawaringin Regency, and Kapuas Regency have the highest scores for the number of students (X1), the number of employees (X2), and the number of teachers (X3). The lowest score for the number of students (X1), the number of employees (X2), the number of teachers (X3), and number of schools (X4) are Sukamara regency and Lamandau Regency.

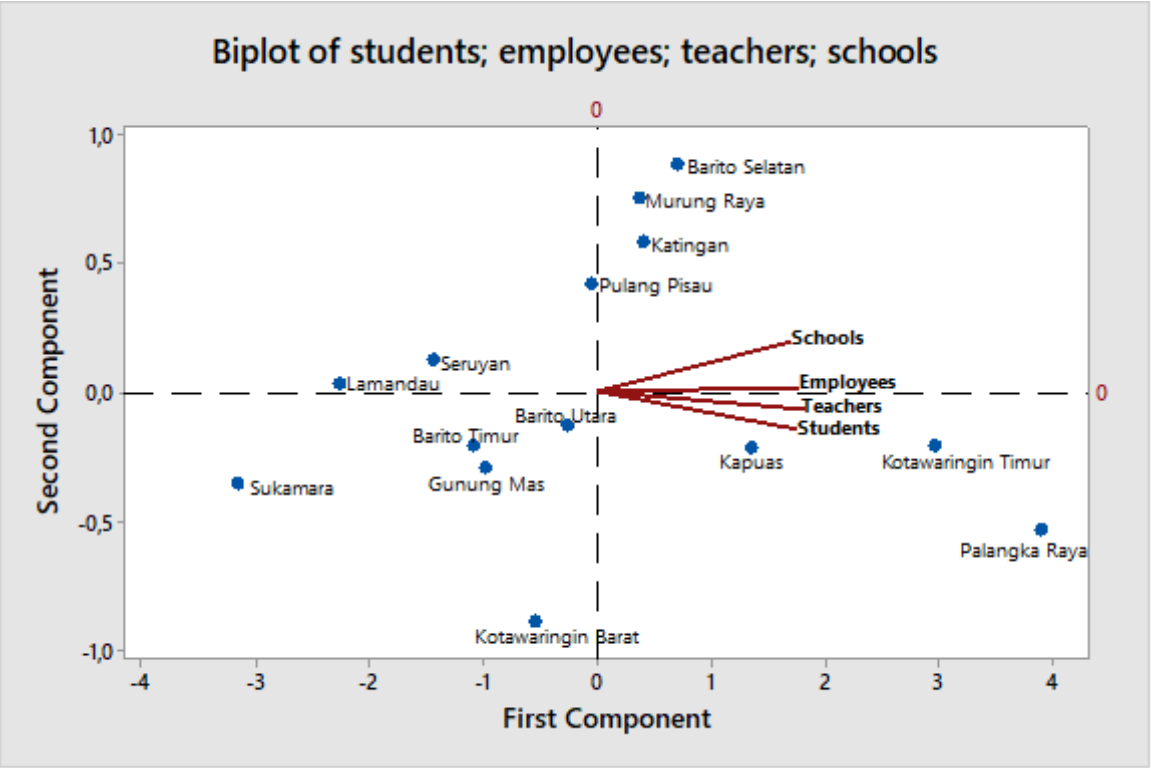

FIGURE 2. Biplot of students; employees; teachers; schools

CONCLUSION

The results of the analysis 1) All variables have almost the same variances; 2) The number of students (X1) and the number of teachers (X2) have the closest positive correlation; 3) Palangka Raya city, East Kotawaringin Regency and Kapuas regency have the highest scores for the number of students (X1), number of employees (X2), and the number of teachers (X3).

REFERENCES

1. Y.A. Taogan, M. Paendong, and C. Mongi, d'Cartesian: Jurnal Matematika dan Aplikasi, **5**(1), 13-20 (2016)
2. M.Z. Sepang, D. Hatidja, and Y. Langi, d'Cartesian: Jurnal Matematika dan Aplikasi, **4**(2), 210-217 (2015)
3. D. Hatidja, and L.I. Momuat, d'Cartesian: Jurnal Matematika dan Aplikasi, **6**(2), 96-108 (2017)
4. BPS-Statistics of Kalimantan Tengah Province. Kalimantan Tengah Province in Figures 2022
5. Direktorat Jenderal Pendidikan Anak Usia Dini, Pendidikan Dasar dan Pendidikan Menengah. Kementerian Pendidikan, Kebudayaan, Riset dan Teknologi. Data Pokok Pendidikan (2022)
6. Jollife, I.T. *Principle Component Analysis*. (Springer Verlag, New York, 1986)