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Statistical Analysis of the Indicators for the Education of Provinces in Turkey

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Abstract. Education is a phenomenon of great individual and social importance along with the changing and developing conditions in the world, and is a very significant concept for the society. This study aimed to examine the provinces in Turkey in terms of education statistics. For this purpose, the data on education indicators related to 81 provinces were obtained from the Ministry of National Education Formal Education Statistics and TURKSTAT for the years 2020-2021. In the study, clustering analysis was applied to determine the similarities of provinces in Turkey in terms of education statistics. Then, a factor analysis was performed to rank the provinces in terms of these statistics. In the clustering analysis, non-hierarchical (k-means clustering technique) and progressive (intra- and inter-group linkage clustering techniques) clustering techniques were used, considering the number of clusters as 3, 4 and 5. Then the provinces were clustered. In the factor analysis, three factors were determined, and factor scores were calculated for the provinces according to these factors. According to the first factor scores, Şanlıurfa and Istanbul were the provinces farthest from each other. In terms of the second factor scores, Bolu and Şanlıurfa were the provinces farthest from each other. Finally, in terms of the third factor scores, Tekirdağ and Ağrı were the provinces farthest from each other.

Keywords. Education statistics, cluster analysis, provinces of Turkey.

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Today, education is a very important concept for individuals and societies due to changing and developing conditions in the world. Thanks to education, individuals become more qualified, thus societies become stronger in sociological, economic and cultural areas. Education facilitates the production of information and technology to create a better qualified workforce required for economic and social needs, to develop the society, to use existing resources more effectively, and thus to create a healthy and productive society. Education is defined as developing one's both physical and mental abilities, allowing them to learn social rules and adapt these rules into their life. In other words, education refers to the use of tools to ensure one's growth and development. Durkheim defines education as an action applied to individuals who are not ready for social life (Gül, 2004).

Education refers to a process, a social phenomenon, a system, or a means of socialization, and contributes to economic growth/development by improving qualified workforce equipped with relevant knowledge and skills for industry and service sectors and increasing individual productivity (Olçay, 2008). Education has several social benefits by decreasing crime rates, raising democracy and active participation in governmental administration, protecting individual health, and increasing individual earnings. Thanks to these features, education is also beneficial to the society, decreasing the cost of public welfare (Taş and Yenilmez 2008).

This study used clustering analysis to cluster the provinces in Turkey in terms of education indicators, and benefited from factor analysis to rank them. Accordingly, the study aimed to reveal the similarities of provinces in terms of education indicators. It consisted of literature review, statistical analysis, results and discussion.

Cengiz and Öztürk (2012) used clustering analysis to determine the similarities of provinces in Turkey in terms of education indicators, and gathered them in six clusters. The first cluster included a total of 51 provinces (mostly metropolitan provinces). The rates of postgraduate and doctorate graduates in these provinces were effective for them to be included in this cluster. The second cluster included Çanakkale, Çankırı, İzmir, Kastamonu, Kütahya, Rize, Aksaray and Batman. The third cluster contained Artvin, Niğde, Denizli and Sinop. The fourth and fifth clusters grouped provinces in the Southeastern Anatolia. The sixth cluster included Ankara, Elazığ, Erzincan, Mersin, Kocaeli, and Sivas. Ar et al. (2016) determined the changes in educational performances at secondary education between 2007 and 2011 for 18 provinces in the Black Sea Region by using the Malmquist-TFV index method. The authors found that educational performance increased by an annual average

of 4.4% as of the examined period, suggesting that the source of this increase was technological development.

Karataş Acer and Güçlü (2016) examined the structural forms of Turkish state universities to establish an organizational model according to perceptions of academic staff, using factor analysis, incremental clustering analysis and multidimensional scaling analysis. The authors determined that although the number of universities increased, the quality of university education did not increase accordingly.

Aksu and Güzeller (2016) classified successful and unsuccessful students in terms of mathematical literacy according to the variables of academic interest, attitude, motivation, perception, self-efficacy, anxiety and study discipline, and determined the effects of these variables on student classification. The sample of their study included students who participated in the Program for International Student Assessment (PISA) in Turkey, and the data were collected from a total of 1391 students aged 15 years and analyzed by data mining and CHAID analysis, a decision tree technique.

Erdoğmuş and Esen (2016) conducted a study to classify universities in Turkey in terms of institutional size and performance, and clustered universities using the gradual clustering technique. Their variables were ranking scores and measures of teaching and research quality of each university. According to their cluster analysis results, institutional size and performance were the variables with better results.

Allahverdi et al. (2021) used multidimensional scaling and clustering analysis to determine the distribution, similarities and differences of functional public expenditure data on provinces in Turkey between 2009 and 2019. The authors determined that per capita educational expenditures differed by province, where the provinces of Tunceli and Ankara formed a cluster on their own.

There are several studies conducted to compare the provinces in Turkey in terms of socio-economic, health, etc. indicators (Alpaykut, 2017; Alptekin, 2017; Çelik, 2013; Çetin & Sevüktekin, 2016; Doğrul & Çelikkol, 2017; Gençoğlu, 2018; Özceylan & Coşkun, 2012; Sakarya & İbişoğlu, 2015; Saraç & Özarı & Eren, 2018; Servi and Erisoglu, 2020). There are also several studies comparing educational indicators in Turkey and other countries (Akın & Eren, 2012; Koşar Taş & Örk Özel, 2017; Uyğun & Yarımoğlu, 2019) and conducted on education data of other countries (Draper & Gittoes, 2004).

Method

This study aimed to determine the similarities and differences between 81 provinces in Turkey in terms of education statistics by cluster analysis and to rank them by factor analysis.

Data Collection Tools

The data on education statistics related to 81 provinces were taken from TURKSTAT and the Ministry of National Education Formal Education Statistics for the year 2020-2021.

Data Analysis

The variables examined in the study

X1: Primary and secondary school_ Number of students per classroom

X2: Primary school_Enrollment rate for 2012 and later-net (%)

X3: Primary school_Number of students per teacher

X4: Primary education (primary school + secondary school)_enrollment rate for 2012 and later-net (%) (%)

X5: Literacy rate (%)

X6: Secondary school_Enrollment rate for 2012 and later-net (%)

X7: Secondary school_Number of students per teacher

X8: Secondary education _Number of students per classroom

X9: Secondary education_Enrollment rate for 2012 and later-net (%)

X10: Secondary education_Number of students per teacher

Results

Cluster Analysis

Cluster analysis is a multivariate statistical analysis technique where the number of clusters is not known and is frequently used to classify raw data according to the most similar aspects to each other. Cluster analysis is used to collect similar (in terms of distance and correlation) units in the same clusters, leading to data reduction (Tatlıdil, 2002).

The purposes of using cluster analysis are as follows:

- To cluster n observations (units, individuals, objects) into homogeneous subgroups (those similar to each other) in terms of features determined in terms of p variables to be used in the analysis,
- To collect n units in subsets with common features according to p variables by examining units and variables together,
- To classify units in terms of their values according to p variables.

A cluster refers to a group of units that are close to each other (most similar) in multidimensional space. Thus, the concept of cluster is associated with the concepts of "similarity" and "distance".

After collecting data, the assignment of units or objects to clusters is performed using the distance values of observations from each other. In clustering methods, distance matrix or similarity matrix is used. Thus, units or variables form homogeneous clusters within themselves. In general, Hierarchical and Non-Hierarchical Clustering Methods are used to determine clusters while ensuring that units or variables are clustered in appropriate groups (Zırhlıoğlu & Karaca, 2006). In progressive clustering methods, the number of clusters is determined without prior knowledge of how many clusters the units in the data set will be divided into. In the non-staged method, the number of clusters is determined at the beginning of the analysis and the analysis continues (Alpar, 2011; Akın & Eren, 2012; Tatlıdil, 2002).

Factor Analysis

Factor analysis aims to determine fewer and new unrelated variables (factors) by using p variables related to each other and to reduce dimensions and eliminate dependency structures (Sharma, 1996; Tatlıdil, 2002). First, the raw data matrix (Xpxn) is standardized, and the standard data matrix (Zpxn) is used. The linear additive model, which is obtained jointly with Zj variables, is called the factor and shows the relationship between the given variables, is expressed in Equation 1.

$$z_j = a_{j1} f_1 + a_{j2} f_2 + ... + a_{jm} f_m + b_j u_j ; j = 1,2,..., p \quad (1)$$

a_{jm}: Load or weight of the jth variable on the mth factor,

f_m: mth factor; u_j : residual factor; b_j : coefficient for residual factor

It is also possible to write the model (1) in matrix form as follows:

$$Z=AF+BU \quad (2)$$

After performing the factor analysis; dimension reduction, orthogonality (orthogonality or independence) and conceptual significance are obtained by factor rotation. Factor analysis introduces the least number of factor definitions that best explain the relationships between variables in the analysis. After determining the most suitable factor by factor rotation, factor loads are calculated and finally the common factor(s) are interpreted. Also, if needed, factor scores for units are estimated (Anderson, 2003; Hair et al. 1998; Johnson & Wichern, 1992; Sharma, 1996).

Table 1 presents descriptive statistics for the variables used in the analysis.

Table 1.

Descriptive Statistics on Variables

Variable	Minimum Value	Maximum Value	Arithmetic Mean	Standard Deviation
X1	12.00	33.00	19.3086	4.52394
X2	79.90	94.30	92.6694	1.83786
X3	12.00	23.00	15.5309	2.30264
X4	79.44	95.69	93.4568	1.91348
X5	93.02	99.07	96.7040	1.57380
X6	74.89	90.67	88.5228	2.14254
X7	8.00	18.00	11.9753	2.16203
X8	11.00	27.00	20.3210	3.12181
X9	62.20	102.22	88.4547	8.32702
X10	8.00	17.00	12.2840	2.25408

Cluster Analysis Results

Tables 2-4 presents the cluster structures obtained as a result of **non-hierarchical clustering** analyzes.

Table 2.

Results for 3 Clusters

1st cluster (17 Cities)	2nd cluster (63 Cities)	3rd cluster (1 City)
Ağrı, Bingöl, Bitlis, Diyarbakır, Erzurum, Gaziantep, Hakkari, Kars, Mardin, Muş, Siirt, Şanlıurfa, Van, Batman, Şırnak, Iğdır, Kilis ,	Adana, Adıyaman, Afyonkarahisar, Amasya, Ankara, Antalya, Artvin, Aydın, Balıkesir, Bilecik, Bolu, Burdur, Bursa, Çanakkale, Çankırı, Çorum, Denizli, Edirne, Elazığ, Erzincan, Erzurum, Eskişehir, Gaziantep, İstanbul, Giresun, Hatay, Isparta, İzmir, Mersin, Kastamonu, Kayseri, Kırklareli, Kırşehir, Kocaeli, Konya, Kütahya, Malatya, Manisa, Kahramanmaraş, Muğla, Nevşehir, Niğde, Ordu, Rize, Sakarya, Samsun, Sinop, Sivas, Tekirdağ, Tokat, Trabzon, Tunceli, Uşak, Yozgat, Zonguldak, Aksaray, Bayburt, Karaman, Kırıkkale, Şırnak, Bartın, Ardahan, Yalova, Karabük, Batman, Osmaniye, Düzce	Gümüşhane

When 81 provinces are classified into 3 clusters; Ağrı, Bingöl, Bitlis, Diyarbakır, Erzurum, Gaziantep, Hakkari, Kars, Mardin, Muş, Siirt, Şanlıurfa, Van, Batman, Şırnak, Iğdır, and Kilis form a cluster; and Gümüşhane forms a cluster by itself. The remaining 63 provinces gather in a separate cluster.

Table 3.

Results for 4 Clusters

1st cluster (16 Cities)	**2nd cluster (49 Cities))**	**3rd cluster (1 City)**	**4th cluster (15 Cities)**
Adana, Adıyaman, Bursa Gaziantep, Hatay, Mersin, İstanbul, İzmir Kayseri, Kocaeli, Konya, Manisa Kahramanmaraş, Tekirdağ, Kilis, Osmaniye	Afyonkarahisar, Amasya, Ankara, Antalya, Artvin, Aydın, Balıkesir, Bilecik, Bolu, Burdur, Çanakkale, Çankırı, Çorum, Denizli, Diyarbakır, Edirne, Elazığ, Erzincan, Eskişehir, Giresun, Isparta, Kastamonu, Kırklareli, Kırşehir, , Kütahya, Malatya, Muğla, Nevşehir, Niğde, Ordu, Rize,, Sakarya, Samsun, Sinop, Sivas, Şanlıurfa, Tokat, Trabzon, Tunceli, Uşak, Van, Yozgat, Zonguldak, Aksaray, Bayburt, Karaman, Kırıkkale, Batman, Şırnak, Bartın, Ardahan, Iğdır, Yalova, Karabük, Batman, Düzce	Gümüşhane	Ağrı, Bingöl, Bitlis, Diyarbakır, Erzurum Hakkari, Kars, Mardin, Muş, Siirt, Şanlıurfa, Van, Batman, Şırnak, Iğdır

When 81 provinces are classified into 4 clusters; Gümüşhane forms a cluster by itself; Ağrı, Bingöl, Bitlis, Diyarbakır, Erzurum Hakkari, Kars, Mardin, Muş, Siirt, Şanlıurfa, Van, Batman, Şırnak, and Iğdır form a cluster; and Adana, Adıyaman, Bursa Gaziantep, Hatay, Mersin, İstanbul, İzmir Kayseri, Kocaeli, Konya, Manisa, Kahramanmaraş, Tekirdağ, Kilis, and Osmaniye form another cluster. The remaining provinces gather in a separate cluster.

Table 4.

Results for 5 Clusters

1st cluster (17 Cities)	**2nd cluster (48 Cities)**	**3rd cluster (1 City)**	**4th cluster (4 Cities)**	**5th cluster (11 Cities)**
Adana, Adıyaman, Bursa, Elazığ, Gaziantep, Hatay, Mersin, İstanbul, İzmir, Kayseri, Kocaeli, Konya, Manisa, Kahramanmaraş, Tekirdağ, Kilis, Osmaniye	Afyonkarahisar, Amasya, Ankara, Antalya, Artvin, Aydın, Balıkesir, Bilecik, Bolu, Burdur, Çanakkale, Çankırı, Çorum, Denizli, Edirne, Erzincan, Eskişehir, Giresun, Isparta, Kırklareli, Kırşehir, Kütahya, Malatya, Muğla, Nevşehir, Niğde, Ordu, Rize, Sakarya, Samsun,	Gümüşhane	Ağrı, Bitlis, Muş, Şanlıurfa	Bingöl, Diyarbakır, Erzurum, Hakkari, Kars, Mardin, Siirt, Van, Batman, Şırnak, Iğdır

	Sinop, Sivas, Tokat, Trabzon, Tunceli, Uşak, Yozgat, Zonguldak, Aksaray, Bayburt, Karaman, Kırıkkale, Bartın, Ardahan, Yalova, Karabük, Düzce			

When 81 provinces are classified into 5 clusters; Gümüşhane forms a cluster by itself; Ağrı, Bitlis, Muş, and Şanlıurfa form a cluster; and Bingöl, Diyarbakır, Erzurum, Hakkari, Kars, Mardin, Siirt, Van, Batman, Şırnak, and Iğdır form another cluster; and Adana, Adıyaman, Bursa, Elazığ, Gaziantep, Hatay, Mersin, İstanbul, İzmir, Kayseri, Kocaeli, Konya, Manisa, Kahramanmaraş, Tekirdağ, Kilis, Osmaniye form another one. The remaining provinces gather in a separate cluster.

Tables 5-7 presents the cluster structures obtained as a result of incremental clustering (**intergroup link clustering technique**) analysis.

Table 5.

Results for 3 Clusters

1st cluster (69 Cities)	**2nd cluster (11 Cities Country)**	**3rd cluster (1 City)**
Adana, Adıyaman, Afyonkarahisar, Amasya, Ankara Antalya, Artvin, Aydın, Balıkesir, Bilecik, Bingöl, Bolu, Burdur, Bursa, Çanakkale, Çankırı, Çorum, Denizli, Edirne, Elazığ, Erzincan, Erzurum, Eskişehir, Gaziantep, Giresun, Hatay, Isparta, İstanbul, İzmir, Mersin, Kars, Kastamonu, Kayseri, Kırklareli, Kırşehir, Kocaeli, Konya, Kütahya, Malatya, Manisa, Kahramanmaraş, Muğla, Nevşehir, Niğde, Ordu, Rize, Sakarya, Samsun, Sinop, Sivas, Tekirdağ, Tokat, Trabzon, Tunceli, Uşak, Yozgat, Zonguldak, Aksaray, Bayburt, Karaman, Kırıkkale, Bartın, Ardahan, Iğdır, Yalova, Karabük, Kilis, Osmaniye, Düzce	Ağrı, Bitlis, Diyarbakır, Hakkari, Mardin, Muş, Siirt, Şanlıurfa, Van, Batman, Şırnak	Gümüşhane

When 81 provinces are classified into 3 clusters, Gümüşhane-Sweden forms a cluster; Ağrı, Bitlis, Diyarbakır, Hakkari, Mardin, Muş, Siirt, Şanlıurfa, Van, Batman, and Şırnak form a cluster; and the remaining countries form a separate cluster.

Table 6.

Results for 4 Clusters

1st cluster (8 Cities)	2nd cluster (62 Cities)	3rd cluster (11 Cities)	4th cluster (1 City)
Adana, Bursa, Gaziantep, Hatay İstanbul Kahramanmaraş, Tekirdağ, Kilis	Adıyaman, Afyonkarahisar, Amasya, Antalya, Artvin, Aydın, Balıkesir, Bilecik, Bingöl, Bolu, Burdur, Çanakkale, Çankırı, Çorum, Denizli, Edirne, Elazığ, Erzincan, Erzurum, Eskişehir, Giresun, Gümüşhane, Isparta, Kars, Kastamonu, Kayseri, Kırklareli, Kırşehir, Kocaeli, Konya, Kütahya, Malatya, Mardin, Manisa Mersin, Muğla, Nevşehir, Niğde, Ordu, Rize, Sakarya Samsun, Sinop, Sivas, Tokat, Trabzon, Tunceli, Uşak, Van, Yozgat, Zonguldak, Aksaray, Bayburt, Karaman, Kırıkkale, Bartın, Ardahan, Iğdır, Yalova, Karabük, Osmaniye, Düzce	Ağrı, Bitlis, Diyarbakır, Hakkari, Muş, Siirt, Şanlıurfa, Van, Batman, Şırnak	Gümüşhane

When 81 provinces are classified into 4 clusters, Gümüşhane forms a cluster by itself. Adana, Bursa, Gaziantep, Hatay, Istanbul, Kahramanmaraş, Tekirdağ, and Kilis form a cluster; and Ağrı, Bitlis, Diyarbakır, Hakkari, Muş, Siirt, Şanlıurfa, Van, Batman, Şırnak constitute another cluster. The remaining 62 provinces form a separate cluster.

Table 7.

Results for 5 Clusters

1st cluster (8 Cities)	2nd cluster (48 Cities)	3rd cluster (13 Cities)	4th cluster (11 Cities)	5th cluster (1 City)
Adana, Bursa, Gaziantep, Hatay, İstanbul, Tekirdağ, Kilis	Adıyaman, Ağrı, Amasya, Ankara, Antalya, Artvin, Aydın, Balıkesir, Bilecik, Bitlis, Bolu, Burdur, Çanakkale, Çorum, Denizli, Diyarbakır, Elazığ, Erzincan, Eskişehir, Giresun, Gümüşhane, Hakkari, ,Isparta, Kastamonu, Kayseri, Kırklareli, Kırşehir, Kocaeli, Konya, Kütahya, Malatya, Kahramanmaraş, Manisa Mardin, Mersin, Muğla, Muş, Ordu, Rize, Sakarya, Samsun, Siirt, Sinop, Sivas, Şanlıurfa, Tekirdağ, Tokat, Trabzon, Uşak, Van, Zonguldak, Bayburt, Karaman, Kırıkkale, Batman, Şırnak, Bartın, Yalova, Karabük, Kilis, Batman, Osmaniye, Düzce	Afyonkarahisar, Bingöl, Çankırı, Edirne, Erzurum, Kars, Nevşehir, Niğde, Tunceli, Yozgat, Aksaray, Ardahan, Iğdır	Ağrı, Bitlis, Diyarbakır, Hakkari, Mardin, Muş, Siirt, Van, Batman, Şırnak	Gümüşhane

When 81 provinces are classified into 5 clusters, Gümüşhane forms a cluster by itself. Adana, Bursa, Gaziantep, Hatay, İstanbul, Kahramanmaraş, Tekirdağ, and Kilis form a cluster; and Afyonkarahisar, Bingöl, Çankırı Edirne, Erzurum, Kars, Nevşehir, Niğde, Tunceli, Yozgat, Aksaray, Ardahan, and Iğdır form another cluster. The remaining 48 provinces form a separate cluster.

Tables 8-10 presents the cluster structures obtained as a result of incremental clustering (**within group link clustering technique**) analysis.

Table 8.

Results for 3 Clusters

1st cluster (8 Cities)	**2nd cluster (64 Cities)**	**3rd cluster (9 Cities)**
Adana, Bursa Gaziantep, Hatay, İstanbul, Kahramanmaraş, Tekirdağ, Kilis,	Adıyaman, Afyonkarahisar, Ağrı, Amasya, Ankara, Antalya, Artvin, Aydın, Balıkesir, Bilecik, Bingöl, Bolu, Burdur, Çanakkale, Çankırı, Çorum, Denizli, Edirne, Elazığ, Erzincan, Erzurum, Eskişehir, Giresun, Gümüşhane, Isparta, İzmir, Mersin, Kars, Kastamonu, Kayseri, Kırklareli, Kırşehir, Kocaeli, Konya, Kütahya, Malatya, Manisa, Muğla, Muş, Nevşehir, Niğde, Ordu, Rize, Sakarya, Samsun, Sinop, Sivas, Tokat, Trabzon, Tunceli, Uşak, Yozgat, Zonguldak, Aksaray, Bayburt, Karaman, Kırıkkale, Batman, Bartın, Ardahan, Iğdır, Yalova, Karabük, Osmaniye, Düzce	Bitlis, Diyarbakır, Hakkari, Mardin, Siirt, Şanlıurfa, Van, Şırnak, Batman,

When 81 provinces are classified into 3 clusters; Adana, Bursa Gaziantep, Hatay, İstanbul, Kahramanmaraş, Tekirdağ, and Kilis form a cluster; and Bitlis, Diyarbakır, Hakkari, Mardin, Siirt, Şanlıurfa, Van, Şırnak, and Batman form another cluster. The remaining 62 provinces form a separate cluster.

Table 9.

Results for 4 Clusters

1st cluster (8 Cities)	**2nd cluster (62 Cities)**	**3rd cluster (3 Cities)**	**4th cluster (8 Cities)**
Adana, Bursa, Gaziantep, Hatay, İstanbul, Kahramanmaraş, Tekirdağ, Kilis	Adıyaman, Afyonkarahisar, Amasya, Ankara, Antalya, Artvin, Aydın, Balıkesir, Bilecik, Bingöl, , Bolu, Burdur, Çanakkale, Çankırı, Çorum, Denizli, Edirne, Elazığ, Erzincan, Erzurum, Eskişehir, Giresun, Gümüşhane, Isparta, İzmir, Kars, Kastamonu, Kayseri, Kırklareli, Kırşehir, Kocaeli, Konya, Kütahya, Malatya, Manisa Mersin, Muğla, Nevşehir, Niğde, Ordu, Rize, Sakarya Samsun, Sinop, Sivas, Tokat, Trabzon, Tunceli, Uşak, Yozgat, Zonguldak, Aksaray, Bayburt, Karaman, Kırıkkale, Batman, Bartın, Ardahan, Iğdır, Yalova, Karabük, Osmaniye, Düzce	Ağrı Bitlis Muş	Diyarbakır, Hakkari, Mardin, Şanlıurfa, Siirt, Van, Şırnak, Batman

When 81 provinces are classified into 4 clusters; Adana, Bursa, Gaziantep, Hatay, İstanbul, Kahramanmaraş, Tekirdağ, and Kilis form a cluster; Ağrı, Bitlis and Muş form another cluster; and Diyarbakır, Hakkari, Mardin, Şanlıurfa, Siirt, Van, Şırnak and Batman form another one. The remaining 62 provinces form a separate cluster.

Table 10.

Results for 5 Clusters

1st cluster (8 Cities)	2nd cluster (62 Cities)	3rd cluster (2 Cities)	4th cluster (8 Cities)	5th cluster (1 City)
Adana, Bursa Gaziantep, Hatay, K.Maraş, Tekirdağ, Kilis, İstanbul	Adıyaman, Afyonkarahisar, Amasya, Ankara, Antalya, Artvin, Aydın, Balıkesir, Bilecik, Bingöl, Bolu, Burdur, Çanakkale, Çankırı, Çorum, Denizli, Edirne, Elazığ, Erzincan, Erzurum, Eskişehir, Giresun, Isparta, İzmir, Kars, Kastamonu, Kayseri, Kırklareli, Kırşehir, Kocaeli, Konya, Kütahya, Malatya, Manisa, Mersin, Muğla, Muş, Nevşehir, Niğde, Ordu, Rize, Sakarya, Samsun, Sinop, Sivas, Tokat, Trabzon, Tunceli, Uşak, Yozgat, Zonguldak, Aksaray, Bayburt, Karaman, Kırıkkale, Batman, Bartın, Ardahan, Iğdır, Yalova, Karabük, Osmaniye, Düzce	Ağrı, Bitlis	Diyarbakır, Hakkari, Mardin, Siirt, Şanlıurfa, Van, Şırnak, Batman	Gümüşhane

When 81 provinces are classified into 5 clusters; Adana, Bursa, Gaziantep, Hatay, Kahramanmaraş, Tekirdağ, Kilis, and İstanbul form a cluster; and Ağrı and Bitlis form another cluster; and Diyarbakır, Hakkari, Mardin, Siirt, Şanlıurfa, Van, Şırnak and Batman form one another cluster. Gümüşhane forms a cluster by itself. The remaining 62 provinces form a separate cluster.

Factor Analysis Results

Both KMO and Bartlett's Sphericity tests were applied to determine the suitability of the data for factor analysis, and the results are given in Table 11.

Table 11.

KMO and Bartlett's Test Results

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Sample Adequacy Test Statistic.		0.692
Bartlett Sphericity Test Results	**Chi-Square Test Statistic**	975.024
	Degree of freedom	45
	Possibility	<0.01

The KMO test value was determined as 0.692, which is a good result for the KMO and shows the sufficiency of the selected sample (0.692>0.60) (Tatlıdil, 2002). Since the probability value is less than 0.01 in Bartlett's test, the H_0 hypothesis is rejected. This means that there are high correlations between variables. In other words, the data is suitable for factor analysis.

As a result of the Factor Analysis, three eigenvalues with a value greater than one were obtained. The two factors explained 95% of the variance. There was an only 5% loss of variance when 10 variables were summed into two factors.

Table 12.

Eigenvalues, Variance Explanation Ratios and Cronbach' Alpha Values for the Factors

Factor	Eigenvalue	Variance Explanation Ratio (%)	Cronbach's Alfa Value
1	4.467	44.672	
2	3.107	31.070	
3	1.283	12.830	
Total	-------	88.572	0.796

The variance explanation rate was 44.672% for the first factor; 31.070% for the second factor and 12.830% for the third factor. In addition, the Cronbach's alpha values were examined for the factors, their reliability was considered good. Their Cronbach's alpha values were between 0.6 and 0.80, suggesting a high level of reliability.

The component matrix is examined to determine in which factors the variables are involved. Table 13 presents the component matrix.

Table 13.

Component Matrix

Variable	Component		
	1	**2**	**3**
x7	0.903	0.191	0.252
x1	0.893	0.145	0.264
x10	0.878	-.252	-0.211
x3	0.872	0.038	0.337
x8	0.854	-0.025	0.057
x9	**-0.597**	**0.574**	0.404
x6	-0.072	0.961	-0.179
x2	0.152	0.948	-0.198
x4	0.381	0.776	-0.478
x5	-0.249	0.480	0.724

The factor in which the X_9 variable takes place cannot be determined exactly. Therefore, the results obtained by VARIMAX factor rotation technique1 are given in Table 14.

Table 14.

Rotated Component Matrix

Variable	Component		
	1	2	3
x_7	**0.941**	0.169	-0.027
x_1	**0.936**	-0.008	-0.016
x_{10}	**0.934**	0.122	-0.034
x_3	**0.812**	0.058	-0.267
x_8	**0.722**	-0.022	-0.598
x_9	0.120	**0.948**	0.217
x_6	0.219	**0.948**	-0.171
x_2	-0.079	**0.924**	0.317
x_4	0.064	0.075	**0.899**
x_5	-0.372	0.257	**0.803**

Table 14 shows in which factor the 10 variables are collected. Table 15 presents the factors obtained and the variables included in these factors.

Table 15.

Variables in Each Factor

Factor	Variable
1	X_3, X_7, X_8, X_{10}
2	X_2, X_6, X_9
3	X_4, X_5

The factor 1 includes the variables X_3 (Primary school_Number of students per teacher), X_7 (Secondary school_Number of students per teacher), X_8 (Secondary education _Number of students per classroom) and X_{10} (Secondary education_Number of students per teacher). The factor 2 includes the variables X_2 (Primary school_Enrollment rate for 2012 and later-net(%)), X_6 (Secondary school_Enrollment rate for 2012 and later-net (%)), and X_9 (Secondary education_Enrollment rate for 2012 and later-net (%)). The factor 3 includes the variables X_4 (Primary education (primary school + secondary school) enrollment rate for 2012 and later-net (%)) and X_5 (Literacy rate (%)).

Table 16 present the factor score coefficient matrix obtained by factor rotation.

[1] VARIMAX rotation technique is one of the most used vertical rotation techniques (Tatlıdil, 2002: 180). In the study, other rotation techniques were also considered, but the VARIMAX rotation technique was chosen because it produced the most appropriate solution. For detailed information on the subject, the study by Saraçlı (2011) can be examined.

Table 16.

Factor Score Coefficient Matrix Obtained by Factor Rotation

Variable	Component		
	1	2	3
x_1	0.264	-0.025	0.119
x_2	-0.009	0.343	0.001
x_3	0.279	-0.081	0.151
x_4	-0.045	0.397	-0.221
x_5	0.166	-0.119	0.551
x_6	-0.049	0.335	0.033
x_7	0.264	-0.008	0.117
x_8	0.193	-0.003	-0.035
x_9	0.003	0.008	0.389
x_{10}	0.117	0.025	-0.241

Subtraction Method: Principal Components Analysis Rotation Method: Varimax Component Score Values with Kaiser normalization.

Tables 15 and 16 included the same results, suggesting that variables with the highest weight in the factors remained the same.

Table 17 presents the scores of provinces for the first factor.

Table 17.

Scores Obtained for the 1st Factor of Provinces as a result of VARIMAX Factor Rotation

Province	F_1	Province	F_1	Province	F_1
Adana	1.61368	Giresun	-0.98663	Samsun	-0.31336
Adıyaman	0.30569	Gümüşhane	-0.82944	Siirt	0.25632
Afyonkarahisar	-0.50112	Hakkari	1.14916	Sinop	-0.79461
Ağrı	0.33571	Hatay	1.50317	Sivas	-0.8342
Amasya	-1.07205	Isparta	-0.81440	Tekirdağ	1.79422
Ankara	0.25187	Mersin	0.83643	Tokat	-0.28405
Antalya	0.54948	İstanbul	2.47209	Trabzon	-0.63862
Artvin	-1.29854	İzmir	0.54226	**Tunceli**	**-2.25973**
Aydın	-0.33108	Kars	-0.72498	Şanlıurfa	2.28391
Balıkesir	-0.28874	Kastamonu	-1.04178	Uşak	-0.46673
Bilecik	0.34258	Kayseri	1.14720	Van	0.87335
Bingöl	-0.21733	Kırklareli	-0.15440	Yozgat	-1.00440
Bitlis	-0.18505	Kırşehir	-1.25661	Zonguldak	-0.65977
Bolu	-0.25805	Kocaeli	1.04542	Aksaray	-0.08729
Burdur	-0.86058	Konya	0.60098	Bayburt	-0.75001
Bursa	1.53590	Kütahya	-0.58084	Karaman	-0.42661
Çanakkale	-0.17063	Malatya	-0.00668	Kırıkkale	-0.99933
Çankırı	-0.23133	Manisa	0.35271	Batman	0.93673
Çorum	-0.53577	Kahramanmaraş	1.45577	Şırnak	1.08790
Denizli	-0.28097	Mardin	0.87511	Bartın	-0.89953
Diyarbakır	1.49841	Muğla	-0.33264	Ardahan	-1.45919
Edirne	-1.14113	Muş	0.00245	Iğdır	-0.32712
Elazığ	0.26931	Nevşehir	-0.82987	Yalova	0.17865

Erzincan	-1.15901	Niğde	-0.31543	Karabük	-1.16119
Erzurum	-0.61168	Ordu	-0.57154	Kilis	2.04852
Eskişehir	-0.22422	Rize	-0.95277	Osmaniye	0.83477
Gaziantep	**2.92881**	Sakarya	0.41963	Düzce	-0.19714

Considering the scores of provinces according to the first factor, the most distant provinces to each other are Gaziantep and Tunceli, while the closest provinces to each other are Gaziantep and İstanbul.

Table 18 presents the scores of provinces for the second factor.

Table 18.

Scores Obtained for the 2nd Factor of Provinces as a result of VARIMAX Factor Rotation

Province	**F_2**	**Province**	**F_2**	**Province**	**F_2**
Adana	0.22932	Giresun	-0.54285	Samsun	0.30306
Adıyaman	0.38784	Gümüşhane	-7.31476	Siirt	0.09730
Afyonkarahisar	-0.33700	Hakkari	-2.15698	Sinop	0.12761
Ağrı	0.57382	Hatay	0.19895	Sivas	0.18713
Amasya	0.84046	Isparta	0.49607	Tekirdağ	0.14190
Ankara	0.46474	Mersin	0.19945	Tokat	-1.75181
Antalya	-0.09204	İstanbul	0.09699	Trabzon	0.35258
Artvin	0.36076	İzmir	0.30603	Tunceli	0.07535
Aydın	0.44496	Kars	0.39996	Şanlıurfa	-0.21517
Balıkesir	0.43495	Kastamonu	0.88133	Uşak	0.25436
Bilecik	0.18126	Kayseri	0.40706	Van	0.38787
Bingöl	-0.28147	Kırklareli	0.46496	Yozgat	-1.61591
Bitlis	0.13347	Kırşehir	-0.01840	Zonguldak	0.80864
Bolu	0.37423	Kocaeli	0.16418	Aksaray	-0.50717
Burdur	0.36215	Konya	-0.25151	Bayburt	-1.06359
Bursa	0.30012	Kütahya	0.46279	Karaman	-0.24842
Çanakkale	0.52438	Malatya	0.47699	Kırıkkale	0.63657
Çankırı	-1.64327	Manisa	0.35906	Batman	-0.07834
Çorum	0.42871	Kahramanmaraş	0.02762	Şırnak	-1.06157
Denizli	0.27789	Mardin	-0.12350	Bartın	0.60011
Diyarbakır	0.29979	Muğla	0.17114	Ardahan	-0.07569
Edirne	0.91219	Muş	0.17323	Iğdır	0.55180
Elazığ	-0.28383	Nevşehir	0.25108	Yalova	-0.68948
Erzincan	0.28561	Niğde	0.09223	Karabük	0.52416
Erzurum	0.04339	Ordu	0.52952	Kilis	0.06517
Eskişehir	0.53065	Rize	0.40335	Osmaniye	0.14254
Gaziantep	0.06661	Sakarya	0.14050	Düzce	-0.06315

Considering the scores of provinces according to the second factor, the most distant provinces to each other are Edirne and Gümüşhane, while the closest provinces to each other are Edirne and Kastamonu.

Table 19 presents the scores of provinces for the third factor.

Table 19.

Scores Obtained for the 3rd Factor of Provinces as a result of VARIMAX Factor Rotation

Province	F_3	Province	F_3	Province	F_3
Adana	0.38769	Giresun	0.12432	Samsun	0.44044
Adıyaman	-0.77603	Gümüşhane	0.50682	Siirt	-2.24385
Afyonkarahisar	0.08496	Hakkari	-0.87214	Sinop	0.09104
Ağrı	-2.90848	Hatay	0.44355	Sivas	-0.31980
Amasya	0.41342	Isparta	0.66332	Tekirdağ	1.32121
Ankara	1.18568	Mersin	0.73681	Tokat	0.53840
Antalya	1.17919	İstanbul	1.20627	Trabzon	0.46164
Artvin	0.42740	İzmir	1.08924	Tunceli	-0.68187
Aydın	0.73432	Kars	-1.97765	Şanlıurfa	-1.82013
Balıkesir	0.56538	Kastamonu	-0.32424	Uşak	0.50383
Bilecik	0.92957	Kayseri	0.70971	Van	-1.72282
Bingöl	-1.07464	Kırklareli	0.71918	Yozgat	-0.11790
Bitlis	-2.09997	Kırşehir	0.42615	Zonguldak	-0.41109
Bolu	0.93951	Kocaeli	1.07838	Aksaray	-0.16560
Burdur	0.39574	Konya	0.74707	Bayburt	-0.22063
Bursa	1.19587	Kütahya	0.68549	Karaman	0.71179
Çanakkale	1.03472	Malatya	-0.13965	Kırıkkale	0.43730
Çankırı	0.44412	Manisa	0.42073	Batman	-0.85587
Çorum	0.17549	Kahramanmaraş	-0.12467	Şırnak	-1.73486
Denizli	0.96926	Mardin	-1.87472	Bartın	0.02773
Diyarbakır	-1.45372	Muğla	0.76816	Ardahan	-1.31160
Edirne	0.28094	Muş	-2.71824	Iğdır	-1.83618
Elazığ	0.38496	Nevşehir	0.20965	Yalova	1.02666
Erzincan	-0.13278	Niğde	-0.08339	Karabük	0.27803
Erzurum	-1.03390	Ordu	-0.24263	Kilis	0.13812
Eskişehir	1.07902	Rize	0.66337	Osmaniye	-0.30776
Gaziantep	0.44730	Sakarya	0.70227	Düzce	0.45556

Considering the scores of provinces according to the third factor, the most distant provinces to each other are Tekirdağ and Ağrı, while the closest provinces to each other are Tekirdağ and Istanbul.

Discussion and Conclusion

Education, in general, can be defined as a process, a social phenomenon, a system and a socialization tool that continues from birth to death. By education, a qualified workforce is trained, increasing the productivity of individuals. Thus, education makes a significant contribution to economic growth. Education has several benefits, reducing crime rates, increasing active participation in management, protecting individual health and improving economic welfare.

In this study, clustering analysis was used to cluster provinces in Turkey in terms of education indicators, and factor analysis was used for ranking them. The study aimed to reveal the similarities of provinces in terms of education indicators. Both non- hierarchical (k-means clustering technique)

and incremental clustering techniques (intergroup linkage and intragroup linkage technique) were used in the cluster analysis, considering the number of clusters as 3, 4 and 5.

When the k-means clustering technique is used and the number of clusters is taken as 3; Ağrı, Bingöl, Bitlis, Diyarbakır, Erzurum, Gaziantep, Hakkari, Kars, Mardin, Muş, Siirt, Şanlıurfa, Van, Batman, Şırnak, Iğdır, and Kilis form a cluster. Gümüşhane forms a cluster by itself. The remaining provinces are gathered in a separate cluster. When the number of clusters is 4, Gümüşhane forms a cluster by itself; Ağrı, Bingöl, Bitlis, Diyarbakır, Erzurum Hakkari, Kars, Mardin, Muş, Siirt, Şanlıurfa, Van, Batman, Şırnak, and Iğdır form a cluster; and Adana, Adıyaman, Bursa Gaziantep, Hatay, Mersin, İstanbul, İzmir Kayseri, Kocaeli, Konya, Manisa, Kahramanmaraş, Tekirdağ, Kilis, and Osmaniye are gathered in another cluster. The remaining provinces form a separate cluster. When the number of clusters is 5, Gümüşhane forms a cluster by itself. Adana, Bursa, Gaziantep, Hatay, Istanbul, Kahramanmaraş, Tekirdağ, and Kilis form a cluster; and Afyonkarahisar, Bingöl, Çankırı, Edirne, Erzurum, Kars, Nevşehir, Niğde, Tunceli, Yozgat, Aksaray, Ardahan, Iğdır are gathered in another cluster. The other provinces form a separate cluster.

When the inter-group link clustering technique, one of the hierarchical clustering techniques, is used and the number of clusters is taken as 3, Gümüşhane-Sweden forms a cluster; Ağrı, Bitlis, Diyarbakır, Hakkari, Mardin, Muş, Siirt, Şanlıurfa, Van, Batman, and Şırnak form another cluster; and the remaining countries form a separate cluster. When 81 provinces are classified into 4 clusters, Gümüşhane forms a cluster by itself. Adana, Bursa, Gaziantep, Hatay Istanbul, Kahramanmaraş, Tekirdağ, and Kilis form a cluster; Ağrı, Bitlis, Diyarbakır, Hakkari, Muş, Siirt, Şanlıurfa, Van, Batman, Şırnak form another cluster; and the remaining provinces form a separate cluster. When the number of clusters is taken as 5, Gümüşhane forms a cluster by itself. Adana, Bursa, Gaziantep, Hatay, Istanbul, Kahramanmaraş, Tekirdağ, Kilis form a cluster; Afyonkarahisar, Bingöl, Çankırı, Edirne, Erzurum, Kars, Nevşehir, Niğde, Tunceli, Yozgat, Aksaray, Ardahan, and Iğdır are gathered in another cluster; and the remaining provinces form a separate cluster.

When the intra-group linkage clustering technique is used and the number of clusters is taken as 3, Adana, Bursa Gaziantep, Hatay, İstanbul, Kahramanmaraş, Tekirdağ, and Kilis formed a cluster; Bitlis, Diyarbakır, Hakkari, Mardin, Siirt, Şanlıurfa, Van, Şırnak, and Batman form another cluster; and the remaining 62 provinces form a separate cluster.

When the number of clusters is taken as 4, Adana, Bursa, Gaziantep, Hatay, İstanbul, Kahramanmaraş, Tekirdağ, and Kilis form a cluster; Ağrı, Bitlis and Muş form another cluster. In

addition, Diyarbakır, Hakkari, Mardin, Şanlıurfa, Siirt, Van, Şırnak and Batman gather in one cluster; and the remaining 62 provinces form a separate a cluster. When the number of clusters is taken as 5, Adana, Bursa, Gaziantep, Hatay, Kahramanmaraş, Tekirdağ, Kilis, and İstanbul form a cluster; Ağrı and Bitlis form another cluster; Diyarbakır, Hakkari, Mardin, Siirt, Şanlıurfa, Van, Şırnak and Batman gather in another cluster; and Gümüşhane form a separate cluster. The remaining 62 provinces form a cluster as well.

The factor analysis suggests three factors to rank the provinces. The first factor scores suggest that Gaziantep and Tunceli are the provinces farthest from each other, while Gaziantep and Istanbul are the provinces closest to each other. The second factor scores suggest that Edirne and Gümüşhane are the provinces farthest from each other, while Edirne and Kastamonu are the provinces closest to each other are. The third factor scores suggest that Tekirdağ and Ağrı are the provinces farthest from each other, while Tekridağ and Istanbul are the provinces closest to each other.

Recommendations

Based on the results of our study, it is recommended to consider the educational status of provinces in Turkey in terms of the education indicators discussed in the study. It can be suggested to raise better qualified manpower, provide more education to increase both economic and social welfare of individuals, and use public resources in an effective and planned manner for this purpose. Considering the results of this study, it should be noted that provinces can have similar educational characteristics through financial, physical and manpower investments in education, especially in public education, encouraging and strengthening public-private sector cooperation, and the results to be obtained will shed light on researchers and decision makers. In addition, by using the data on countries' education statistics, both similarities and differences of Turkey with other countries can be determined, allowing us to compare our country with other countries; and the results to be obtained will shed light on researchers and decision makers.

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Conflict of Interest

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