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Ranking of the States of India
Based on Higher Education Development Indicators

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Abstract:
Quality education fosters creativity and knowledge, and ensures the acquisition of the foundational skills of literacy and numeracy as well as analytical, problem solving and other high-level cognitive, interpersonal and social skills. It includes equitable and increased access to quality technical and vocational education and training and higher education and research, with due attention to quality assurance. The provision of flexible learning pathways, as well as the recognition, validation and accreditation of the knowledge, skills and competencies acquired through non-formal and informal education, is important. It is also committed to strengthening science, technology and innovation. Information and communication technologies (ICTs) must be harnessed to strengthen education systems, knowledge dissemination, information access, quality and effective learning, and more effective service provision. According to the UNESCO report 2015, indicators will be based on five criteria: relevance, alignment with the concepts in the target, feasibility for regular (but not necessarily annual) data collection across countries, ease of communication to a global audience, and interpretability. An attempt has been made to quantify the higher education development using the indicators in the line of UNESCO Education 2030 agenda. Thereby, the states have been ranked.

1. Introduction
→   In our world, knowledge is power, and education empowers. It is an indispensable part of the development equation. It has intrinsic value – extending far beyond the economic – to empower people to determine their own destiny. That is why the opportunity to be educated is central to advancing human development.   -- Helen Clark, UNDP Administrator

The United Nations' vision of the worldwide movement for Education for All (EFA) initiated in Jomtien in 1990 and reiterated in Dakar in 2000, helped to drive a significant progress in education. UN reaffirmed the vision which reflected in numerous international and regional human rights treaties that stipulate the right to education and its interrelation with other human rights. Still it is recognized with great concern that we are far from having reached education for all.

The Muscat Agreement developed through broad consultations and adopted at the Global Education for All Meeting 2014, successfully informed the proposed education targets of the Open Working Group on Sustainable Development Goals (SDGs). It recognized the important contribution of the Global Education First Initiative as well as the role of governments and regional, intergovernmental and non-governmental organizations in galvanizing political commitment for education. Having taken stock of progress made towards the EFA goals since 2000 and the education-related Millennium Development Goals (MDGs) as well as the lessons learned, and having examined the remaining challenges and deliberated on the proposed Education 2030 agenda.

Our vision is to transform lives through education, recognizing the important role of education as a main driver of development and in achieving the other proposed SDGs. It is an urgency to a single, renewed education agenda that is holistic, ambitious and aspirational, leaving no one behind. It is transformative and universal, attends to the 'unfinished businesses of the EFA agenda and the education-related MDGs, and addresses global and national education challenges. It is inspired by a humanistic vision of education and development based on human rights and dignity; social justice; inclusion; protection; cultural, linguistic and ethnic diversity; and shared responsibility and accountability. We reaffirm that education is a public good, a fundamental human right and a basis for guaranteeing the realization of other rights. It is essential for peace, tolerance, human fulfilment and sustainable development. It is recognized that education is as key to achieving full employment and poverty eradication. It will focus on access, equity and inclusion, quality and learning outcomes, within a lifelong learning approach. It will ensure the provision of 12 years of free, publicly funded, equitable quality in education with relevant learning outcomes. Therefore, it will commit to addressing all forms of exclusion and marginalization, disparities and inequalities in access, participation and learning outcomes. No education target should be considered met unless met by all. It is committed to making the necessary changes in education policies and focusing our efforts on the most disadvantaged, especially those with disabilities, to ensure that no one is left behind to achieve the right to education for all. So, it is committed to support gender-sensitive policies, planning and learning environments; mainstreaming gender issues in teacher training and curricula; and eliminating gender-based discrimination and violence in schools towards quality education and to improving learning outcomes, which requires strengthening inputs, processes and evaluation of outcomes and mechanisms to measure progress.

It will ensure that teachers and educators are empowered, adequately recruited, well-trained, professionally qualified, motivated and supported within well-resourced, efficient and effectively governed systems. Quality education fosters creativity and knowledge, and ensures the acquisition of the foundational skills of literacy and numeracy as well as analytical, problem solving and other high-level cognitive, interpersonal and social skills. It also develops the skills, values and attitudes that enable citizens to lead healthy and fulfilled lives, make informed decisions, and respond to local and global challenges through education for sustainable development (ESD) and global citizenship education (GCED). This includes equitable and increased access to quality technical and vocational education and training and higher education and research, with due attention to quality assurance. Further, the provision of flexible learning pathways, as well as the recognition, validation and accreditation of the knowledge, skills and competencies acquired through non-formal and informal education, is important. It is also committed to strengthening science, technology and innovation. Information and communication technologies (ICTs) must be harnessed to strengthen education systems, knowledge dissemination, information access, quality and effective learning, and more effective service provision. A strong global and regional collaboration, cooperation, coordination and monitoring of the implementation of the education agenda are based on data collection, analysis and reporting at the country level. It is recommended to increase public spending on education in accordance with country context, and urge adherence to the international and regional benchmarks of allocating efficiently at least 4 - 6% of Gross Domestic Product and/or at least 15 - 20% of total public expenditure to education. It is further entrusted UNESCO, as the United Nations' specialized agency for education, to continue its mandated role to lead and coordinate the Education 2030 agenda. UN further request the WEF 2015 co-convenors and partners to support capacity development in data collection, analysis and reporting at the country level. Countries should seek to improve the quality, levels of disaggregating and timeliness of reporting to the UNESCO Institute for Statistics20.

Gross Enrolment Ratio (GER) is the total enrolment in a specific level of education, regardless of age, expressed as a percentage of the eligible official school-age population corresponding to the same level of education in an year1,2,3,6,7,9,11,12. The purpose is to show the general level of participation in a given level of education. It indicates the capacity of the education system to enrol students of a particular age group. It can also be a complementary indicator to net enrolment rate (NER) by indicating the extent of over-aged and under-aged enrolment. It is the number of pupils (or students) enrolled in a given level of education regardless of age by the population of the age group which officially corresponds to the given level of education, and multiply the result by 100. It this communication, it is attempted to frame an index to quantify higher education status of the states in India and thus ranking the states of India will be made. It is the first step in the series where all the criterion discussed in UNESCO report have not been included due to lack of data. In absence of data, the true mathematical model/s may not concrete and complete. Further modifications are in process.

2. Data

Following the UNESCO report 2015, indicators will be based on five criteria: relevance, alignment with the concepts in the target, feasibility for regular (but not necessarily annual) data collection across countries, ease of communication to a global audience, and interpretability. For some targets, indicators are already available for a large number of countries. For others, efforts are required to build countries' capacity to collect and use data. Monitoring quality in education requires a multidimensional approach covering system design, inputs, content, processes and outcomes. The draft report indicated the following as indicators -per capita income, household size, female literacy rate, percentage of urbanisation, total number of students passed out, percentage of institutions with Wi Fi facilities, percentage of students with ICT facilities, percentage of institutions having infrastructure and materials for disabilities, percentage of students getting scholarship, Pupil Teacher Ratio, average salary per teacher, proportion of females (female enrolment / male enrolment), percentage of filled up teachers, Staff per student, percentage of private institutions, percentage of institutions (colleges) having NAAC accreditation (active), number of books per student, population in the age group 18-23 years, percentage of enrolment in distance mode and average expenditure per student.

AISHE has been taken as main source of data. The following variables are being used for indexing the higher education growth in 2014-15. The AISHE survey for 2014-15 was closed on 31.03.2016. The responses from the states of India for 2014-15 are almost complete. The reports were considered from the portal www.aishe.gov.in. The author being APEX user of the portal (as approved by MHRD), the state-wise reports downloaded and put into the common database. The reports are considered and the following variables(X) are being considered for analysis - per capita income 2011-12 (X_{01}); household size 2011 (X_{02}); female literacy rate 2011 (X_{03}); percentage of urbanisation 2011 (X_{04}); total number of students passed out 2014-15 (X_{05}); percentage of institutions with Wi Fi facilities 2014-15 (X_{06}); percentage of students with ICT facilities 2014-15 (X_{07}); percentage of institutions having infrastructure and materials for disabilities 2014-15 (X_{08}); percentage of students getting scholarship 2014-15 (X_{09}); Pupil Teacher Ratio 2014-15 (X_{10}); average salary per teacher 2014-15 (X_{11}); proportion of females (female enrolment / male enrolment) 2014-15 (X_{12}); percentage of filled up teachers 2014-15 (X_{13}); Staff per student 2014-15 (X_{14}); percentage of private institutions 2014-15 (X_{15}); percentage of institutions (colleges) having NAAC accreditation (active) July 2016 (X_{16}); number of books per student 2014-15 (X_{17}); population in the age group 18-23 years 2015 (X_{18}); percentage of enrolment in distance mode 2014-15 (X_{19}); average expenditure per student 2014-15 (X_{20});

3. Analysis

X_{ij} is the value of X_i (ith variable) corresponding to jth state; i=01(1)20(p) and j=1(1)31.

It is to note that the variables are in different scales and units. To make variables comparable, a standardised transformation is used as follows –

For fixed j, $Z_{ij} = (X_{ij} – Minimum\ value)/ (Maximum\ value – Minimum\ value)$ for each of the variables, i=01(1)20 and j=1(1)31. It is to note that each Z_{ij} lies between 0 and 1.

PCA is used on Z_{ij}`s to determine weights for each variables and each state. The factor weights(F1 and F2) are being used as weights for variables.

The jth State index $SI1_j = \sum_{i=0}^{p}$ $\{W1_{ij}Z_{ij}\}$ …………….. ………………… ……………….………… (1)

Where Z_{ij} = the transformed score for ith variable and jth State

$W1_{ij}$ = the weight for ith variable as contributions (F1) (obtained using PCA) and jth State; i = 01,02, …., 20(p),   j = j th State – Andhra Pradesh, …., West Bengal.

The model using (1) is

$SI1 = 0.000073*Z_{01} + 0.000607*Z_{02} + 0.024639*Z_{03} + 0.002624*Z_{04} + 0.126326*Z_{05} + 0.131415*Z_{06} + 0.138457*Z_{07} + 0.136752*Z_{08} + 0.035192*Z_{09} + 0.021032*Z_{10} + 0.037353*Z_{11} + 0.008089*Z_{12} + 0.001128*Z_{13} + 0.002481*Z_{14} + 0.098873*Z_{15} + 0.043599*Z_{16} + 0.005659*Z_{17} + 0.108764*Z_{18} + 0.036967*Z_{19} + 0.039971*Z_{20}$ … …. …. (2)

STATE	Z01	Z02	Z03	Z04	Z05	Z06	Z07	Z08	Z09	Z10
Andhra Pradesh	0.35902	0.18182	0.178	0.26674	0.24886	0.33160	0.52545	0.44439	0.91621	0.07060
Arunachal Pradesh	0.24248	0.59091	0.176	0.14753	0.00195	0.00694	0.00000	0.00000	0.17080	0.29241
Assam	0.17746	0.54545	0.372	0.04647	0.07914	0.02778	0.08052	0.07656	0.15368	0.26900
Bihar	0.15994	0.86364	0.015	0.01446	0.21136	0.05729	0.10487	0.09415	0.04975	0.26450
Chandigarh	0.82981	0.86364	0.730	0.88129	0.01113	0.00347	0.00351	0.00466	0.01122	0.66877
Chhattisgarh	0.29842	0.77273	0.201	0.15104	0.08940	0.07986	0.12637	0.11640	0.74732	0.27644
Delhi	0.14092	0.68182	0.718	1.00000	0.22101	0.02604	0.03620	0.06880	0.00000	0.13113
Goa	0.19369	0.31818	0.740	0.59609	0.00423	0.00521	0.00878	0.01190	0.20165	0.43560
Gujarat	0.07305	0.54545	0.458	0.37229	0.24438	0.30903	0.44866	0.44853	0.43799	0.61678
Haryana	0.15760	0.81818	0.359	0.28406	0.10572	0.21528	0.19109	0.25504	0.27978	0.24691
Himachal Pradesh	0.27496	0.50000	0.608	0.00000	0.03762	0.05208	0.05814	0.05484	0.13889	0.29683
Jammu and Kashmir	0.23747	1.00000	0.135	0.19829	0.04189	0.03819	0.05112	0.04604	0.06352	0.32701
Jharkhand	0.04247	0.86364	0.089	0.16025	0.07313	0.02257	0.05244	0.06777	0.14894	0.12762
Karnataka	0.35820	0.50000	0.392	0.32742	0.32020	0.68750	0.73234	0.77186	0.50463	0.01084
Kerala	0.39635	0.36364	1.000	0.43065	0.11336	0.21007	0.26547	0.32850	0.23352	0.11993
Madhya Pradesh	0.25957	0.68182	0.186	0.20124	0.36102	0.38368	0.49298	0.43766	0.61483	0.17053
Maharashtra	0.21140	0.54545	0.580	0.40231	0.57066	0.81250	0.86244	0.92861	0.67589	0.23491
Manipur	1.00000	0.68182	0.522	0.25633	0.00946	0.00521	0.00965	0.01345	0.21331	0.26259
Meghalaya	0.09718	0.72727	0.537	0.11477	0.00483	0.00000	0.00527	0.00310	0.66756	0.00000
Mizoram	0.04229	0.59091	0.934	0.48107	0.00000	0.00174	0.00329	0.00103	0.11349	0.58071
Nagaland	0.37588	0.45455	0.611	0.21524	0.00281	0.00000	0.00790	0.00673	0.45142	0.11777
Odisha	0.15613	0.45455	0.298	0.07608	0.12574	0.07986	0.19219	0.20797	0.32946	0.19730
Puducherry	0.11956	0.00000	0.725	0.47099	0.00774	0.01389	0.01645	0.02431	0.25543	0.08067
Punjab	0.33631	0.77273	0.473	0.31384	0.17616	0.23611	0.21413	0.29333	0.49778	1.00000
Rajasthan	0.57835	0.90909	0.000	0.16965	0.36921	0.52951	0.50592	0.53130	0.20765	0.10321
Tamil Nadu	0.00000	0.00000	0.539	0.43861	0.60372	0.69618	0.55331	0.71857	0.57036	0.07087
Telangana	0.72906	0.00000	0.539	0.43876	0.19962	0.25521	0.41027	0.35644	1.00000	0.06933
Tripura	0.08657	0.36364	0.774	0.18450	0.00682	0.00521	0.00680	0.00569	0.46431	0.25544
Uttar Pradesh	0.20870	1.00000	0.168	0.13990	1.00000	1.00000	1.00000	1.00000	0.34887	0.06889
Uttarakhand	0.17769	0.68182	0.458	0.23095	0.07830	0.05208	0.05946	0.06880	0.13759	0.26282
West Bengal	0.04096	0.45455	0.471	0.24971	0.24932	0.11458	0.20184	0.25091	0.24250	0.26625

Table 1: showing Z-values for first 10 variables for all states

STATE	Z11	Z12	Z13	Z14	Z15	Z16	Z17	Z18	Z19	Z20
Andhra Pradesh	0.00079	0.1284	0.12776	0.27002	0.97500	0.04616	0.49186	0.22848	0.40727	0.00187
Arunachal Pradesh	0.18174	0.2292	0.73549	0.05884	0.29619	0.75274	0.00000	0.00131	0.01094	0.10835
Assam	0.00913	0.3982	0.35644	0.11484	0.02846	0.55183	0.41882	0.14680	0.11531	0.00923
Bihar	0.00594	0.0142	1.00000	0.00003	0.06860	0.07981	0.07399	0.44973	0.16268	0.00280
Chandigarh	0.38802	0.5081	0.48547	0.24975	0.08539	0.72255	0.20059	0.00146	0.03654	0.32405
Chhattisgarh	0.00443	0.3902	0.29474	0.15627	0.49315	0.04380	0.39829	0.12125	0.08489	0.00518
Delhi	0.04041	0.1487	0.98338	0.01557	0.41572	0.21791	0.09848	0.08587	1.00000	0.01955
Goa	0.14984	0.5077	0.18571	0.46662	0.20077	0.61550	0.69347	0.00150	0.00194	0.24765
Gujarat	0.15340	0.0132	0.38708	0.10388	0.67897	0.22606	0.27491	0.29107	0.11627	0.15255
Haryana	0.00408	0.2461	0.19794	0.26088	0.80158	0.48090	0.43419	0.12632	0.04031	0.00604
Himachal Pradesh	0.01675	0.5937	0.27757	0.24748	0.52456	0.12784	0.16431	0.02574	0.04326	0.01960
Jammu and Kashmir	0.01032	0.4007	0.45619	0.15349	0.43075	0.25869	0.20593	0.05092	0.10651	0.00883
Jharkhand	0.02034	0.2955	0.94647	0.02358	0.43143	0.04587	0.13705	0.14810	0.03621	0.01009
Karnataka	0.00304	0.3921	0.06839	0.35860	0.80384	0.18062	1.00000	0.29203	0.10289	0.00676
Kerala	0.00361	1.0000	0.13434	0.28733	0.71449	0.14886	0.54815	0.12199	0.27223	0.00634
Madhya Pradesh	0.00138	0.0627	0.31391	0.16169	0.70032	0.01622	0.42390	0.35558	0.28280	0.00172
Maharashtra	0.00072	0.1220	0.35112	0.15452	0.72406	0.36339	0.42424	0.54778	0.98637	0.00095
Manipur	0.06338	0.4387	0.30706	0.10207	0.17070	0.33940	0.30682	0.00667	0.00000	0.06868
Meghalaya	1.00000	0.4622	0.34691	0.12085	0.23916	0.30825	0.20122	0.00890	0.00431	1.00000
Mizoram	0.25835	0.1519	0.20863	0.21036	0.00000	1.00000	0.45725	0.00000	0.00057	0.34583
Nagaland	0.04846	0.4114	0.15882	0.32643	0.14776	0.18365	0.36556	0.00487	0.00000	0.07384
Odisha	0.00410	0.1871	0.25510	0.19361	0.33058	0.23438	0.38311	0.18776	0.05293	0.00526
Puducherry	0.06101	0.3715	0.00000	1.00009	0.58592	0.21119	0.54398	0.00063	0.00162	0.15507
Punjab	0.00477	0.3632	0.13504	0.31414	0.73019	0.28316	0.39611	0.13069	0.05007	0.00818
Rajasthan	0.00086	0.1442	0.38610	0.11693	0.87564	0.02353	0.30320	0.35010	0.14459	0.00096
Tamil Nadu	0.00181	0.3603	0.12775	0.30451	0.92740	0.33242	0.44752	0.30128	0.73795	0.00353
Telangana	0.00117	0.2550	0.11139	0.26762	1.00000	0.00000	0.25676	0.16398	0.09619	0.00263
Tripura	0.18751	0.0000	0.46307	0.18892	0.06647	0.16651	0.26213	0.01282	0.00714	0.17123
Uttar Pradesh	0.00000	0.3647	0.58399	0.04552	0.90338	0.02314	0.13230	1.00000	0.10387	0.00000
Uttarakhand	0.01744	0.3047	0.27440	0.24291	0.43518	0.11918	0.25223	0.04528	0.03702	0.02036
West Bengal	0.00317	0.2372	0.59081	0.02777	0.45257	0.31762	0.22535	0.44646	0.28817	0.00240

Table 2: showing Z-values for last 10 variables for all state

The Scores for the states using (2) and Average Scores (SI2) are given below. The ranks corresponding to them are R2 and R1 respectively.

STATE	SI2	SI1	R1	R2
Andhra Pradesh	0.30965	0.39090	9	6
Arunachal Pradesh	0.21056	0.09538	24	28
Assam	0.20156	0.11032	26	25
Bihar	0.18646	0.13750	31	18
Chandigarh	0.30923	0.11371	10	22
Chhattisgarh	0.22834	0.16698	19	16
Delhi	0.29566	0.17147	15	15
Goa	0.31987	0.11232	8	24
Gujarat	0.34107	0.36332	6	8
Haryana	0.30578	0.24960	12	13
Himachal Pradesh	0.21226	0.12367	23	19
Jammu and Kashmir	0.21766	0.10703	21	27
Jharkhand	0.19903	0.10777	28	26
Karnataka	0.39398	0.49995	4	4
Kerala	0.33884	0.27328	7	11
Madhya Pradesh	0.30695	0.37811	11	7
Maharashtra	0.49333	0.65760	1	2
Manipur	0.20030	0.07564	27	30
Meghalaya	0.30465	0.16056	13	17
Mizoram	0.28641	0.11339	16	23
Nagaland	0.19826	0.07111	29	31
Odisha	0.20292	0.17540	25	14
Puducherry	0.22652	0.12262	20	20
Punjab	0.34569	0.28203	5	10
Rajasthan	0.30373	0.40457	14	5
Tamil Nadu	0.40812	0.55166	3	3
Telangana	0.27159	0.34031	18	9
Tripura	0.19570	0.07668	30	29
Uttar Pradesh	0.45583	0.75957	2	1
Uttarakhand	0.21694	0.11811	22	21
West Bengal	0.27180	0.25768	17	12

Table 3: showing Score - values for the states and their ranks

The rank is highly related with rank correlation is 0.776. In respect of ranks thus obtained, the most developed state in higher education is Maharashtra, then Uttar Pradesh and West Bengal is in 17th position. The less developed state is Bihar.

4. Remarks
Using PCA, the development indices with the indicators in the line of UNESCO Education 2030 agenda has been framed as weighted average of 20 standard variable scores. Based on the development indices for higher education, the states have been ranked. Based on

the indices (SI1 & SI2), the top states are Maharashtra, Uttar Pradesh, etc. West Bengal has the rank 17. It is an attempt to rank states based on higher education development indicators. Each year rating may be calculated based on the data for the corresponding year.

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