INFORMATION AND COMMUNICATION TECHNOLOGIES (ICT) AND SOCIAL DEVELOPMENT: A SOCIAL DEVELOPMENT INDEX RECOMMENDATION FOR TÜRKİYE

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Abstract

Social development is a vital element of sustainability. However, the fact that it is a wide-ranging and dynamic field makes the measurement of the concept difficult, and it reveals the need for updating its content depending on the developments. In the literature, social development has generally been measured with dimensions such as education, health, and gender equality. Today, however, technological indicators have become a part of social development and there is a need to prepare a new social development index to which information and communication technologies (ICT) are added. In this study, an index of social development including the ICT dimension were prepared and index calculations for Türkiye were performed. There are twelve variables under four dimensions, namely ICT, education, health, and gender equality, in the index covering the years 2008–2020. Principal Component Analysis was used in the index calculation. The results of the analysis revealed that the values of the social development index in Turkey increased over time. However, the increase in social development needs to be continued. For this, more importance should be given to the dissemination of information and communication technologies, increasing the education level of the society, facilitating access to health services, and ensuring gender equality.

Keywords: *Sustainable Development, Social Development, Information and Communication Technologies, Principal Components Analysis.*

BİLGİ VE İLETİŞİM TEKNOLOJİLERİ (BİT) VE SOSYAL KALKINMA: TÜRKİYE İÇİN SOSYAL KALKINMA ENDEKSİ ÖNERİSİ

Öz

Sosyal kalkınma, sürdürülebilirliğin sağlanmasında önemli bir unsurdur. Ancak geniş kapsamlı ve dinamik bir alan olması kavramın ölçümünü zorlaştırmakta, yaşanan gelişmeler doğrultusunda içeriğinde güncelleme yapılması ihtiyacını ortaya çıkarmaktadır. Literatürde sosyal kalkınma genellikle eğitim, sağlık, cinsiyet eşitliği gibi boyutlarla yansıtılmıştır. Günümüzde ise teknolojik göstergeler sosyal kalkınmanın bir parçası haline geldiği için bilgi ve iletişim teknolojilerinin eklendiği yeni bir sosyal kalkınma endeksinin oluşturulmasına ihtiyaç vardır. Çalışmada, bilgi ve iletişim teknolojileri boyutunun dâhil edildiği bir sosyal kalkınma endeksi oluşturularak Türkiye için endeks hesaplamaları yapılmıştır. 2008-2020 yılları arasını kapsayan endekste bilgi ve iletişim teknolojileri, eğitim, sağlık, cinsiyet eşitliği olmak üzere dört boyut altında toplam on iki değişken bulunmaktadır. Endeks hesaplama aşamasında Temel Bileşenler Analizi kullanılmıştır. Analiz sonuçları Türkiye'de sosyal kalkınma endeksi değerlerinin zaman içinde yükseldiğini ortaya koymuştur. Ancak sosyal kalkınmadaki artış devam ettirilmelidir. Bunun için bilgi ve iletişim teknolojilerinin yaygınlaştırılmasına, toplumun eğitim seviyesinin yükseltilmesine, sağlık hizmetlerine erişimin kolaylaştırılmasına ve cinsiyet eşitliğinin sağlanmasına daha fazla önem verilebilir.

Anahtar kelimeler: *Sürdürülebilir kalkınma, Sosyal kalkınma, Bilgi ve İletişim teknolojileri, Temel bileşenler analizi.*

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1. INTRODUCTION

The belief that growth should be inclusive and sustainable is gaining prominence. The main principle of the sustainable development approach is to ensure that current generations may live in the best conditions possible while also considering the interests of future generations. The idea that it is not sufficient to focus solely on economic goals and that social and environmental goals should be given priority has also emerged along with an understanding of sustainable development. Hence, economic, social, and environmental factors are all included in sustainable development. The social aspect of sustainable development will be the main topic of this study. Due to the changes in the substance of social development brought about by technological advancements, there is a need to update and diversify the components that make up the concept. Social development is a broad concept that encompasses several aspects such as gender equality, education, and health. ICT is now also a part of social development in the current context in addition to these other variables. Information and communication technologies are a basic need that every citizen must have access to and use, not a luxury good or service that only some groups can use. A social development index has been developed, and the variables connected to ICT are included in the index, based on the notion that these technologies are a necessary component of social development. However, variables from other dimensions were also included in the index because of the complex structure of social development. The study used a data set with a total of twelve variables grouped into the categories of gender equality, education, health, and information and communication technology. Calculations of Turkey's social development index were done using data from 2008 to 2020. Multidimensional concepts are very difficult to quantify and express with a single numerical indicator. For this reason, composite indices are commonly used in the measurement of multidimensional concepts. One of the most widely used techniques for calculating composite indices is principal component analysis (PCA), which makes it possible to calculate many dimensions with a single indicator and reflects the weights of the variables used in the index. The weights of the variables in the ICT dimension for social development must be determined. It is possible to comment on whether this dimension is required for measuring social development. Principal Component Analysis was chosen as the study method because of these advantages.

The study begins by providing basic information on the idea of social development and highlighting the significance of sustainable development. In the second stage, it was discussed how ICT relates to social development and why it was necessary to include this dimension in the measurement of social development. By providing a review of the literature, the difference between this study and other studies and its contribution to the literature is highlighted in the following section. The application step began following the completion of the literature review. The dataset and the methodology were described during the application phase, and tests were run to see whether the dataset is appropriate for PCA. The following confirmation that the dataset is appropriate for the method, index calculations were performed to determine how Turkey's social development changed over time. The study's last phase included recommendations for actions that could be taken to promote social development in Turkey.

2. CONCEPT OF SOCIAL DEVELOPMENT

Economic growth was seen as the primary development indicator throughout the 1950s and 1960s. Over time, critics have questioned limiting progress to simply quantitative metrics, and the notion that qualitative indicators should also be considered has gained popularity (Mohamed et al., 2020: 15-16). Development and economic progress are no longer viewed as being mutually exclusive. Humans should be at the core of the concept of development, according to the United Nations Development Program (UNDP) study released in 1990. It also claimed that development cannot be described solely in terms of revenue. In addition to income, the development process considers several variables, including long life expectancy, literacy, information access, human rights, personal security, and political freedom. This idea that growth cannot be portrayed in a single dimension is gaining popularity. As a result, several goals have been established and accepted by world leaders. The Millennium Development Goals have made it their mission to eradicate severe poverty. The period covered by the Millennium Development Goals is 2000–2015 (Nanda, 2016: 389-392). Most Millennium Development Goals, however, were unable to be accomplished by 2015 because they placed too much emphasis on reducing poverty and disregarded other social objectives. Due to this, a new development concept for the years following

2015 was developed. The Sustainable Development Goals were considered when creating the framework for the new development strategy. The flaws of the Millennium Development Goals have not been the only things fixed by the Sustainable Development Goals. It has given the concept of social development, which has sometimes been overlooked in development literature, a new focus and direction. The Sustainable Development Goals consist of seventeen objectives. Three fundamental dimensions were used to group the predetermined targets. Development on these fronts includes economic, social and ecological aspects (Mohamed et al., 2020: 15-16).

As can be seen from Figure 1 one of the three fundamental pillars of sustainable development is social development. Every aspect should be prioritized to meet the aims of sustainable development. The process of sustainable growth will be halted if a dimension is disregarded and the harmony between the three dimensions is disturbed. The figure below will help you better understand the fundamental aspects of sustainable development and how they interact.

Figure 1: Key Elements of Sustainable Development
Source: Hernández-Calzada et al., 2019: 2

The most basic requirements such as clothing, food and shelter can be purchased with an income level that is indicative of social development. However, the industrial revolution changed the social development backdrop, and this transformation persisted in the years that followed. The concept of social development has evolved since the industrial revolution to incorporate factors such as rising welfare, rising technological advancement, rising productivity and achieving political reforms. The complexity of social evolution has increased in the knowledge-based society of today. In the knowledge economy, the relationship between social development and economic progress is complex and undergoing an ongoing change. Cultural growth follows social progress. Innovation processes stimulate cultural growth. Technological advancements and innovations speed up economic growth. The quality of life improves as the economy grows. Along with economic and social advancements, there has also been an improvement in institutional stability and confidence (Castells, 1999: 11-13).

3. THE RELATIONSHIP BETWEEN ICT AND SOCIAL DEVELOPMENT

One of the key drivers of societal innovation and advancement is the field of ICT. The sector's developments both set the pace for breakthroughs in other industries and aid in the diffusion of technological advances throughout society. ICT are fundamentally intertwined with economic and social life due to factors such as integrating technology into work and daily life, altering the structure of commercial organizations, and growing demand for skilled labor (Holtgrewe, 2014: 9-10). ICT has an impact on a variety of industries, including business, education, and social and economic development. As a result, it is challenging to describe ICT in an absolute way because each scientific discipline has its own definition of the term. ICT, on the other hand, can be broadly defined as the "creation of infrastructure and devices that will ease the movement of information through digital methods" (Zuppo, 2012: 13-17).

Globalization has removed obstacles to the flow of capital and the movement of goods and services. The expansion of commerce and the liberalization of capital flows both contributed to economic growth. However, these are not the only repercussions of globalization. Among the most significant effects of globalization is the creation of information, the use of inventions and technological advancements to boost the production, and the promotion of cooperation. People can use information repeatedly without losing any of its value, unlike commodities. In other words, information does not experience a process of diminishing returns. ICT is used to create innovations. Innovations boost output, distribution, and productivity and the accumulation of physical capital. Innovations also promote economic growth. (Kozma, 2005: 117-118).

Information and communication technology advances have had a significant impact on social development because they have increased information exchange and facilitated quick and simple access to information. By bridging the gaps between industrialized and developing nations, as well as rural and urban areas, facilitating access to information contributes to the development of a fairer and just social structure. This calls for the careful management of information and communication technology policies, particularly in developing nations. Developing nations can advance in both economic and social development with good process management. The gap between developed and developing countries could widen if the process is badly managed and innovations are not expanded and integrated into daily life (Kamel, 2008). The effects of information and communication technologies on social development are explained in more detail below.

Information and communication technologies are significant for companies because they reduce costs and support the scale economy. Information and communication technologies facilitate and accelerate communication among individuals, firms, institutions, and governments. Thus, several types of costs, such as operational transportation costs, information costs, and bureaucratic costs, are reduced. Thus, total production costs are reduced. Although a decrease in production costs has positive effects for all companies, this effect is greater for SMEs. Because most SMEs struggle with financial constraints and capacity problems, their competitiveness is low. The decrease in production costs both helps to reduce financing problems and to increase competitiveness (Gomez Sanchez, Castillejo & Sanchis Llopis, 2023: 2-3). ICT enables companies to expand their domestic customer base as well as expand abroad. ICT offers significant opportunities, especially in marketing. The internet and social media platforms are the main marketing tools of today. With these tools, relations with customers are strengthened, feedback about products is received directly, demands and requests of customers are followed, and marketing and advertising costs are reduced. In addition, by using ICT, it becomes easier to closely observe the market situation of rival companies and to reshape strategies accordingly. Technological networks are significant in bringing new ideas to life with small budgets and paving the way for entrepreneurship. All these opportunities and conveniences increase competitive power (Aslan & Özata, 2007: 16-19).

The widespread use of ICT causes changes in organizational structure and competitive strategies. In information societies, time loss due to bureaucratic procedures is less, coordination and cooperation is more. The decision-making mechanism operates faster and more efficiently. Collaboration among different departments of institutions is increasing, and a more comprehensive approach is adopted. Firms do not apply a strategy of increasing their competitive power by reducing costs only. Being open to innovation, they increase their competitive power by adapting ICT to their production processes, adapting to changing customer demands as soon as possible, and increasing their product range. Advances in ICT also change the qualitative characteristics of the workforce. The demand for a workforce that is open to innovation, has high creativity, and is prone to teamwork is increasing (Aktan & Vural, 2016: 12). The impact of ICT is critical for attaining the functions demanded by the business world. With the introduction of ICT into our lives, changes have occurred in the education system. Today, the "network-based learning" system is becoming increasingly common. ICT remove the limitations of time and space and offer many new opportunities for individuals to develop themselves. With network connections, people in various parts of the world can receive the same training at the same time and develop their skills without being subject to spatial restrictions. Online training and technological information programs start at an early age and continue in the following years. Even professional workers gain new skills and techniques by increasing their knowledge of ICT. It is much easier to follow innovations by using information and communication theories, not to lag technological developments, and to learn the developments in the world. ICT provide significant opportunities to increase personal knowledge by investing in human development (Öztürk, 2014: 232-234).

The definition of development has changed due to advancements in ICT. International organizations concur with this conclusion. For instance, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) emphasizes that having access to knowledge is a fundamental human right rather than a luxury. According to the International Telecommunication Union (ITU), information and communication infrastructures are a must for social and economic growth. New ideas such as e-commerce have emerged because of the expansion of smart mobile phones, faster internet connections, and improvements in the supply chain. The change in consumer behavior has made e-commerce one of the fundamental components of societal progress (Pook & Pence, 2001: 415-416).

4. STUDIES ON THE SUBJECT

Cahill and Sanchez (2001) developed an economic and social development index using the PCA approach in their study. In the study, a large data set consisting of thirty-six variables was used under the categories of health and life expectancy, information and communication, and access to products. Index calculations are made with data from 1990 on Latin American countries and US states. In addition, index values for the US states for 1960 were calculated. Thus, the development of the states over time was revealed, and a comparison was made between the US states and Latin American countries. According to the results of the analysis, the development structure in Latin America is like that in the United States.

Giambona and Vasallo (2014) attempted to measure the level of social inclusion by creating a four-dimensional composite index. Social inclusion is an important indicator of social development. It cannot be said that social development has been achieved in a country where the proportion of those who are in poverty and who are exposed to social exclusion is high. For this reason, it is aimed to reveal the level of social development using the social inclusion index created in the study. The index was calculated for the EU Member States for the years 2006-2010. The dimensions considered are the percentage of the population at risk of poverty after social transfers, the percentage of those with severe material deprivation in the total population, the percentage of people living in high-intensity households in the total population, and the percentage of those who leave education and training early. As a method, the BoD approach, which is based on the application of data envelopment analysis to the field of composite indicators, was used. In general, it was concluded that the level of social inclusion in EU member countries increased from 2006 to 2010. Bulgaria is the country with the weakest performance. Slovenia, Sweden, and the Czech Republic are the strongest performing countries.

Haan and Foa (2014) created an index to reflect social development in the African region. A new dimension has been added to the social development indices by adding some variables that are not included in current studies on the measurement of social development. The researchers used six categories: civic activism, clubs, and associations, sense of safety and security, intergroup cohesion, minority community integration, and gender equality. The relationship of the variables with GDP per capita was also examined, and a negative relationship was found between clubs and associations and GDP per capita. In the study, it was concluded that there is a positive correlation between civic activism, intergroup cohesion, minority status, gender equality and GDP per capita. Safety and security are not related to GDP per capita.

In their study, Coşkun et al. (2015) looked at Türkiye's social development performance. The Social Progress Imperative's Social Progress Index values were used in the study. The researchers used three key dimensions in the Social Progress Index: basic human needs, foundations of well-being, and opportunities. Each dimension has a set of indicators, and for each indicator different countries are compared. The categories where Türkiye performs well in terms of basic human needs are access to electricity and housing. Its scores are higher in the indicators of continuing primary education in the dimension of foundations of well-being and in the indicators of continuing advanced education in the dimension of opportunity. In Türkiye, the number of deaths from outdoor air pollution in the dimension of basic human needs, obesity based on welfare, and personal freedom, and the number of choices in the dimension of opportunity are lower than in other countries.

Güler et al. (2019) discussed the relationship between basic human needs and opportunities, a sub-index of the Social Progress Index. Index values for 2016 were analyzed for 138 countries using the Canonical Correlation Analysis method. It was concluded that there is a statistically significant and strong relationship between basic

human needs and opportunities sub-indices. In the basic human need sub-index, the weight of the shelter variable was the highest. The most influential variable in the sub-index of opportunities is access to higher education.

Khan, Ju and Hassan (2019) investigated effects of economic growth and ICT on sustainable human development. The analysis was conducted using a Pakistani example. The data between 1990 and 2014 were considered in the study, in which the autoregressive distributed lagged model (ARDL) and vector error correction model (VECM) methods were used. The results reveal that ICT supports sustainable human development and increases the performance of the Human Development Index. In addition, economic growth has positive and statistically significant effects on human development.

Iqbal et al. (2019) examined the effects of economic growth and ICT on human development. Data from 1990 to 2016 were used in the analysis for five selected countries in South Asia. ICT was measured using two variables. These are mobile phone and internet penetration. The analysis results show that cell phone usage and economic growth positively affect human development. However, this cannot be said to apply to internet usage.

Hoz Rosales, Camacho, and Tamayo (2019) investigated the effects of entrepreneurship and ICT on social development. Entrepreneurship was measured using Global Entrepreneurship Monitor data, and social development was measured using Social Progress Index data. ICT was measured using the Networked Readiness Index. Analysis using the least squares method was performed on fifty-six selected countries. A positive relationship was found between ICT and social development. Entrepreneurship has also been shown to support social development by increasing the quality of life.

Barska et al. (2020) created a multidimensional index to reflect social development and compared the social development levels of EU member countries. In the index, the Hellwig method was applied using many variables under five basic categories: poverty and exclusion, health, education, labor market, and demographics. The period covering the years 2014-2018 is discussed. According to the results of the analysis, the level of social development differs between EU countries. While the difference is more pronounced in the labor market and health categories, there is a similarity in the demographic category. In addition, a comparison was made between Poland and other EU countries in the study. Social programs in Poland have largely contributed to education and the reduction of poverty and exclusion.

Diakomihalis (2020) measured social development at the local level in his study. The index was calculated using questionnaires made by the people living in the Epirus region of Greece. The researcher used three categories in the index: basic human needs, the foundations of well-being, and personal and social opportunities. In each category, he used four different variables. Participants selected in the survey studies were categorized according to their education and employment status. Analytical Hierarchy Process was used as a method. According to the results of the analysis, when compared with Greece and the world in general, the level of satisfaction in the foundations of well-being, personal and social opportunities categories in the Epirus region was low. When it comes to basic human needs, the level of satisfaction is fairly high.

Yılmaz & Ciğerlioğlu (2020) examined the provinces in Turkey in their studies by measuring social development at the local level. A composite index was prepared for measuring social development using the Life Index in Provinces data published by TURKSTAT. 41 variables and 11 different dimensions were used. The dimensions of education, health, working life, income and wealth distribution, environment, security, civic participation, housing and access to infrastructure services were examined. The index was created with the data from 2015, and exploratory spatial data analysis was used as the method. According to the results of the analysis, the development level of the provinces where social policies are implemented successfully is higher. In addition, interactions among the provinces were identified.

Altıntaş (2021) looked at the connections between the sub-dimensions and variables of the Social Progress Imperative created by the Social Progress Imperative. The sub-dimensions of the index and the relationship between the variables within the dimensions were examined. The review was conducted in 27 EU member states using data from 2020. The method used is Somers' D-based DEMATEL methods. The researcher used two variables under the three-dimensional index in the index: basic human needs, foundations of well-being, and opportunities. According to the results of the analysis, the dimension of opportunities is the dimension that

makes the highest contribution to the interactional structure among the dimensions. The results regarding the characteristics of the variables included in the index are also presented. Therefore, the housing component is the variable that influences, whereas the other components are the variables that are impacted.

Wang et al. (2021) studied the effects of ICT on socioeconomic development. Data from 31 provinces in China between 2009 and 2018 were used. First, two composite indexes were created. The first of these indexes is the ICT index, and the second is the socioeconomic development index. Principal component analysis is the method used to create indexes. Regional assessments were then made using the spatial Durbin model (SDM). ICT makes significant contributions to socioeconomic development. However, it has been determined that there are significant differences in ICT between provinces and that these create imbalances in socioeconomic development

Singh et al. (2021) examined the sustainable development circumstances of 39 selected economies between 2000 and 2016 to create the Global Sustainable Development Index. The arithmetic average of the three sub-indices is used to create the Global Sustainable Development Index. As a result, calculations focused primarily on the Economic Development Index, Social Development Index, and Environmental Sustainability Index. There are nine variables in the Social Development Index. Variables are sex ratio at birth, female workforce ratio in the total workforce, female unemployment rate, female infant mortality rate, life expectancy at birth, share of education expenditures in national income, age dependency ratio, number of fixed telephone subscriptions per 100 people, and ratio of female to male labor force participation rate. The index was computed using composite Z-score method.

Qadikolaei, Zali, and Soltani (2022) examined the disparities between access and use of ICT. The examination was conducted in Iran. Data from 31 provinces in Iran between 2011 and 2020 were used. It has been determined that there are regional disparities between the access and use of ICT. The degree of inequality has changed over time. Inequality is more pronounced when education levels are low. Household income and the number of R&D centers are important factors that affect inequality.

Oyelami, Sofoluwe, and Ajeigbe (2022) studied the effects of ICT on agricultural development. Data from 39 countries in Sub-Saharan Africa between 1995 and 2017 were used, and the ARDL method was applied. The two main variables used in the measurement of ICT are mobile-cellular telephone subscription and individual use of the internet. It has been determined that the infrastructure of ICT eventually positively affects agricultural production. However, no evidence has been found that ICT infrastructure alone is sufficient to increase agricultural production. Therefore, agricultural producers should be made aware of the use of this infrastructure.

5. RESEARCH

5.1. Methodology

When using many variables, PCA is frequently chosen as the method. It ensures that the relationship explained by p number of variables that are correlated is explained by m number of variables that are not correlated (m ≤ p). Also, m variables can explain most of the total variance. In other words, while the number of variables is reduced, there is no great loss of variance (Gökçe, 2014: 60).

The first principal component has the highest contribution to the total variance. The second principal component makes the highest contribution to the variance remaining from the variance explained by the first principal component. The third principal component makes the highest contribution to the variance remaining from the variance explained by the first and second principal components. The process continues in this way according to the number of basic components. Principal components with an eigenvalue less than 1 are not considered statistically insignificant (Karaer &Tatlıdil, 2019: 47-48).

There are two major benefits to using the PCA method for calculating indexes. First, it enables the number of variables to be reduced if many variables are used in the study. Many of the variables used in the initial data are kept while the number of variables decreases. Second, principal component indices are a linear combination of chosen variables (Bethere et al., 2017: 951-952).

The steps performed in principal component analysis method can be shown as follows. Here, the variables $Z_1, Z_2 ... Z_p$ are the rows of the standardized data matrix. Variables expressed as $Y_1, Y_2, ... Y_p$ are the principal

components. A_{ij} is a constant number expressed as principal component loads (Ersungur et al., 2007: 58-59):

$$Y_1 = (a_1)^t Z = a_{11} Z_1 + a_{21} Z_2 + ... + a_{p1} Z_p$$

$$Y_2 = (a_2)^t Z = a_{12} Z_1 + a_{22} Z_2 + ... + a_{p2} Z_p$$

$$..... \qquad ..... \qquad ....$$

$$Y_p = (a_p)^t Z = a_{1p} Z_1 + a_{2p} Z_2 + ... + a_{pp} Z_p$$

5.2. Data Presentation and Description

Choosing the indicators by which the social aspect of sustainable development will be assessed is highly challenging due to its broad scope. Typically, social development indicators are categorized into categories including education, health, equality, housing, security, and population growth. Research on gender equality and studies on economic equality are both included in the equality dimension (Çelik, 2006: 34). In addition to these indicators, information and communication technology have additionally evolved into a component of social development. This is due to various factors. Technologies of information and communication assist the economy to grow. Access to social services including education and health care is made much easier. By using resources more effectively in areas such as transportation and urbanization, it facilitates resource optimization. It affects both interpersonal communication and the job search process, changing both (Goswami, 2014: 129-130). Information and communication technology cannot now be divorced from social development and sustainable development; hence, this issue needs to be considered when measuring social development.

Information and communication technology was one of four categories under which the variables chosen for the study's measurement of social progress were categorized. Health, gender equality, and education are other dimensions. The dataset contains twelve variables. The data cover the years 2008 through 2020. The longest time interval that could be reached in terms of the variables was attempted to be found while choosing the study schedule. For some variables, data from 2008 and later are available. As a result, the study began in 2008. For each variable considered, the most recent data are available for 2020. As a result, the analysis was carried out from 2008 to 2020. Undoubtedly, new variables can be added to each dimension of the index. Principal Component Analysis, the method that is generally used, requires that the number of variables be less than the number of observations to produce accurate findings. The maximum number of variables that can be used is twelve because the data cover the years 2008-2020 and annual data is used. Thirteen years of data are available. The number of observations is therefore thirteen. The twelve best indicators that are suitable with the study goal and scope were tried to be chosen due to limitations on the period and number of variables. In the Table 1, the variables used, and their dimensions are listed. The information was obtained from the websites of the Turkish Statistical Institute and the Ministry of National Education.

Table 1: Dimensions and Variables Included in the Social Development Index

Variables	Dimensions
Households with Access to the Internet (%)	ICT
Internet Usage in Households (%)	
The Proportion of Availability of Mobile Phones (incl. Smartphones) in Households (%)	
The Proportion of Availability of Desktop Computers in Households (%)	
Individuals Purchased Goods or Services over the Internet (%)	
The Proportion of at least Tertiary Graduates in the Population (+25)	Education
Budgets of HEC + HEQC + Universities (Thousand TL)	
The Proportion of the Total Education Budget in GDP	
Total Health Expenditure (General Government) (million TL)	Health
Total Health Staff	
Labour Force Participation Rate (Female) (%) (+15)	Gender Equality
Unregistered Employment (Female) (%)	

5.3. Research Findings

When the research using PCA is examined, while standardization is frequently done, some studies do not. However, standardization is important, especially in data sets where variables are in various units of measurement. As a result of the standardization method, each variable in the dataset is turned into another variable with a mean of 0 and a standard deviation of 1. Unit differences between variables are eliminated. A few of the study variables are expressed as monetary units, while others are expressed as percentages. To remove unit differences and produce more trustworthy results, each variable underwent a standardization process. The study's subsequent phases were carried out using standardized data. The formula below is used for standardization (Gökçe, 2014: 59):

$$Standardized\ value\ of\ xi = \frac{xi - mean\ of\ x}{Std.Deviation\ of\ x}$$

It should be assessed whether the dataset used in the model is appropriate for PCA following the standardization process. Two strategies are typically employed for this in the literature. The Kaiser-Meyer-Olkin (KMO) test was used as the first technique. The values for the KMO test range from 0 to 1. Kaiser (1974) asserted that test results should be more than 0.5 to accept the dataset as appropriate for study. Test results between 0.5 and 0.7 are regarded as mediocre, 0.7 and 0.8 as good, and 0.8 and 0.9 as excellent (Muthukumar & Vidhya, 2015: 87). The KMO value for the dataset used in the study was determined to be 0.751, as can be seen from the table below. Since the value of 0.751 is more than 0.5, the dataset can be deemed appropriate for investigation.

Another method is the Bartlett test, where the p value should be less than 0.05. (Tuan, 2020: 784). The p value is displayed as 0.000. The Bartlett test confirms that the dataset meets the criteria for PCA because the value of 0.000 is less than 0.05.

Table 2: Results of Kaiser-Meyer-Olkin (KMO) and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,751
Bartlett Test of Sphericity	Approx. Chi-Square	328,253
	df	66
	Sig.	,000

The following action was taken after it was established that the dataset used in the study was appropriate for analysis. The number of principal components must be determined next. It is necessary to look at the total variance explained table to establish the number of principal components. The table below demonstrates that there are two principal components. Principal components are variables with an eigenvalue greater than 1. The table contains two variables with eigenvalues greater than 1. Therefore, twelve variables used in the study can be grouped under two main components. 85,828% of the total variance can be explained by the first principal component alone. Together, the two major components account for 95.549% of the overall variance, with the second principal component accounting for 9.720% of the variation on its own. The principal components percentage of explaining the overall variance is quite high.

Table 3: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loading			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	10,299	85,828	85,828	10,299	85,828	85,828	10,294
2	1,166	9,720	95,549	1,166	9,720	95,549	1,308
3	,282	2,347	97,896				
4	,149	1,241	99,137				
5	,064	,530	99,667				
6	,016	,134	99,801				
7	,015	,124	99,924				
8	,005	,038	99,962				
9	,002	,019	99,982				
10	,001	,012	99,994				
11	,000	,004	99,998				
12	,000	,002	100,000				
Extraction Method: Principal Component Analysis.							
a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.							

Examining the component matrix comes after figuring out the principal component number. The component matrix is crucial for expressing the relative importance of many elements in social development.

Table 4: Component Matrix[a]

	Component	
	1	2
Internet Usage in Households (%)	,996	
Individuals Purchased Goods or Services over the Internet (%)	,995	
The Proportion of at least Tertiary Graduates in the Population (+25)	,994	
Budgets of HEC + HEQC + Universities (Thousand TL)	,991	
Households with Access to the Internet (%)	,987	
Total Health Staff	,985	
Unregistered Employment (Female) (%)	-,969	
The Proportion of Availability of Mobile Phones (incl. Smartphones) in Households (%)	,957	
Total Health Expenditure (General Government) (Million TL)	,946	
The Proportion of Availability of Desktop Computers in Households (%)	-,927	
Labour Force Participation Rate (Female) (%) (+15)	,878	,316
The Proportion of the Total Education Budget in GDP		,962
Extraction Method: Principal Component Analysis.		
a. 2 components extracted.		

Nine of the eleven variables explained by the first principal component have positive impacts, while two have negative effects, according to the component matrix in Table 4. The percentage of women who work unregistered and the proportion of households having desktop computers are the variables that have a negative impact. In other words, the rise in the proportion of women working in the informal sector and the use of desktop

computers in households have a negative impact on social development. The second principal component can account for two variables. Both factors have a positive impact.

The variables with the largest weight on social development index, according to the first principal component, are the percentage of households using the internet; the percentage of people who use the internet to buy products or services; the percentage of adults over 25 who have completed at least a tertiary education; total budget of Higher Education Council (HEC), Higher Education Quality Committee (HEQC) and universities; the percentage of households that have internet access. The information and communication technology dimension includes three of these five factors. The two additional factors are connected to the education component. Nowadays, the internet is used for practically all transactions. As a result, using the internet has turned into a need for maintaining life. Moreover, changes in consumer behavior are a result of technical advancements and the growth of supply chain networks. Online purchasing has significantly increased. Even essentials like food and transportation are now available for online purchase. Internet shopping has an important place in people 's lives in terms of facilitating daily transactions.

When evaluated in terms of the variables in the education dimension, the variable with the greatest importance in the first principal component is the proportion of the population with at least a university degree. The variable that follows is the budgets of HEQC and universities. The ratio of the total education budget to the GDP is not included in the first principal component.

Among the variables found in the ICT dimension, the rate of having a smartphone in the household is a variable of great importance in the first principal component. The smartphone is an indispensable part of modern life and a basic building block of social progress. The rate of having desktop computers in the household negatively affects social development. The main reason for this decline in desktop computer use is technological developments. People are using laptops, tablets, and smartphones instead of desktop computers.

The importance of the number of workers employed in the health sector in the first principal component is higher than public expenditure on health. The rate of informal employment in women negatively affects the first principal component. The labor force participation rate of women and the ratio of the general education budget to GDP are the two variables explained by the second principal component. The most important variable within the second principal component is the ratio of the total education budget to GDP.

The social development index was calculated the following analysis of the principal component load matrix. The calculation of the index requires a component score coefficient matrix. As a result, the component score coefficient matrix was initially computed. Below is the matrix.

Table 5: Component Score Coefficient Matrix

	Component	
	1	2
Households with Access to the Internet (%): X_1	,097	,053
Internet Usage in Households (%): X_2	,096	-,027
The Proportion of Availability of Mobile Phones (incl. Smartphones) in Households (%): X_3	,097	,152
The Proportion of Availability of Desktop Computers in Households (%): X_4	-,086	,161
Individuals Purchased Goods or Services over the Internet (%): X_5	,095	-,069
The Proportion of at least Tertiary Graduates in the Population (+25): X_6	,098	,055
Budgets of HEC + HEQC + Universities (Thousand TL): X_7	,095	-,062
The Proportion of Total Education Budget in GDP: X_8	,005	,820
Total Health Expenditure (General Government) (million TL): X_9	,087	-,191
Total Health Staff: X_{10}	,095	-,047
Labour Force Participation Rate (Female) (%) (+15): X_{11}	,092	,258
Unregistered Employment (Female) (%): X_{12}	-,096	-,060
Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization. Component Scores.		

Following the calculation of the component score coefficient matrix, the following steps were taken: The coefficient of the component score coefficient matrix was multiplied by the standardized value of each variable for the relevant year while constructing the model. This procedure was followed throughout the years. Two models were created one for each of the two primary components. In the final step, weights were assigned to the models based on how well they explained the principal components total variances. The sum of the weights given to the principal components is 1. Hence, the values of the general social development index were computed. The social development index calculation formula is shown below.

$$SDI = \alpha_1 Y_1 + \alpha_2 Y_2$$

$$SDI = 0{,}898 Y_1 + 0{,}102 Y_2 \quad \text{(SDI: Social Development Index)}$$

Table 6 displays the Social Development Index values computed for Türkiye using the PCA method. The table shows that social development in Türkiye has progressed steadily throughout time. Even though the rate of increase varies from year to year, some years see a more noticeable increase. However, in general, social development in Türkiye has gradually increased between 2008 and 2020.

Table 6: Social Development Index Values (2008-2020)

Years	Social Development Index
2008	-1,376977514
2009	-1,087185631
2010	-0,983653081
2011	-0,78276178
2012	-0,520141733
2013	-0,173670263
2014	0,152461123
2015	0,184804027
2016	0,542531784
2017	0,728953794
2018	0,947720967
2019	1,092892847
2020	1,27502546

It would be preferable to analyze the trend of the index findings over time rather than the numerical values as there is no defined reference range in the index calculations generated using the PCA approach. Since the index values can vary based on the analysis unit of measurement and whether standardization is applied or not. The index findings are therefore represented graphically in Figure 2. How Türkiye's social development has altered throughout time can be seen more clearly when looking at the graph.
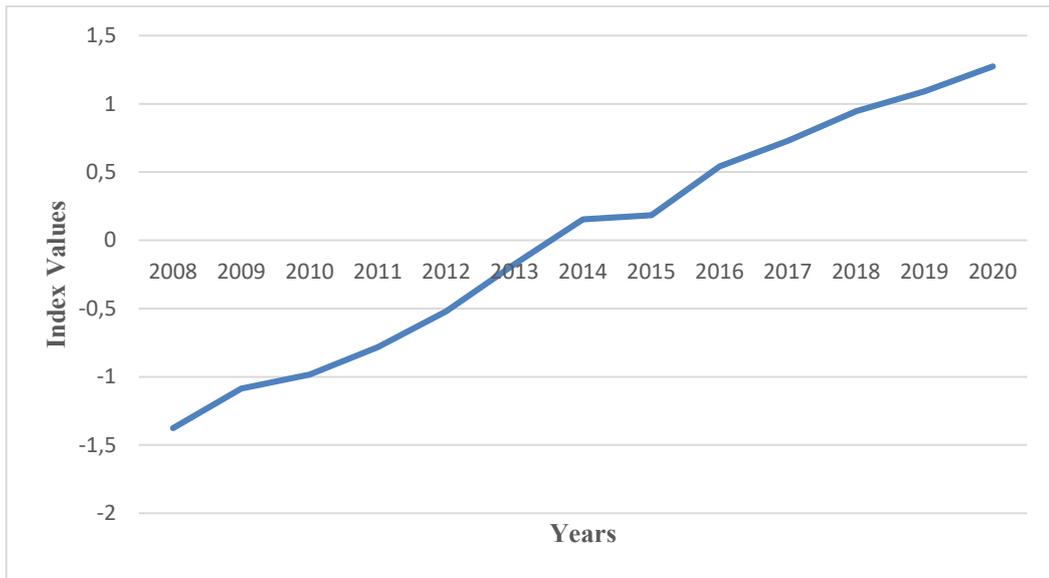
Figure 2: Social Development Index Values (2008-2020)

It is encouraging for sustainable development that Türkiye's social development has shown a rising trend over time. But the achievement that has already been attained needs to be elevated. The imagery could become upside down if the speed cannot be maintained and the shifting and evolving social development framework cannot be maintained. As a result, social development strategies should be prioritized, and Türkiye's social dimension should be strengthened.

It can be stated that every dimension from ICT to education, health, and gender equality is important for social development. Therefore, it is necessary to continue the positive developments achieved in social development. We live in a rapidly changing world. The technological and social changes experienced should not be left behind. For this reason, what can be done in the future for each dimension included in the index is explained below

5.4. Suggestions to Increase Social Development

There are still some who cannot access these products and services, although access to fundamental technology products and services, including computers, mobile phones, and the internet, has considerably increased over time. ICT is difficult to access, especially for those with low levels of education and income. Since business life is typically run on a technology-based framework, it can be challenging for those without access to basic technological products and services to find employment or move to positions with better benefits. Income and other economic and social inequalities are increasing. Computers and the Internet ought to be available to everyone in society. This is a fundamental right and an important indicator of social progress. Information and communication technology should be made available to all societal groups to prevent harmful effects (Öztürk, 2005: 127–128). First, it is crucial to address the infrastructural problems that make it difficult to access the internet and computers. For the infrastructure to be strengthened, more resources should be given to information and communication technology. Between 2008 and 2017, governmental institutions' investments in Türkiye's ICT increased quickly. After 2017 a slowdown in the rise was seen. Both the institutions' altered organizational structures and the inadequate information exchange between them contributed to the decrease in the rate of investment. However, institutions should accelerate their adaptation to the new structure (Türkmen & Akar, 2021: 510).

ICT must be made available at affordable prices if they are to be broadly used in society. Hardware and software should be made in the nation to cut costs. The level of social development and the added value created will both rise if Türkiye can move away from being a technology importer and toward becoming a technology

producer (Ercan, 2021: 418). R&D breakthroughs are the primary means through which Türkiye can improve its worldwide competitiveness in technology products. Implementing an effective incentive system is crucial. The market should be made more appealing for new businesses to enter and firms engaged in R&D should receive more support. Expanding on fundamental policies like credit support, facilitating the allocation of locations and laboratories where activities will be carried out, and tax reduction or exemption is possible. Also, there is a need for a consulting system that can offer advice on matters such as marketing, sales, and forming relationships abroad. It is possible to increase the development and use of information and communication technology in Türkiye if the state fulfils its regulatory, directing, and supervisory duties as necessary. Thus, the process of social development is fostered (Ministry of Development, 2018: 99-102).

Robust infrastructure networks and the absence of access restrictions are crucial for efficient usage of the services provided. The rate of the adoption of the available technology has decreased for a variety of reasons, including ignorance, lack of awareness, and personal prejudices. As a result, the process of social development is interrupted. The entire society should be informed about effective information and communication technology use, and social awareness should be increased. The study of technological knowledge should begin immediately. The process should start in the elementary school years with the acquisition of fundamental technological abilities, and it should accelerate in the subsequent school years. The resources they require to use ICT efficiently should be provided, especially for university students (Alaca & Yılmaz, 2016: 521–522).

Today, the rate of consumers shopping online has become one of the indicators of social development. In Türkiye, the amount of online purchasing is growing along with the number of people and businesses using the E-commerce system. The outbreak of the COVID-19 virus accelerated that trend. Notwithstanding this rise, more people should shop online, and the E-Commerce system should be made more widely used. To minimize consumer concerns about security, security mechanisms should be enhanced, and internet access should be made faster. Also, more businesses ought to be focused on the e-commerce sector. Hence, the degree of competitiveness can be raised (Artan et al., 2021: 112-113).

Policies on gender equality, education, and health should not be ignored in addition to ICT. The amount of funding given to universities should be expanded, and young people should be encouraged to pursue higher education.

In Turkey, there were 9.84% of people over 25 who had at least a bachelor's degree in 2008; by 2020, this number had risen to 22.14% (TurkStat, 2022). University education should be expanded despite a rise over time. Increased labor supply is not the main goal of higher education. University education may assist the knowledge economy, ensure global social mobility, and foster professional management and leadership. The advantages of a university degree are more obvious in the interconnected and knowledge-based society of today. Social injustice increases on a national and international scale in nations that are unable to take advantage of the potential presented by the knowledge economy. By reducing the income and social status differences among individuals, the expansion of higher education in society can aid in social development (Rena, 2010: 313-314).

We might conclude from the health perspective that more health professionals are needed to ensure social growth. Turkey has a large population. The elderly population is also steadily growing in number. Due to this, the need for health services in the nation is growing. More employees are required to handle the growing demand and deliver high-quality service to the public. More schools should provide health education, the quality of that education should improve, and young people should be encouraged to pursue careers in the health sector. The process also includes the establishment of regulations for the hiring of recent graduates from health departments. There ought to be more public and private hospitals. The health sector should receive more funding. Health-related expenses should account for a larger portion of public expenditures. Using resources in the most efficient way is also crucial. Health spending should be allocated to the proper projects, and more monitoring and control of spending should be implemented (Özer & Yıldırım, 2016: 158-159).

In Türkiye, the proportion of women who work informally is quite high. The high rate of unregistered female employment causes social and economic problems.Positive changes will also occur in the positions and working conditions of women as their level of education, knowledge and competence increases. Incentives offered to

businesses hiring female personnel should also be enhanced. Employers of unregistered workers should be identified and punished. One of the fundamental components of preventing informality is an extremely stringent regulatory mechanism (Varışlı, 2021: 14).

6. CONCLUSION

The main purpose of this study is to create an index that will help monitor the change in social development in Türkiye over time. Because social development has a dynamic and multidimensional structure, it is very difficult to measure it using a single variable. Therefore, composite indices are generally used to measure social development. However, in most of the indices created to measure social development, technological factors have been ignored and arithmetic or geometric mean methods, which assume that each variable contributes equally to social development, are used. This study aimed to contribute to the literature in two main ways. The first is to propose a social development index that considers current developments by adding the variables for ICT. The second step is to calculate the weights of the variables on the social development index and achieve healthier results. For this purpose, the principal component analysis method is used. The index includes four dimensions and 12 variables: ICT, education, health, and gender equality. The index includes the years 2008–2020.

According to the analysis results, twelve variables were gathered under two main components. The ratio of explaining the total variance of these two main components is 95,549%. It was determined that ten of the twelve variables in the index had a positive effect on social development and two negatively affected social development. Two variables that negatively affect social development are the unregistered employment rate of women and the rate of having desktop computers in households. For each of the two principal components, the index calculation was performed according to the coefficients of the variables. Then, considering which basic component explains how much of the total variance, the general social development index was formed. According to the results of the index, social development in Türkiye has increased over time. However, the upward trend in social development should be maintained. To do this, the changes and transformations occurring in the world should be closely followed. Now, the transition from an industrial society to an information society has passed. In the information society, technological skills and adaptation to ICT are extremely important. It should be ensured that individuals in society have access to ICT and use these technologies with the highest level of efficiency. Education, health, and gender equality issues should not be neglected while developing technological skills. The education level of society should be increased, and all citizens should be able to benefit from health services. Regulation and control mechanisms should be run better so that women are not excluded from business life and are not subjected to negative discrimination.

It is hoped that this study will guide other studies aimed at measuring social development. New indices that consider technological factors and show the characteristics of the information society can be created. In this study, Turkey's example was examined. Other researchers may also do similar studies for different countries. Thus, comparisons between countries can be made. However, although an attempt was made to create a social development index that best fits current developments, some limitations were encountered. These constraints are related to the choice of variables and the data set. For some variables, data before 2008 are not available, whereas for some variables, the most up-to-date data are for 2020. Therefore, the analysis started in 2008 and covers the period from 2008 to 2020. Since it is 13-year dataset, the maximum number of variables that can be suitable for principal component analysis is twelve. The number of variables in the principal component analysis should be less than the number of observations. Therefore, it was very difficult to select the twelve variables most suitable for the study.

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