NEW ERA INTERNATIONAL JOURNAL OF INTERDISCIPLINARY SOCIAL RESEARCHES ISSN 2757-5608

Article Arrival Date
13. 07. 2025

Article Type
Research Article

Article Published Date
25.12.2025

Doi Number:10.5281/zenodo.18134361

MAPPING TÜRKİYE'S PROGRESS ON EDUCATION FOR THE SUSTAINABLE DEVELOPMENT GOALS

Aslı DOLU
Assistant Professor, Izmir Bakircay University, Izmir, Türkiye
e-mail: asli.dolu@bakircay.edu.tr; ORCID ID: 0000-0001-6099-8704

Feray ELDENİZ
Head of Research, Development and Innovation, Presidency of Strategy and Budget, Ankara, Türkiye
e-mail: eldeniz@sbb.gov.tr; ORCID ID: 0000-0002-2496-2541

Abstract

Sustainable Development Goals-Education (SDG4) is defined as "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all". In this article, the progress made in education within the framework of Sustainable Development Goals (SDG) in Türkiye is shown. In this context, 12 indicators related to the field of education were addressed for SDG4. The indicators were grouped under four thematic headings: early childhood education, basic education, higher education, and lifelong learning. .These indicators were mainly selected on the basis of the OECD's approach, which states that the quantitative targets defined in the global policy agenda should be followed at the country level using individual approaches. TOPSIS method was applied to create an education index value for the SDG4 by using these indicators. PCA method was utilized to determine the weights of each indicator in this index. Thus, Türkiye's progress on the SDG4 were mapped out.

Keywords: sustainable development goals, SDG, SDG4, education, TOPSIS.

Introduction

In 2015, the United Nations (UN) launched the Sustainable Development Goals (SDGs) 2030, which comprises 169 targets under 17 main universal goals for all countries across the globe to provide a sustainable development path until 2030. Goal 4 (henceforth called the 'SDG4') is related to the site of education and is delineated as "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" (United Nations, 2015b). Occupying a profound role in global education governance discourse, SDGs mainly treats education as a prominent figure in promoting sustainable development. The seven targets adopted in SDG4 embrace a comprehensive format, ranging from universal education enrolment to quality education at all levels and lifelong learning. The SDG4, which supersedes the Millennium Development Goals (MDGs) adopted in New York in 2000, goes beyond the education vision of MDGs. The targets related to education endorsed at MDGs were to ensure that all children complete primary education and to eliminate the gender gap in education by 2015. Although the schooling rate in primary school, including girls, was considerably raised in the context of the MDGs (United Nations, 2015a), severe educational problems remain after the MDGs. MDGs narrowed the wide-ranging concern in education (Unterhalter and Dorward, 2013), overlooked the significance of learning outcomes and neglected what procedures, processes and factors lead to quality education. The SDG4 was developed from the lessons learned in the MDGs process (Kumar et al., 2016), and the SDG4 is therefore broader in terms of its purpose and context (Fukuda-Parr, 2016). Given the overarching context of SDGs regarding inequality, gender, inclusiveness, learning outcomes, etc., there has been a concern

about measuring educational targets in the context of SDG4, unlike MDGs (Brolan, 2016; Unterhalter, 2019). Accordingly, SDG4 represents a remarkable example in the midst of debates over whether the development of education is measurable.

Although there are many discussions in the literature regarding the impossibility of measuring quality education and educational progress has been a basic approach utilized by many stakeholders who address quality education from a broad or narrow perspective. Given the significance of measuring states' performance in SDG4, the UN has set 12 indicators related to its global education targets. Many say that the indicator-based approach in SDG4 is a useful tool for holding governments accountable and serving evidence-based policymaking (see Davis et al., 2012; Eurostat, 2014; Birdsall et al., 2016; Allen at al., 2017).

Nevertheless, some call the UN-determined global sustainability indicators an "unprecedented statistical challenge" (MacFeely, 2020), citing their concerns over the extent of the comprehensiveness of the indicators for the targets (King, 2017). In that regard, the availability of data in a national context, the lack of a common understanding of education for sustainable development among stakeholders and differentiated country circumstances and needs lead governments and scientific studies to resort to indicators different from those put forward by the UN. Alongside the issues of indicator selection, there are several measurement methods and technics to measure progress in SDG4. The complex networks and relations in quality education have made the measurement of 'quality education' a highly contentious issue. The idiosyncrasies of quality education and the aforementioned factors affecting the indicator selection as a whole shape the measurement methods used to describe progress in SDG4. In a nutshell, the literature shows a range of indicator selection and various measurement methods in the context of SDG4.

Being aware of the significance of a tailored approach to specific needs and country circumstances in measuring SDG4, as noted by Firoiu et al. (2019), in this article, we have formulated a measurement method specific to the Turkish context to map Türkiye's progress in implementing SDG4 since 2015. Therefore, our guiding research question is: "to what extent has Türkiye shown progress in achieving education for sustainable development since 2015?". Türkiye constitutes a peculiar case. There is starkly limited academic research on the measurement of Türkiye's progress in SDG4. Moreover, the Voluntary National Reviews, through which countries submit to the High-Level Political Forum (HLPF) for Sustainable Development (HLPF) under the UN, allow making country-level assessments of SDG progress. VNRs basically represent the countries' efforts to achieve SDGs. In that regard, the VNRs submitted by Türkiye to the HLPF, in 2016 and 2019 respectively (Türkiye 1st VNR, 2016; Türkiye 2nd VNR in 2019), merely depict a descriptive picture of Türkiye and do not allow an indicator-based assessment. Presenting perspectives on the trend in SDG4, this research aims to illustrate how Türkiye has made progress in SDG4 since 2015, thus highlighting the sites of education that need improvement.

On the other hand, the aforementioned gap in empirical study regarding the Turkish context is partly based on the lack of a common concept among stakeholders in education regarding the interpretation of SDG4. The interpretation of the SDG4 is needed in order to generate a common understanding in the national context. In this regard, we also aim to create an impetus to initiate the interpretation of SDG4 in Türkiye and then to encourage other studies on measuring SDG4 in the Turkish context.

For this purpose, SDG4 for Türkiye was measured and this index was compared on annual base. Regarding the selection of these indicators, recalling the OECD (1996)'s approach , which reports that quantitative targets defined in the global policy agenda should be pursued by using individual approaches at the country level, we have identified 12 indicators to measure the education for sustainable development in this research. These indicators were formed under four thematic headings, namely early childhood education, basic education, higher education and lifelong learning. Thematic areas were selected to cover all sites of education with the exception of vocational and technical education, where data availability is limited. Under these four umbrella headings, we have adopted an essentially pragmatic focus in the data selection and prioritized the relevance of indicators to the quality education goal, which is central to SDG4.

In this article, we have applied the Proponent Component Analyses (PCA) to portray Türkiye's progress in the implementation of SDG4. First of all, PCA was used to determine the weight of 12 indicators for the value to be created. Then, the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method was used to calculate a single index value to measure the SDG4 performance of Türkiye.

This article consists of seven sections. First, we will review the attempts in measuring performance in the context of SDG4, both in terms of measurement methods and indicator selection. Next, we will provide an overview of Türkiye's assessment of SDG4 performance. Subsequently, we will address theoretical background of particular measurement methods applied in measuring and monitoring SDG. This is followed by the methodology and data selection we have applied to measure Türkiye's performance in SDG4 since 2015. Lastly, the results and analyses will be presented, and recommendations for further studies will be noted.

In addition, it is worth acknowledging the limitation of this article. Considering the comparative education literature, which draws attention to the immeasurable characteristics of education by its nature, this paper offers a limited perspective in terms of fully capturing all aspects of the complex dynamics in the Turkish education system. Accordingly, this research should be complemented by further research focusing on how different interactive dynamics in the site of education lead to particular outcomes. Another limitation is related to the data selection. The data selection in this research is based on data currently available for Türkiye. This raises concerns about better capturing Türkiye's progress in SDG4. Similarly, another point about data is that the period 2015-2020 is used for the data selection, since 2015 is the year in which the SDGs were launched. As such, we did not handle a more extended analyse period. That's being the case, this research can be presumed as a starting point, which will be accompanied by other studies incorporating datasets with longer time intervals.

Attempts to measure the progress in SDG4

Given the fact that the focus of SDG4 is quality education, the existence of international large-scale assessments (ILSAs) (i.e. Programme for International Student Assessment-PISA, Trends in International Mathematics and Science Study-TIMSS, etc.), which mainly measure the human capital on a global scale, has both accelerated and facilitated benchmarking of countries' progress on SDG4 via different measurement methods. The comparative education literature criticizes the measurement methods of educational quality led by International Organisations (IOs) with a political instinct because of presenting the complex information ostensibly in a simplified format (see Cowen, 2014; Gorur, 2014; Unterhalter, 2017; Unterhalter, 2019; MacFeely, 2020). Quality education goal is, in its nature, abstract and cannot be reduced to a

learning outcome, such as test performance, and cannot be simply quantified. The complex characteristics of relationships and networks within education, the existence of social and cultural dynamics and therefore, their impacts on education pose a challenge regarding fully capturing the quality education issues via measurement methods. Bringing this discussion in the comparative education literature to the fore in the SDG context, Unterhalter (2017:2) delineate SDG4 as an attempt to "measure the unmeasurable". Her stance highlights a challenge for the attempts to measure the progress of nation-states in SDG4.

Then, with regard to the discourses above, why do we desire to measure Türkiye's progress in SDG4? Concrete indicators and measurement methods are needed to grasp and implement global education targets at the national level. Although there are debates about the fact that embracing this precision in education obscures the significance of education, herein, we aim to show a reflective practice in the Turkish case. While measurement depicts the de facto picture of countries' performance, it also triggers to ensure accountability, boost the quality of education and thus unearth societies' potential. Davis et al. (2012), Eurostat (2014) and Allen et al. (2017) draw attention to the importance of using data in education for sustainable development which constitutes evidence in the policymaking process and yields comprehensible messages for the public and policymakers. In that regard, there are studies which comprise indicator-based measurement based on a single country and multiple country comparisons (i.e. Munda, 2005; Allen et al., 2017; Allen et al., 2018; Unterhalter, 2019). Various studies conducted by both IOs and academia apply multi-criteria methods and several sustainability indicators to portray progress in the SDG4. However, studies using quantitative measurement methods based on sustainability indicators note their awareness of how the complex characteristics of education for sustainable development pose a challenge in measurement (see Cinelli et al., 2014; Kioupi and Voulvoulis, 2019; Roszkowska and Filipowicz-Chomko, 2020; Momete and Momete, 2021). This shows that this is not only the concern of proponents who argue that measurement methods are not applicable to education, but this is also fully appreciated by many engaged with measurement methods.

A Brief overview of SDG4 in the Turkish context

SDG2030 is a universal, inclusive, and results-oriented vision that provides a policy framework for all countries and societies, including the so-called least developed, developing and developed countries, to direct their development towards sustainable development, with the slogan of "leaving no one behind" on a global scale. With this SDG framework, what is expected from countries is to ensure development in all dimensions within the framework of their own unique conditions and to the extent of their possibilities. Following the SDG2030 agenda adopted in 2015 after lengthy intergovernmental negotiations, the implementation phase of the SDG2030 was started on 1 January 2016. With regard to the implementation of the SDGs, the former Ministry of Development and later Presidency of the Republic of Türkiye Presidency of Strategy and Budget (SB) deployed the task of national focus and coordination in Türkiye. Türkiye does not have a separate SDG national framework and addresses the SDG through its existing Development Plans. SB is the authority responsible for publishing Development Plans for five-year period, which mainly frame and guide economic, social, and cultural agenda. Development Plans, the highest-level policy document, include policies that public institutions in Türkiye should enforce. The policies adopted in Development Plans serve as a guide for the private sector. Addressing the SDGs through the Development Plans ensures that the targets are reflected in all sectoral or thematic national policy and strategy documents (Presidency of the Republic of Türkiye Presidency of Strategy and Budget, 2022). However, when the

Eleventh Development Plan (2019-2023) in force is examined, it is not easy to assess and monitor Türkiye 's performance in SDGs on an indicator-basis through Development Plans.

Regarding the monitoring and review of countries' progress in SDGs, the High-Level Political Forum (HLPF) organized under the UN General Assembly is the competent body responsible for this task. The HLPF hosts heads of state every four years. Reviewing countries' progress is conducted on a voluntary basis. In this regard, countries submit to the HLPF the Voluntary National Reviews (VNRs), policy documents that address the extent to which the SDGs have been achieved. In VNRs, countries make self-assessments of their progress. Türkiye submitted two VNRs to the HLPF in 2016 and 2019, respectively. With regard to the SDG4, the Turkish VNRs mainly include the national policy framework, official descriptive statistics (i.e. schooling ratio, the number of students per classroom, etc.), and activities that serve to reach the so-called quality education, such as updating education programs, increasing financial support, providing free transportation, ensuring internet connection to the schools, and installing smart blackboards, etc. (Türkiye 1st VNR, 2016; Türkiye 2nd VNR in 2019). However, both Turkish VNRs merely depict a descriptive picture of Türkiye and do not supply comprehensive information on indicator-based progress. In that sense, the VNRs provide limited answers to the question of what steps Türkiye should take in the future to reach SDG4, based on the lessons learned from past experiences.

Besides, with regard to establishing a national monitoring and evaluation system of SDGs, the national authority responsible for monitoring and reviewing, namely the Turkish Statistical Institute (Türkiye İstatistik Kurumu, TURKSTAT), has published the sustainability indicators covering the years 2010-2019 since 2019. In the context of education, data on nine sustainability indicators can be accessed (TURKSTAT, 2019). While TURKSTAT mainly organizes the sustainability indicators by referring to 12 reference indicators published by the UN, some indicators in education differ from those in the UN. Further, all datasets in education published by TURKSTAT were not regularly produced between 2010 and 2019, and the data availability problem exists in that regard.

Apart from the statistical data, the international reports and national policy documents are helpful in monitoring Türkiye 's performance in SDG4. The Sustainable Development Reports, published annually by the UN since 2015, reveal the performance of countries comparatively. These Reports are based on the results of the SDG Index and Dashboards, created by Bertelsmann Stiftung and the UNSDSN. Bertelsmann Stiftung and UNSDSN have created the SDG Index and Dashboard to help countries measure their SDGs, as alluded to above, and view their future progress, using comparable scores and rankings for all countries in the same indicator basket. In this context, the 2021 Sustainable Development Report published by the UN lists Türkiye's overall SDG performance in 70 out of 165 countries and states that Türkiye has progressed in SDG4. In addition, Türkiye's Evaluation Report on Sustainable Development Goals was published by SB in 2019. The Report exhibits where Türkiye stands in the year 2017 regarding SDGs, and it fundamentally addresses the existing state of Türkiye in terms of policy, legislation, institutional framework and particular projects on the basis of each goal. Although the Report points to areas that need improvement in terms of SDG4, progress on the basis of indicators is interpreted by considering the net schooling ratio, early school leavers, and the literacy rate, which are input indicators. As such, our research occupies to present a more holistic trend analysis covering input indicators as well as output indicators.

Theoretical Background

The complex structure of education for sustainable development and lack of common accepted 'sustainability' understanding across the globe have resulted in applying various technics in measuring the progress of nation-states toward SDG4. With reference to a range of techniques/methods, Bidarbakhtina (2020) highlights the raising question of 'what is the most convenient method to monitor countries' progress?'. Selecting appropriate sustainability indicators and methods is delineated as a part of the decision-making puzzle (Munda, 2005), and embracing a method and/or particular indicators leads to an opportunity cost because of crowding out the other methods and/or indicators. Revisiting the views of Munda (2005) in terms of the selection of indicators, Fukuda-Parr and McNeill (2019) point out that the choice of sustainability indicator can change or weaken or distort the meaning of the goal. The choice of methods and/or indicators depends on data availability, the size of the data set, and which data/method best fits the country's circumstances and ambitions for SDG4. As a solution to the decision-making puzzle stated above by Munda (2005), Eurostat (2014) proposes two main approaches to the selection of sustainability indicators: (1) a policy-based perspective and (2) conceptual perspective. In the first approach, the structure of indicators mainly is drawn from a national development policy framework. Accordingly, the objectives and themes in the development framework shape the selection of indicators. The latter considers the relation between different targets and is derived from thematic issue selection. Thematic issue selection can be based on a policy framework or independent from a policy document. Embracing conceptual approaches facilitate what to measure and how to measure SDG4. As such, this research occupies the conceptual perspective in the selection of sustainability indicators.

IOs also offer various indices to measure countries' progress in SDG. The United Nations Sustainable Development Solutions Network (UNSDSN) and Organization for Economic Cooperation and Development (OECD) use aggregate indexes which benchmark country performances based on comparison with other country examples (OECD, 2017; OECD, 2019). Showing how countries perform in SDG with respect to the best and/or worst performers and therefore, ranking spur the public awareness. However, MacFeely (2020) argues that international comparison of data has remained a problem despite all attempts shown by IOs, and the SDG process has aggravated this concern. Recalling this argument, we are, herein, occupied with the indices that measure a single country's performance on a country basis, not by measuring it in comparison with the other country instances, because our primary goal is not to locate Türkiye's performance compared with its counterparts. At this point, the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) uses methods which assess every country individually. These methods are the 'current status index (CSI)' and the 'anticipated progress gap (APG)' (Bidarbakhtina, 2020). While the CSI measures the extent to which a specific target has been achieved, the APG measures the value the indicator can reach by 2030. Therefore, showing the predicted value of a particular indicator for 2030, the APG signifies for which targets nations should take additional measures. In this research, we fundamentally focus on the rationality which is embedded in the CSI approach.

Most of the studies done in measuring countries' achievements in SDG4 focus on portraying the variations between countries through comparison. For instance, Singth et al. (2009) point out the use of composite indices for sustainable development and they refer to the scaling, weighting and normalization methodology. Some uses the multi-criteria methods-also called as 'Multi-Criteria Decision Analysis (MCDA)' in literature- to measure and monitor sustainability. Munda (2005) signifies MCDA as an appropriate measurement method for monitoring sustainability. Boggia and Cortina (2010) apply MCDA method to rank the areas

which need progress. They address sustainability indicators, such as socio-economic and environmental indicators, to show the development of the Umbria region in Italy by conducting multi-criteria measurement method. Roszkowska and Filipowicz-Chomko (2020) also uses the extended TOPSIS method as one of the method of MCDA to show whether there are disparities across European Union countries in terms of SDG4. The MCDA method is also used in other fields of sustainable development. Boggia et al. (2018) uses the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method to assess and monitor the environmental, economic and social sustainability of Malta's sub-regions. Mateusz et al. (2008) apply the TOPSIS method to asses and compare the sustainable development of EU countries. The multi-criteria technics applied in the studies aforementioned are mainly aimed to make cross-country and/or cross-regions comparison.

There is a limited research mainly reveals to what extent SDG4 has been achieved in a single country context. It has been observed that different measurement methods and data selections are used in studies carried out in the context of a single country. This draws attention to variations in the conceptualization of SDG4 and the corresponding emergence of specific approaches specific to the country context. Studies handling a specific country context complete quantitative measurement method with qualitative approaches, or at least signify the importance of qualitative studies as a compensatory tool (see Szymańska and Zalewska, 2021). On the other hand, as Prieto-Jiménez et al. (2021) noted in their research, a limited number of scientists have studied this field across the globe. Many (i.e. Allen et al., 2017; Momete and Momete, 2021, etc.) starkly underpin this argument in their studies. This is also the case for the Turkish context. As far as we know, there are extremely limited studies on measuring Türkiye's progress in SDG4 by applying a multi-criteria approach. As such, the dominant appearance of IOs is evident in measurement methods, mainly allowing international comparison, as alluded to above.

In a nutshell, the literature on whether SDG4 is measurable presents inconclusive findings. The limited work done in the quantitative measurement of SDG4 draws attention to the use of factors specific to the case country. As such, a cocktail of measurement methods exists.

Methodology

In this section, a brief review will be made of Principle Component Analysis (PCA) and TOPSIS methods used in the article.

The indicators we choose for the education for sustainable development, namely SDG4 target, were first weighted with the PCA method. Thus, the weights of each indicator in the analysis were obtained through the PCA method. Then, the progress in education for sustainable development for Türkiye from 2015 to 2020 was revealed by using the TOPSIS method on the weighted indicators. A brief review of PCA and TOPSIS methods is stated below.

Principle Component Analysis (PCA)

PCA is the oldest and best-known technique of multivariate analysis and is used to examine the structure of the relationship between variables. The basic idea of this technique is to explain the data set containing many variables related to each other with fewer variables (Jollife, 1986). This technique, which is generally used for the purpose of eliminating the dependency structure between the variables and/or reducing the size, is not only an analysis on its own but is also used as a data preparation technique for other analyses. The PCA calculates the importance of

the eigenvalues in order of magnitude, taking advantage of the fact that the eigenvectors corresponding to the eigenvalues of the correlation or covariance matrix are independent of each other. In this article, 12 indicators cited in the section 'Data' were weighted by using this method. These weights obtained for 12 indicators were used to calculate the sustainability index in education, and this index was created for each year from 2015 to 2020.

Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)

TOPSIS, one of the methods used in the decision-making process, is a technique that allows the best choice among all alternatives. TOPSIS is one of the multi-objective decision-making methods developed by Hwang and Yoon in 1981. The TOPSIS method is a very basic method that does not involve complex algorithms and complex mathematical models. TOPSIS technique is used in almost many fields because it is easy to understand, and it is not difficult to interpret the results. The TOPSIS method is one of the most used techniques in the literature due to its advantages such as rationality and easy understanding, simplicity in calculation and weighting of evaluation criteria (Behzadian et al., 2012). The TOPSIS method is a method based on the idea of the shortest distance to the positive-ideal solution and the longest distance to the negative-ideal solution of the solution alternative, and the steps outlined below are followed in this method (Monjezi et al., 2010; Alpaykurt, 2017).

Step-1: Creating the decision matrix

Step-2: Normalizing the decision matrix

Step-3: Obtaining the weighted normalized decision matrix

Step-4: Calculation of positive and negative ideal solution sets

Step-5: Making discrimination measurements

Step-6: Calculating the relative closeness to the ideal solution

Data

In the context of quantitative measurements, input indicators (i.e. schooling ratio, the number of students per class, etc.) and/or output indicators (i.e. achievement in basic skills, etc.) are generally resorted in many studies (see also Roszkowska and Filipowicz-Chomko, 2020; Szymańska and Zalewska, 2021). Although the UN Statistical Commission basically set 12 normative indicators in SDG4 as a starting point in March 2017, the UNESCO (2014) and OECD (1996) signify the data gathering according to the country circumstances. Since the term 'sustainability' is inherently ambiguous and is open to interpretation in the nation-state context, country circumstances and priorities mainly shape the data selection. Acknowledging this fact, we identified 12 indicators in this research. Besides, in the selection of indicators, we applied the conceptual perspective as explained in section 'Attempts to measure the progress in SDG4'. This research is based on data for the period 2015-2020. The data sources in this research are Türkiye Ministry of National Education, TURKSTAT, OECD and the EUROSTAT databases. Given the limited data availability, indicators were selected in a way that allows us to analyse them. Regarding the selection of indicators, we prioritized their relevance to the quality education goal, which is central to SDG4. The list of the indicators is categorized under four thematic themes that reflect each site of education. The vocational and technical education is

not included here due to lack of data. Selected indicators and four thematic themes are listed as follows:

A1. Early childhood education

Net schooling ratio in pre-primary education by age1

A2. Basic education

Completion rate by education level2

Early leavers from education and training of population aged 18-243

Young people (aged 15-34) neither in employment nor in education and training4

The proportion of children achieving at least a minimum proficiency level in mathematics5

A3. Higher education

Gross enrolment ratio for tertiary education7

Net enrolment ratio for tertiary education8

Graduates in tertiary education by age groups9

Employment rates by tertiary education level10

A4. Lifelong learning

Adult participation (aged 25 to 64) By din learning11

Indicators under these four thematic headings will be used in the article as determinants of sustainability in education. The descriptive statistics table of the variables included is below.

Variable	Obs	Mean	Std. Dev.	Min	Max
aged 3-5 net schooling ratio in pre-primary education by age	6	3.608.833	4.809.455	28.35	41.78
aged 4-5 net schooling ratio in pre-primary education by age	6	46.51	593.582	36.79	52.41
primary education completion rate by education level	6	98.65	0.697854	98	100
lower secondary education completion rate by education level	6	9.411.666	3.849.371	88.9	97.7
upper secondary education completion rate by education level	6	6.553.333	3.818.726	59.7	70.3
Early leavers from education and training of population aged 18-24 (%)	6	31.6	3.575.472	26.7	36.4
Young people (aged 15-34) neither in employment nor in education and training	6	3.028.333	1.756.606	29.1	33.6
Gross enrolment ratio for tertiary education (%)	6	1.075.433	7.748.893	95.91	117.7
Net enrolment ratio for tertiary education (%)	6	43.35	1.775.984	40.87	45.64
Graduates in tertiary education by age groups - per 1000 of population aged 20-29	6	5.063.333	2.728.858	48.3	55
Employment rates by tertiary education level	6	7.123.333	173.282	68	73
Adult participation (aged 25 to 64) in learning in the four weeks	6	5.8	0.228035	5.5	6.2

Table 1. Descriptive statistics.

Within the scope of the article, we calculated the SDG4 performance as an index for Türkiye between the years 2015-2020 using these indicators. Thus, we aim to find how far Türkiye has shown progress on sustainable development in education since 2015.

Results

The main purpose of this article is to rank where Türkiye stands for the SDG4 by years. In this direction, the PCA method was used to determine the weights of the variables required for this method. While determining the weights of the variables, the average of the weights of all the variables among all the statistically significant (eigenvalues greater than 1) components was used, instead of only basing the first principal component or determining the weights according to different principal components.

Variables	Label	Weights
aged 3-5 net schooling ratio in pre-primary education by age	x1	4.080%
aged 4-5 net schooling ratio in pre-primary education by age	x2	2.440%
primary education completion rate by education level	x3	0.210%
lower secondary education completion rate by education level	x4	18.950%
upper secondary education completion rate by education level	x5	2.000%
Early leavers from education and training of population aged 18-24 (%)	x6	1.350%
Young people (aged 15-34) neither in employment nor in education and training	x7	2.060%
Gross enrolment ratio for tertiary education (%)	x8	1.420%
Net enrolment ratio for tertiary education (%)	x9	15.820%
Graduates in tertiary education by age groups - per 1000 of population aged 20-29	x10	0.060%
Employment rates by tertiary education level	x11	2.040%
Adult participation (aged 25 to 64) in learning in the four weeks	x12	37.060%

Table 2. Variable weights determined by PCA

By using these weights obtained as a result of the PCA Analysis, the sustainable education index for Türkiye between the years 2015-2020 were generated. The TOPSIS results are shown in Table 3 below.

Year	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10	x11	x12	Index	Rank
2015	0.015	0.015	0.017	0.017	0.015	0.019	0.016	0.015	0.016	0.016	0.017	0.016	0.3103	**6**
2016	0.016	0.016	0.017	0.016	0.016	0.018	0.016	0.016	0.016	0.016	0.017	0.017	0.4380	**5**
2017	0.018	0.018	0.017	0.016	0.017	0.017	0.016	0.017	0.018	0.016	0.017	0.017	0.6215	**3**
2018	0.018	0.018	0.017	0.017	0.017	0.016	0.016	0.017	0.017	0.017	0.017	0.018	0.7273	**2**
2019	0.019	0.019	0.017	0.017	0.018	0.015	0.017	0.017	0.017	0.017	0.017	0.016	0.8042	**1**
2020	0.013	0.013	0.017	0.017	0.017	0.014	0.018	0.018	0.017	0.018	0.016	0.017	0.4441	**4**

Table 3. Türkiye's Education Index Ranking by Years for Sustainable Development Goals4

As seen in Table 3, 2019 is the year with the highest educational performance for sustainable development goals in Türkiye. 2019 is followed by 2018, 2017, 2020, 2016 and 2015,

respectively. Although Türkiye showed progress in sustainable development for education between 2015 and 2019, there was a sharp decrease in 2020. Türkiye's performance in 2019 was approximately three times higher than that one in 2015. The main factor contributing to the increase in performance between 2015 and 2019 is related to the input indicators, such as the rise in the pre-primary enrolment rate and gross enrolment ratio in tertiary education. That's being the case, with the sharp decrease in the enrolment rates due to the Covid-19 pandemic, we see a dramatic decline in the sustainability index.

Conclusion and Recommendations

This article focuses on how Türkiye has shown progress in education for sustainable development. Regarding measuring countries' performance in SDG4, various multi-criteria methods based on different data sets are utilized. Although the UN has set 12 indicators related to SDG4 as a starting point for countries, data selection on a country basis for measuring the SDG progress is fundamentally based on the country-specific context and data availability. In this context, being aware of the significance of a tailored approach to specific needs and country circumstances in measuring SDG4, the selected indicators concerning the Turkish case in this article were analysed using PCA and TOPSIS methods. In doing so, our main aim is to map where Türkiye stands through intertemporal times between 2015 and 2020.

PCA and TOPSIS were applied to show Türkiye's progress in the implementation of SDG4. PCA was used to determine the weight of the indicators for the value to be created. Then, the TOPSIS method was used to calculate a single index value to measure the SDG4 performance of Türkiye. According to the results obtained, the educational performance values for Türkiye's SDG vary from year to year. While there is a gradual increase in the index value calculated between 2015 and 2019, the decrease in 2020 is noteworthy. While the index value of 2015 is nearly less than tripled the index value of 2019, the index value for 2020 is almost close to the index value of 2016. The sharp decrease in the index value of 2020 can be attributed to the decline in the enrolment rates because of the pandemic.

This study provides a useful literature contribution to serve evidence-based policy making for SDG4. For the first time, this article puts forward a study that will evaluate Türkiye's SDG4 performance not by comparing it with other countries, but by comparing Türkiye with itself. It can be a starting point for future Türkiye-specific studies that will evaluate a country's performance concerning a country-specific context. On the other hand, SDG4 covers a range of issues with regard to the quality education, such as effective learning environments, inclusiveness, citizenship rights, learning outcomes, etc. Due to the lack of updated and regular data availability for these indicators, this research is predominantly based on input indicators. With the regular production of statistics on these indicators in the Turkish context, this research can be advanced.

Notes

1. Net schooling ratio in pre-primary education by aged 3-5 and aged 4-5, Türkiye Ministry of National Education formal education statistics (2021)
2. Completion rate in primary, lower secondary and upper secondary education, TUIK data (2020)
3. Early leavers from education and training of population aged 18-24, EUROSTAT data (2022)

4. Neither in employment nor in education and training for young people aged 15-34, EUROSTAT data (2022)
5. The percentage of students showing underachievement in reading, mathematics and science of 15-year-old students in PISA Survey, OECD data (2021)
6. Gross enrolment ratio at the tertiary education, Türkiye Ministry of National Education formal education statistics (2021)
7. Net enrolment ratio at the tertiary education, Türkiye Ministry of National Education formal education statistics (2021)
8. Share of graduates in tertiary education by age groups per 1000 of the population aged 20-29, EUROSTAT data (2022)
9. Employment rates by tertiary education level, EUROSTAT data (2022)
10. The participation rate of youth and adults aged 25 to 64 who stated that they received formal or non-formal education and training in the four, EUROSTAT data (2022)

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