UNDP
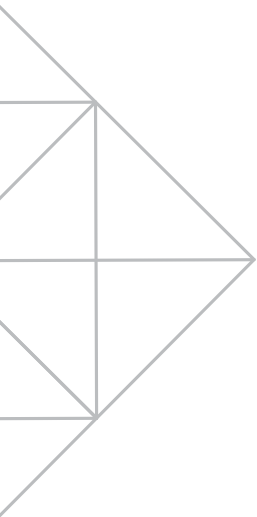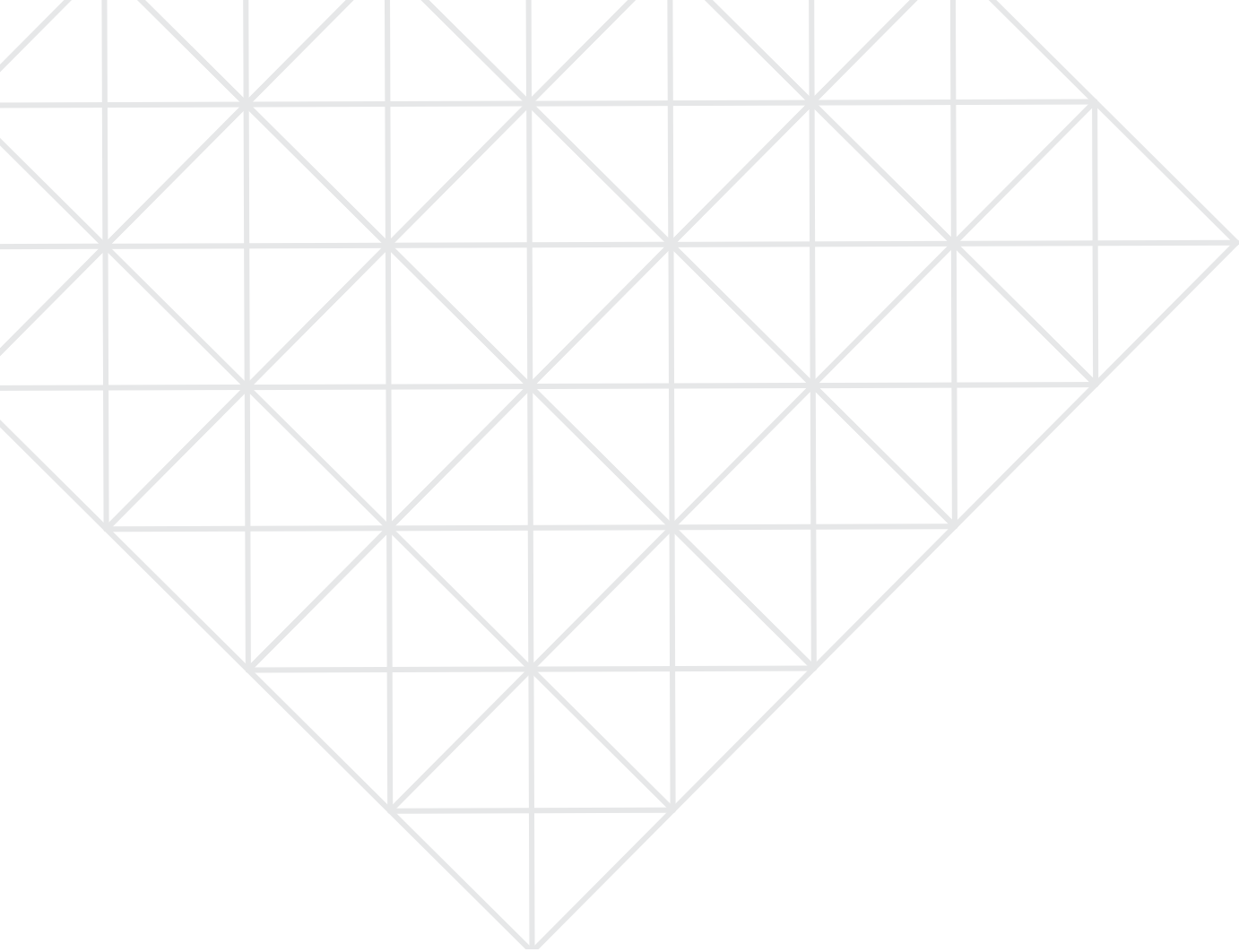
مؤسسة محمد بن راشد آل مكتوم للمعرفة
MOHAMMED BIN RASHID AL MAKTOUM
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Participants

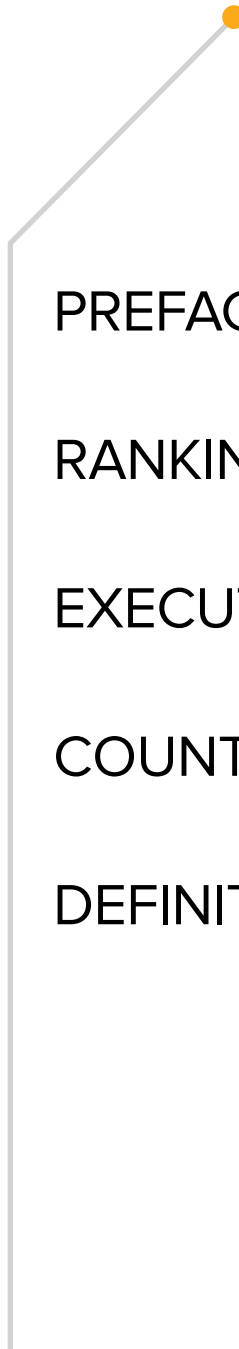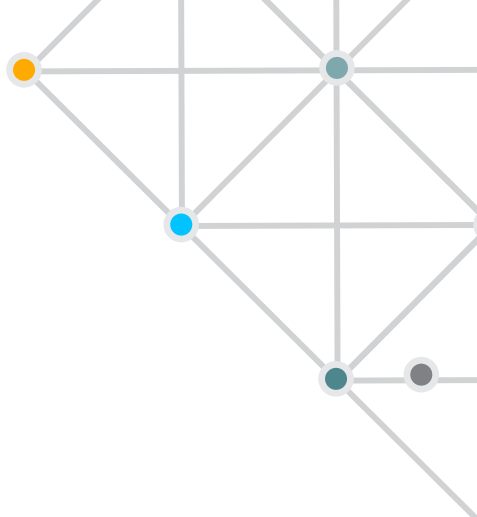|	
Advisory Board	Philip Altbach, Susan Bainbridge, Kevin Balanda, Sylvain Côté, Pedro Conceição, Anna Cristina d'Addio, Nicola Duell, Yousry El Gamal, Sarah Elson-Rogers, Paul Foley, Najoua Fezzaa Ghriss, Daria Golebiowska-Tataj, Ali Hadi, Hugo Hollanders, Ali Ibrahim, Nibal Idlebi, Mohamed Ismail, Dana Kelly, Motaz Khorshid, Pirjo Koivula, Cordelia Mason, Marie Mc Andrew, Boris Najman, Jose Felipe Otero, Harry Anthony Patrinos, Hamdy Ragb, Jozef Ritzen, Matti Rossi, Youssef Sadik, Brahima Sanou, Wagdy Sawahel, Andreas Schleicher, Rebecca Schendel, Luis Serven, Sid Ahmed Soussi, Jacques Van Der Meer, Marieke Vandeweyer, Khalid Al-Wazani, and Yanchun Zhang
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Graphic Design and Layout	Phoenix Design Aid

Contents
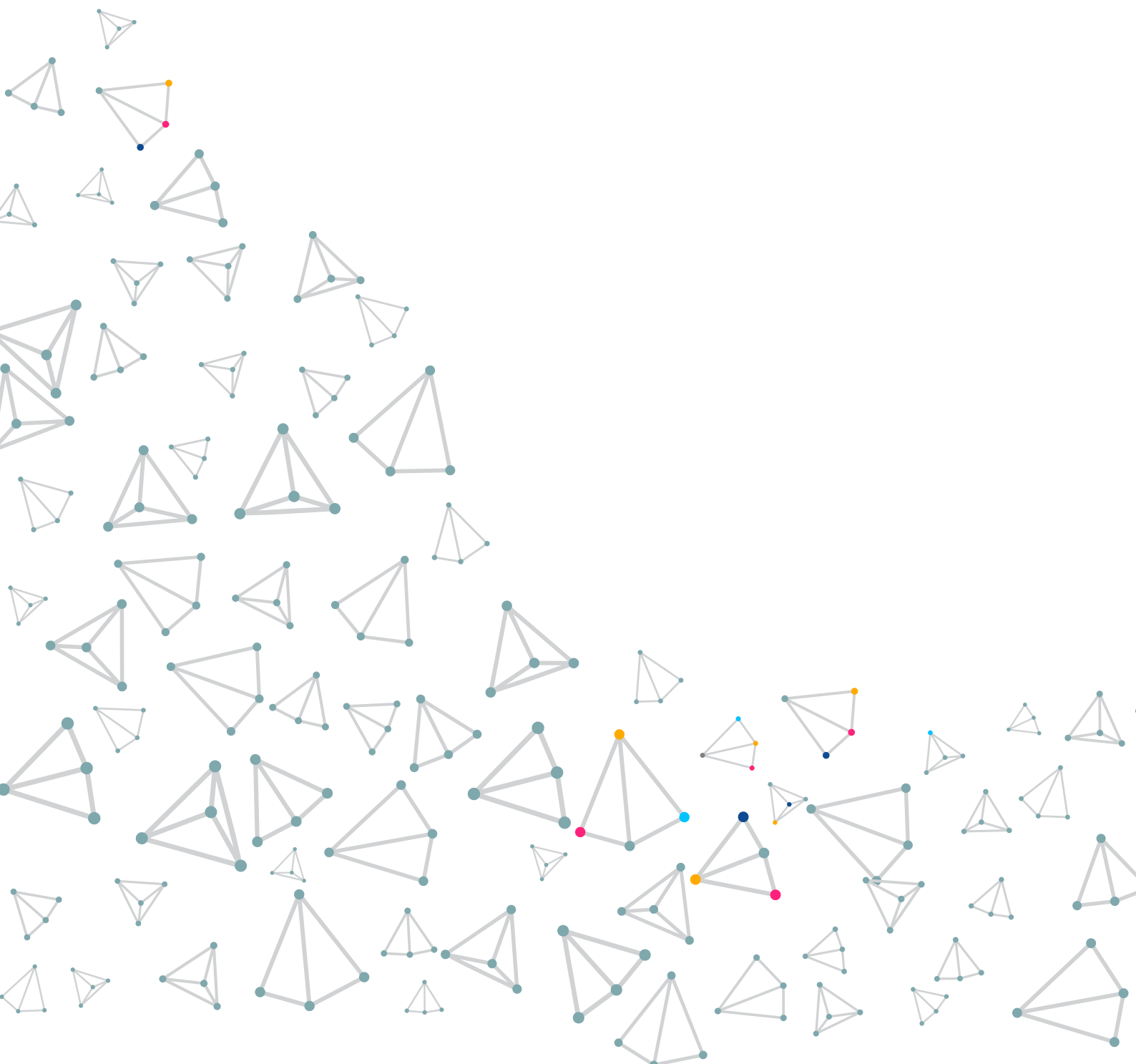
Preface

GLOBAL KNOWLEDGE INDEX 2023

Welcome to the Global Knowledge Index (GKI) report for 2023. The GKI remains a testament to the enduring commitment to fostering global knowledge sharing and development. Born from the collaborative spirit of the Knowledge Project, this index is a partnership that commenced in 2017 between the United Nations Development Programme - Regional Bureau for Arab States (UNDP RBAS) and the Mohammed bin Rashid Al Maktoum Knowledge Foundation (MBRF).

In an era underscored by the urgency of the 2030 Agenda, the demand for comprehensive and actionable indicators is more pronounced than ever. The GKI meets this demand, offering a unique vantage point from which we can objectively decipher the intricate landscape of knowledge and development. By facilitating a deep understanding of this landscape, the GKI empowers stakeholders to formulate development policies that are both informed and impactful. It emerges as an indispensable tool, illuminating the myriad challenges and avenues leading towards sustainable community advancement.

The GKI's structure has been steadfast since its inception in 2017, encompassing seven composite sub-indices that meticulously measure the performance of six critical sectors: pre-university education; technical and vocational education and training; higher education; information and communications technology; research and development, and innovation; and economy. Complementing these is a distinct sub-index that delves into the enabling environment, encapsulating the socio-economic, governance, health, and environmental backdrops that underpin these sectors. It's noteworthy that while the 2023 GKI echoes its predecessors in general structure, it adheres to the revised methodology of 2021, which brought forth a nuanced examination of sub-indices.

For an exhaustive exploration of the GKI, including intricate country-specific data, our evolved methodology, and interactive information on variable definitions and sources, we invite you to visit our dedicated platform at www.knowledge4all.org.

GKI 2023

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RANK	COUNTRY	GKI 2023	RANK	COUNTRY	GKI 2023	RANK	COUNTRY	GKI 2023
1	Switzerland	69.1	51	Georgia	50.0	101	Nepal	38.6
2	Finland	68.1	52	Thailand	49.9	102	Rwanda	38.2
3	Sweden	68.0	53	Seychelles	49.2	103	Zimbabwe	38.1
4	Netherlands	67.3	54	Brunei Darussalam	48.9	104	Cambodia	37.8
5	United States	66.9	55	Mauritius	48.5	105	Ghana	37.3
6	Denmark	66.7	56	Bahrain	48.1	106	Honduras	37.1
7	Luxembourg	66.0	57	Russian Federation	47.9	107	Eswatini (Kingdom of)	36.9
8	United Kingdom	65.7	58	Colombia	47.9	108	Guatemala	36.5
9	Austria	65.3	59	Moldova (Republic of)	47.7	109	Lao People's Democratic Republic	36.2
10	Norway	65.1	60	Türkiye	47.4	110	Lesotho	36.1
11	Estonia	64.2	61	Panama	47.4	111	Tajikistan	36.1
12	Singapore	64.2	62	Peru	47.2	112	Bangladesh	36.0
13	Belgium	64.1	63	Mongolia	47.2	113	Gambia	34.8
14	Israel	63.9	64	Bolivia (Plurinational State of)	47.1	114	Uganda	34.5
15	Germany	63.7	65	Albania	47.1	115	Côte d'Ivoire	33.1
16	Australia	63.1	66	Oman	47.1	116	Senegal	33.0
17	Korea (Republic of)	62.9	67	Armenia	46.7	117	Pakistan	32.7
18	Malta	62.7	68	Ukraine	46.5	118	Myanmar	32.7
19	Slovenia	62.5	69	Argentina	46.4	119	Togo	32.1
20	Canada	62.4	70	Costa Rica	46.4	120	Tanzania (United Republic of)	31.2
21	Iceland	62.3	71	Viet Nam	46.1	121	Cameroon	31.0
22	New Zealand	62.1	72	Bosnia and Herzegovina	46.0	122	Madagascar	31.0
23	Ireland	61.6	73	Botswana	45.9	123	Benin	30.9
24	France	61.1	74	Kazakhstan	45.6	124	Burundi	29.5
25	Czechia	60.9	75	Brazil	45.4	125	Mauritania	29.2
26	United Arab Emirates	60.5	76	Trinidad and Tobago	45.0	126	Mozambique	28.1
27	Portugal	60.1	77	Cabo Verde	44.8	127	Guinea	27.9
28	Latvia	59.5	78	Uzbekistan	44.8	128	Ethiopia	27.8
29	Cyprus	59.3	79	Indonesia	44.7	129	Mali	27.6
30	Spain	59.0	80	Philippines	44.7	130	Burkina Faso	27.5
31	Hong Kong, China (SAR)	58.9	81	Tunisia	44.5	131	Congo (Democratic Republic of the)	26.6
32	Lithuania	58.2	82	Mexico	44.4	132	Niger	25.5
33	Italy	58.1	83	Suriname	44.1	133	Chad	23.2
34	Slovakia	57.0	84	Kyrgyzstan	44.1			
35	Hungary	56.7	85	South Africa	44.0			
36	Croatia	56.5	86	Ecuador	43.6			
37	Poland	56.0	87	Dominican Republic	43.3			
38	Bulgaria	55.0	88	Paraguay	43.2			
39	Qatar	54.8	89	Palestine, State of	42.6			
40	Saudi Arabia	54.5	90	Egypt	42.5			
41	Serbia	53.3	91	Sri Lanka	42.5			
42	Romania	53.0	92	Morocco	42.5			
43	Malaysia	52.4	93	Bhutan	42.4			
44	Kuwait	52.4	94	Azerbaijan	42.0			
45	Montenegro	51.9	95	India	41.7			
46	Chile	51.5	96	Namibia	41.3			
47	Greece	51.3	97	Jordan	41.1			
48	North Macedonia	51.1	98	Iran (Islamic Republic of)	39.6			
49	Belarus	51.0	99	Kenya	39.3			
50	Uruguay	50.2	100	El Salvador	39.3			

Heat map

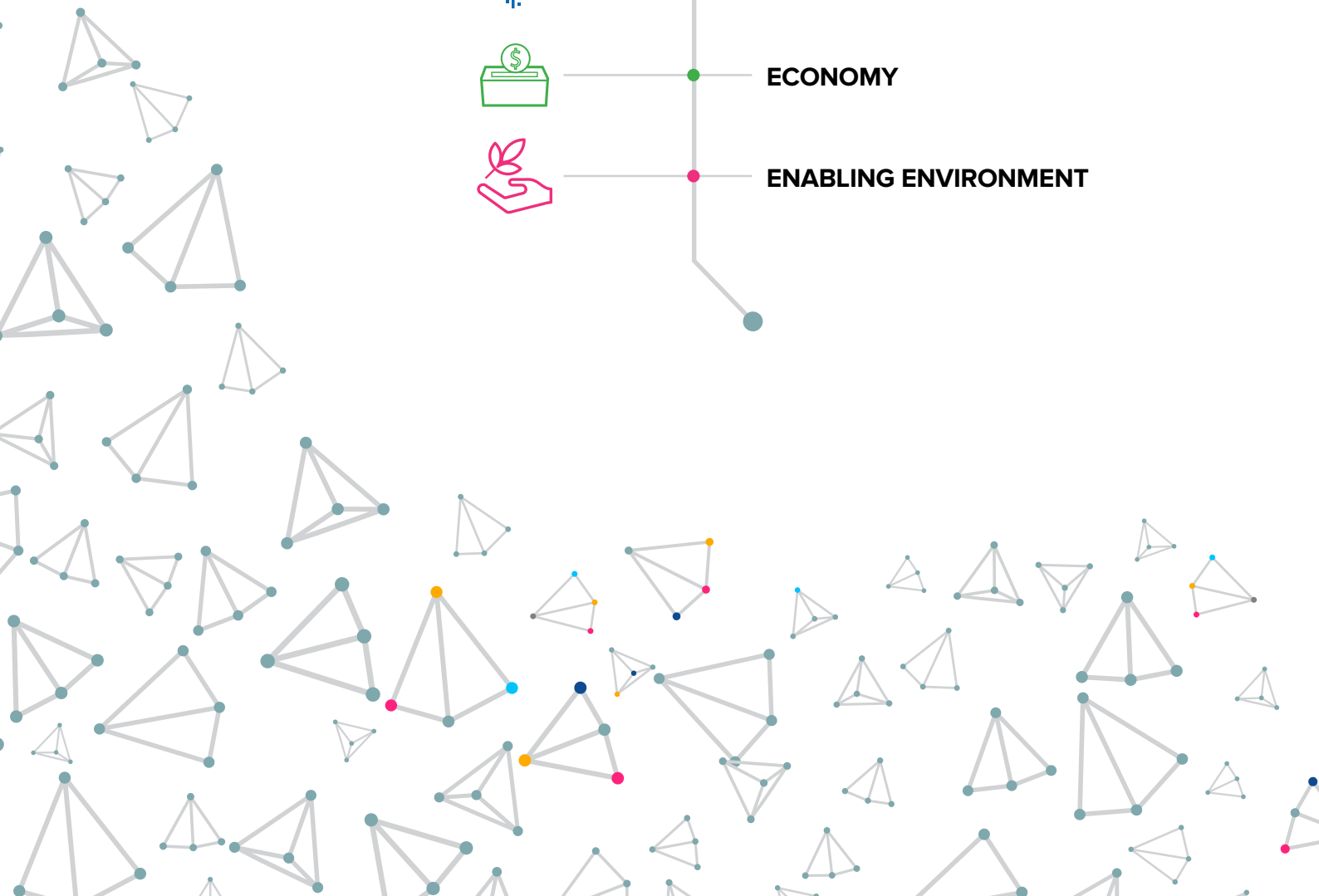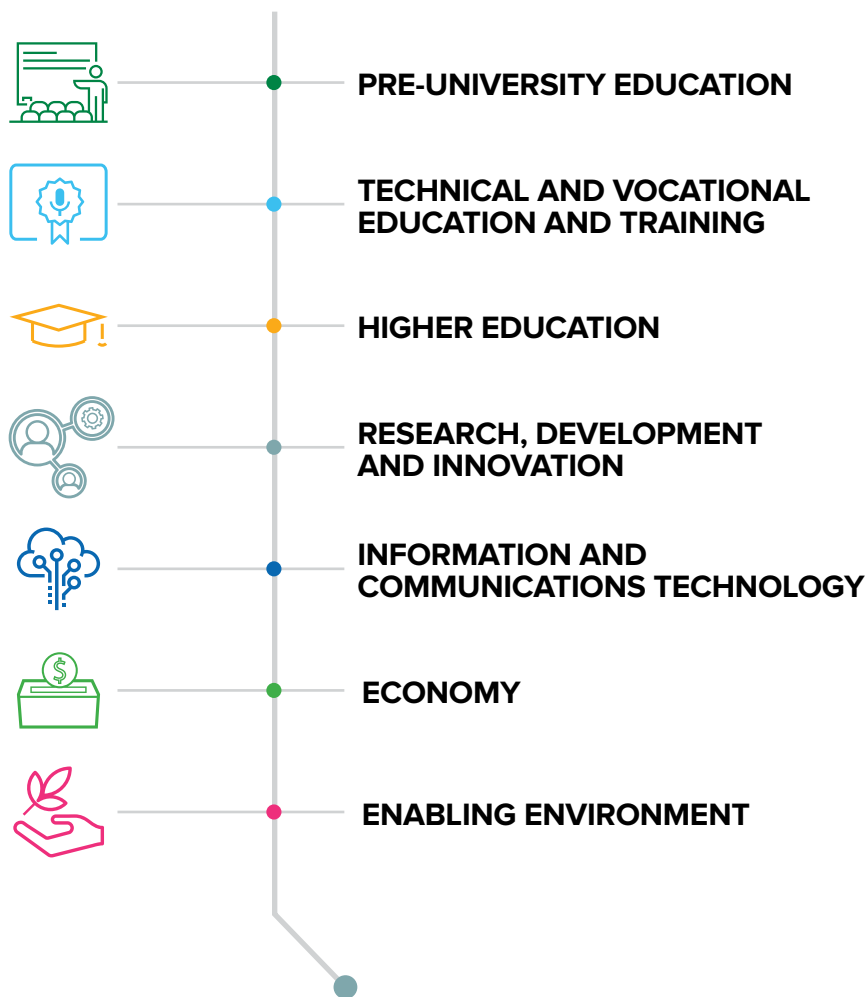| RANK	COUNTRY	GKI	PRE-UNIVERSITY EDUCATION	TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING	HIGHER EDUCATION	RESEARCH, DEVELOPMENT AND INNOVATION	INFORMATION AND COMMUNICATIONS TECHNOLOGY	ECONOMY	ENABLING ENVIRONMENT
1	Switzerland	69.1	84.5	62.2	68.6	54.3	70.2	69.0	85.0
2	Finland	68.1	84.3	68.2	61.3	50.7	71.8	66.7	85.8
3	Sweden	68.0	82.3	61.2	62.4	54.7	72.4	68.1	85.7
4	Netherlands	67.3	83.8	68.1	63.0	48.8	71.6	65.6	80.6
5	United States	66.9	83.7	59.9	66.1	51.5	75.1	70.5	66.5
6	Denmark	66.7	79.8	57.5	63.5	50.3	70.8	73.6	83.4
7	Luxembourg	66.0	77.2	64.1	66.4	45.9	72.6	65.4	82.4
8	United Kingdom	65.7	79.7	56.0	64.8	54.0	70.4	66.0	76.6
9	Austria	65.3	79.6	67.4	64.7	43.5	66.1	67.8	79.4
10	Norway	65.1	81.8	64.1	64.6	39.6	71.5	65.0	87.7
11	Estonia	64.2	79.9	64.2	62.5	43.3	71.1	63.4	76.5
12	Singapore	64.2	75.3	50.7	55.8	46.2	77.5	78.2	81.4
13	Belgium	64.1	84.0	64.9	63.2	43.7	59.8	67.6	78.0
14	Israel	63.9	77.6	56.1	62.2	55.0	69.8	66.9	62.3
15	Germany	63.7	75.7	63.7	61.1	47.3	61.9	66.5	79.4
16	Australia	63.1	79.6	63.7	61.7	42.0	63.8	66.2	76.4
17	Korea (Republic of)	62.9	85.3	54.9	47.3	51.4	72.5	71.0	68.1
18	Malta	62.7	78.2	52.7	58.0	46.7	71.5	68.5	73.8
19	Slovenia	62.5	82.4	65.5	61.4	39.8	63.7	62.6	75.5
20	Canada	62.4	91.2	59.4	60.7	37.2	62.0	69.8	73.8
21	Iceland	62.3	77.2	60.0	59.1	38.4	68.7	63.5	89.1
22	New Zealand	62.1	73.4	67.4	57.2	40.5	64.2	65.8	79.7
23	Ireland	61.6	70.4	60.3	55.3	42.9	62.4	72.3	81.8
24	France	61.1	78.5	55.2	53.5	45.7	65.2	65.5	75.3
25	Czechia	60.9	83.1	63.4	59.1	39.1	55.8	65.7	73.9
26	United Arab Emirates	60.5	76.2	69.1	51.0	37.9	70.0	66.9	62.9
27	Portugal	60.1	85.7	62.1	63.3	34.9	57.3	59.5	77.2
28	Latvia	59.5	80.5	62.8	59.3	32.6	63.1	63.3	71.7
29	Cyprus	59.3	77.5	50.6	67.1	41.7	65.1	55.3	68.9
30	Spain	59.0	79.1	59.7	55.4	37.4	62.0	60.4	73.1
31	Hong Kong, China (SAR)	58.9	81.2	48.7	51.4	43.0	69.2	79.2	47.7
32	Lithuania	58.2	79.3	58.2	56.9	32.6	62.2	62.4	73.9
33	Italy	58.1	75.4	62.4	52.4	42.3	55.5	59.7	68.7
34	Slovakia	57.0	80.1	69.1	58.3	30.5	54.2	56.6	69.0
35	Hungary	56.7	70.6	67.1	47.8	34.9	56.7	66.2	67.0
36	Croatia	56.5	74.0	60.7	59.5	32.1	57.6	58.3	68.4
37	Poland	56.0	83.4	55.3	54.8	31.6	57.9	57.8	69.3
38	Bulgaria	55.0	69.8	58.7	58.6	34.1	56.5	55.8	61.6
39	Qatar	54.8	79.8	52.8	57.4	30.8	50.8	65.0	63.1
40	Saudi Arabia	54.5	70.9	57.0	44.7	37.9	65.4	58.8	53.6
41	Serbia	53.3	75.9	63.3	48.3	29.9	59.2	52.8	58.1
42	Romania	53.0	60.2	57.7	55.0	32.0	54.2	58.9	64.6
43	Malaysia	52.4	60.8	51.0	48.0	36.3	56.8	62.3	59.3
44	Kuwait	52.4	66.8	68.2	44.7	24.4	62.4	65.0	54.1
45	Montenegro	51.9	76.2	53.4	58.4	25.8	58.1	49.8	59.6
46	Chile	51.5	69.7	46.7	47.1	30.7	56.8	57.5	69.0
47	Greece	51.3	72.8	47.0	47.2	34.8	53.0	52.5	63.9
48	North Macedonia	51.1	71.2	60.6	49.8	28.3	50.9	52.8	58.1
49	Belarus	51.0	85.9	58.9	49.4	28.2	52.8	46.7	51.6
50	Uruguay	50.2	67.8	53.4	47.8	25.1	53.3	50.5	79.6
51	Georgia	50.0	79.1	48.4	51.7	26.5	49.4	53.0	60.8

Heat map

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RANK	COUNTRY	GKI	PRE-UNIVERSITY EDUCATION	TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING	HIGHER EDUCATION	RESEARCH, DEVELOPMENT AND INNOVATION	INFORMATION AND COMMUNICATIONS TECHNOLOGY	ECONOMY	ENABLING ENVIRONMENT
52	Thailand	49.9	72.6	51.6	37.5	30.6	52.4	62.3	57.8
53	Seychelles	49.2	73.2	47.2	48.2	26.3	52.4	53.2	62.0
54	Brunei Darussalam	48.9	68.1	54.9	55.7	21.4	52.2	49.1	64.5
55	Mauritius	48.5	71.9	50.5	46.1	21.0	52.1	58.1	65.6
56	Bahrain	48.1	67.9	62.2	35.7	22.1	59.3	58.6	53.1
57	Russian Federation	47.9	80.5	52.4	41.1	27.4	51.0	49.7	48.1
58	Colombia	47.9	66.2	47.1	48.5	34.0	44.5	48.5	54.0
59	Moldova (Republic of)	47.7	75.0	51.5	42.0	25.4	51.1	50.7	54.9
60	Türkiye	47.4	66.7	57.0	32.8	33.5	49.3	52.5	50.8
61	Panama	47.4	62.4	46.7	51.6	25.6	45.7	55.3	59.2
62	Peru	47.2	65.7	43.5	50.4	30.7	43.4	53.9	52.5
63	Mongolia	47.2	71.9	52.7	38.8	29.9	45.1	50.3	54.9
64	Bolivia (Plurinational State of)	47.1	73.5	62.6	52.2	27.2	38.7	41.5	50.5
65	Albania	47.1	69.1	41.8	51.8	30.5	48.9	41.7	60.4
66	Oman	47.1	71.9	54.9	39.6	23.7	53.0	53.4	49.6
67	Armenia	46.7	73.2	38.3	53.0	27.7	49.8	45.2	55.4
68	Ukraine	46.5	73.4	52.1	43.7	27.0	50.5	40.8	52.9
69	Argentina	46.4	65.6	52.9	50.0	25.7	47.6	40.9	57.0
70	Costa Rica	46.4	70.0	53.2	45.0	19.3	48.8	47.9	70.0
71	Viet Nam	46.1	70.9	54.0	34.6	25.6	44.7	56.7	54.5
72	Bosnia and Herzegovina	46.0	55.9	57.5	48.9	25.2	47.5	46.2	51.9
73	Botswana	45.9	52.0	60.0	44.7	31.5	34.8	51.4	59.2
74	Kazakhstan	45.6	70.7	42.9	44.7	21.9	49.6	51.9	58.0
75	Brazil	45.4	66.6	51.7	38.7	26.0	49.0	46.1	54.3
76	Trinidad and Tobago	45.0	63.4	44.9	51.1	18.0	50.7	54.8	55.0
77	Cabo Verde	44.8	65.0	46.8	43.7	28.7	35.4	46.5	65.9
78	Uzbekistan	44.8	77.4	48.8	39.9	23.9	42.5	49.7	48.7
79	Indonesia	44.7	58.0	49.5	45.2	21.4	47.2	54.6	52.4
80	Philippines	44.7	63.9	56.1	48.1	23.2	37.8	50.0	48.3
81	Tunisia	44.5	71.2	50.4	39.1	26.0	43.1	45.8	50.6
82	Mexico	44.4	64.6	53.7	45.3	18.5	44.7	53.7	51.3
83	Suriname	44.1	57.6	56.3	48.2	27.1	45.3	35.1	50.1
84	Kyrgyzstan	44.1	76.9	50.3	47.5	23.3	38.4	43.2	46.2
85	South Africa	44.0	50.5	54.6	38.9	30.5	43.7	46.9	49.5
86	Ecuador	43.6	69.8	48.5	42.3	25.7	37.0	43.6	54.4
87	Dominican Republic	43.3	57.6	41.9	46.3	26.8	39.4	47.1	56.1
88	Paraguay	43.2	50.4	47.1	55.5	20.9	45.3	44.4	55.3
89	Palestine, State of	42.6	75.4	48.2	36.1	28.5	35.1	43.1	46.6
90	Egypt	42.5	64.8	55.9	37.7	24.0	39.8	45.9	42.1
91	Sri Lanka	42.5	65.2	55.2	37.1	23.3	39.0	41.9	52.6
92	Morocco	42.5	58.6	49.8	33.1	26.0	45.4	45.3	51.3
93	Bhutan	42.4	66.7	38.6	41.3	22.3	38.4	48.2	65.3
94	Azerbaijan	42.0	62.9	50.9	42.1	23.2	40.7	42.4	43.6
95	India	41.7	57.4	38.8	35.0	30.1	41.3	52.9	43.6
96	Namibia	41.3	54.9	59.2	43.5	22.2	30.4	41.6	58.3
97	Jordan	41.1	58.3	42.4	35.3	25.3	38.1	49.7	51.5
98	Iran (Islamic Republic of)	39.6	63.8	50.8	31.3	27.7	38.5	38.8	34.9
99	Kenya	39.3	60.6	39.5	32.2	28.3	33.3	44.8	47.5
100	El Salvador	39.3	59.2	47.4	35.5	19.1	35.3	47.2	49.2
101	Nepal	38.6	57.3	42.8	43.4	26.6	26.5	40.5	44.0
102	Rwanda	38.2	41.8	49.9	31.3	25.1	35.2	41.4	55.9
103	Zimbabwe	38.1	45.8	47.0	35.0	37.1	28.2	36.0	42.4

Heat map

RANK	COUNTRY	GKI	PRE-UNIVERSITY EDUCATION	TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING	HIGHER EDUCATION	RESEARCH, DEVELOPMENT AND INNOVATION	INFORMATION AND COMMUNICATIONS TECHNOLOGY	ECONOMY	ENABLING ENVIRONMENT
104	Cambodia	37.8	43.4	47.8	34.5	20.4	37.5	48.6	43.4
105	Ghana	37.3	48.2	40.2	35.6	24.5	35.5	35.2	53.3
106	Honduras	37.1	43.8	54.4	42.5	21.1	27.1	39.8	44.5
107	Eswatini (Kingdom of)	36.9	51.7	46.9	37.9	25.5	29.6	34.1	40.5
108	Guatemala	36.5	37.5	49.2	36.8	19.6	33.7	48.2	41.2
109	Lao People's Democratic Republic	36.2	45.2	42.9	38.1	21.7	30.3	39.1	46.8
110	Lesotho	36.1	51.6	54.0	34.9	19.7	26.1	40.0	42.1
111	Tajikistan	36.1	67.5	42.7	36.8	18.2	30.5	36.8	36.6
112	Bangladesh	36.0	48.5	49.6	33.7	17.4	31.9	44.4	40.7
113	Gambia	34.8	41.5	37.0	29.1	37.6	20.4	44.3	43.6
114	Uganda	34.5	32.5	44.4	37.0	23.6	24.0	44.8	47.7
115	Côte d'Ivoire	33.1	36.8	37.1	35.8	15.9	31.3	42.8	46.4
116	Senegal	33.0	34.0	44.9	30.9	17.3	29.6	41.8	47.4
117	Pakistan	32.7	42.1	41.9	33.6	15.3	29.7	43.7	35.1
118	Myanmar	32.7	46.2	41.5	23.1	20.6	28.9	42.0	37.9
119	Togo	32.1	40.1	42.1	31.7	16.3	25.3	41.4	42.3
120	Tanzania (United Republic of)	31.2	34.4	31.2	26.5	24.8	22.7	42.0	49.8
121	Cameroon	31.0	37.6	42.8	29.0	23.7	20.7	32.8	40.6
122	Madagascar	31.0	29.7	40.6	40.9	20.2	20.8	34.5	43.1
123	Benin	30.9	32.2	34.5	25.3	24.0	29.2	36.2	41.3
124	Burundi	29.5	31.8	38.8	38.9	21.3	17.7	29.3	40.4
125	Mauritania	29.2	31.7	33.5	22.1	21.9	28.0	37.2	36.4
126	Mozambique	28.1	36.3	26.0	34.5	18.2	16.7	39.7	39.9
127	Guinea	27.9	23.0	37.8	32.9	16.4	28.3	32.2	32.9
128	Ethiopia	27.8	33.8	37.3	28.4	15.0	15.7	40.1	44.8
129	Mali	27.6	23.7	35.6	30.1	19.2	23.2	35.5	31.7
130	Burkina Faso	27.5	27.8	35.5	29.8	16.4	22.2	34.1	36.0
131	Congo (Democratic Republic of the)	26.6	28.4	29.4	20.1	19.9	24.1	38.2	32.6
132	Niger	25.5	17.1	45.2	25.3	15.4	20.7	34.5	36.9
133	Chad	23.2	18.4	28.4	26.9	18.3	19.1	28.7	27.2

Sectoral indices

PRE-UNIVERSITY EDUCATION

TECHNICAL AND VOCATIONAL
EDUCATION AND TRAINING

HIGHER EDUCATION

RESEARCH, DEVELOPMENT
AND INNOVATION

INFORMATION AND
COMMUNICATIONS TECHNOLOGY

ECONOMY

ENABLING ENVIRONMENT

Pre-university education

RANK	COUNTRY	VALUE
1	Canada	91.2
2	Belarus	85.9
3	Portugal	85.7
4	Korea (Republic of)	85.3
5	Switzerland	84.5
6	Finland	84.3
7	Belgium	84.0
8	Netherlands	83.8
9	United States	83.7
10	Poland	83.4
11	Czechia	83.1
12	Slovenia	82.4
13	Sweden	82.3
14	Norway	81.8
15	Hong Kong, China (SAR)	81.2
16	Russian Federation	80.5
17	Latvia	80.5
18	Slovakia	80.1
19	Estonia	79.9
20	Qatar	79.8
21	Denmark	79.8
22	United Kingdom	79.7
23	Austria	79.6
24	Australia	79.6
25	Lithuania	79.3
26	Georgia	79.1
27	Spain	79.1
28	France	78.5
29	Malta	78.2
30	Israel	77.6
31	Cyprus	77.5
32	Uzbekistan	77.4
33	Luxembourg	77.2
34	Iceland	77.2
35	Kyrgyzstan	76.9
36	Montenegro	76.2
37	United Arab Emirates	76.2
38	Serbia	75.9
39	Germany	75.7
40	Palestine, State of	75.4
41	Italy	75.4
42	Singapore	75.3
43	Moldova (Republic of)	75.0
44	Croatia	74.0
45	Bolivia (Plurinational State of)	73.5
46	New Zealand	73.4
47	Ukraine	73.4
48	Armenia	73.2
49	Seychelles	73.2
50	Greece	72.8

RANK	COUNTRY	VALUE
51	Thailand	72.6
52	Oman	71.9
53	Mauritius	71.9
54	Mongolia	71.9
55	North Macedonia	71.2
56	Tunisia	71.2
57	Saudi Arabia	70.9
58	Viet Nam	70.9
59	Kazakhstan	70.7
60	Hungary	70.6
61	Ireland	70.4
62	Costa Rica	70.0
63	Bulgaria	69.8
64	Ecuador	69.8
65	Chile	69.7
66	Albania	69.1
67	Brunei Darussalam	68.1
68	Bahrain	67.9
69	Uruguay	67.8
70	Tajikistan	67.5
71	Kuwait	66.8
72	Türkiye	66.7
73	Bhutan	66.7
74	Brazil	66.6
75	Colombia	66.2
76	Peru	65.7
77	Argentina	65.6
78	Sri Lanka	65.2
79	Cabo Verde	65.0
80	Egypt	64.8
81	Mexico	64.6
82	Philippines	63.9
83	Iran (Islamic Republic of)	63.8
84	Trinidad and Tobago	63.4
85	Azerbaijan	62.9
86	Panama	62.4
87	Malaysia	60.8
88	Kenya	60.6
89	Romania	60.2
90	El Salvador	59.2
91	Morocco	58.6
92	Jordan	58.3
93	Indonesia	58.0
94	Suriname	57.6
95	Dominican Republic	57.6
96	India	57.4
97	Nepal	57.3
98	Bosnia and Herzegovina	55.9
99	Namibia	54.9
100	Botswana	52.0

RANK	COUNTRY	VALUE
101	Eswatini (Kingdom of)	51.7
102	Lesotho	51.6
103	South Africa	50.5
104	Paraguay	50.4
105	Bangladesh	48.5
106	Ghana	48.2
107	Myanmar	46.2
108	Zimbabwe	45.8
109	Lao People's Democratic Republic	45.2
110	Honduras	43.8
111	Cambodia	43.4
112	Pakistan	42.1
113	Rwanda	41.8
114	Gambia	41.5
115	Togo	40.1
116	Cameroon	37.6
117	Guatemala	37.5
118	Côte d'Ivoire	36.8
119	Mozambique	36.3
120	Tanzania (United Republic of)	34.4
121	Senegal	34.0
122	Ethiopia	33.8
123	Uganda	32.5
124	Benin	32.2
125	Burundi	31.8
126	Mauritania	31.7
127	Madagascar	29.7
128	Congo (Democratic Republic of the)	28.4
129	Burkina Faso	27.8
130	Mali	23.7
131	Guinea	23.0
132	Chad	18.4
133	Niger	17.1

Technical and vocational education and training

RANK	COUNTRY	VALUE
1	Slovakia	69.1
2	United Arab Emirates	69.1
3	Kuwait	68.2
4	Finland	68.2
5	Netherlands	68.1
6	Austria	67.4
7	New Zealand	67.4
8	Hungary	67.1
9	Slovenia	65.5
10	Belgium	64.9
11	Estonia	64.2
12	Norway	64.1
13	Luxembourg	64.1
14	Germany	63.7
15	Australia	63.7
16	Czechia	63.4
17	Serbia	63.3
18	Latvia	62.8
19	Bolivia (Plurinational State of)	62.6
20	Italy	62.4
21	Bahrain	62.2
22	Switzerland	62.2
23	Portugal	62.1
24	Sweden	61.2
25	Croatia	60.7
26	North Macedonia	60.6
27	Ireland	60.3
28	Iceland	60.0
29	Botswana	60.0
30	United States	59.9
31	Spain	59.7
32	Canada	59.4
33	Namibia	59.2
34	Belarus	58.9
35	Bulgaria	58.7
36	Lithuania	58.2
37	Romania	57.7
38	Bosnia and Herzegovina	57.5
39	Denmark	57.5
40	Saudi Arabia	57.0
41	Türkiye	57.0
42	Suriname	56.3
43	Israel	56.1
44	Philippines	56.1
45	United Kingdom	56.0
46	Egypt	55.9
47	Poland	55.3
48	Sri Lanka	55.2
49	France	55.2
50	Oman	54.9

RANK	COUNTRY	VALUE
51	Korea (Republic of)	54.9
52	Brunei Darussalam	54.9
53	South Africa	54.6
54	Honduras	54.4
55	Viet Nam	54.0
56	Lesotho	54.0
57	Mexico	53.7
58	Montenegro	53.4
59	Uruguay	53.4
60	Costa Rica	53.2
61	Argentina	52.9
62	Qatar	52.8
63	Mongolia	52.7
64	Malta	52.7
65	Russian Federation	52.4
66	Ukraine	52.1
67	Brazil	51.7
68	Thailand	51.6
69	Moldova (Republic of)	51.5
70	Malaysia	51.0
71	Azerbaijan	50.9
72	Iran (Islamic Republic of)	50.8
73	Singapore	50.7
74	Cyprus	50.6
75	Mauritius	50.5
76	Tunisia	50.4
77	Kyrgyzstan	50.3
78	Rwanda	49.9
79	Morocco	49.8
80	Bangladesh	49.6
81	Indonesia	49.5
82	Guatemala	49.2
83	Uzbekistan	48.8
84	Hong Kong, China (SAR)	48.7
85	Ecuador	48.5
86	Georgia	48.4
87	Palestine, State of	48.2
88	Cambodia	47.8
89	El Salvador	47.4
90	Seychelles	47.2
91	Paraguay	47.1
92	Colombia	47.1
93	Greece	47.0
94	Zimbabwe	47.0
95	Eswatini (Kingdom of)	46.9
96	Cabo Verde	46.8
97	Panama	46.7
98	Chile	46.7
99	Niger	45.2
100	Trinidad and Tobago	44.9

RANK	COUNTRY	VALUE
101	Senegal	44.9
102	Uganda	44.4
103	Peru	43.5
104	Lao People's Democratic Republic	42.9
105	Kazakhstan	42.9
106	Nepal	42.8
107	Cameroon	42.8
108	Tajikistan	42.7
109	Jordan	42.4
110	Togo	42.1
111	Dominican Republic	41.9
112	Pakistan	41.9
113	Albania	41.8
114	Myanmar	41.5
115	Madagascar	40.6
116	Ghana	40.2
117	Kenya	39.5
118	Burundi	38.8
119	India	38.8
120	Bhutan	38.6
121	Armenia	38.3
122	Guinea	37.8
123	Ethiopia	37.3
124	Côte d'Ivoire	37.1
125	Gambia	37.0
126	Mali	35.6
127	Burkina Faso	35.5
128	Benin	34.5
129	Mauritania	33.5
130	Tanzania (United Republic of)	31.2
131	Congo (Democratic Republic of the)	29.4
132	Chad	28.4
133	Mozambique	26.0

Higher education

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RANK	COUNTRY	VALUE
1	Switzerland	68.6
2	Cyprus	67.1
3	Luxembourg	66.4
4	United States	66.1
5	United Kingdom	64.8
6	Austria	64.7
7	Norway	64.6
8	Denmark	63.5
9	Portugal	63.3
10	Belgium	63.2
11	Netherlands	63.0
12	Estonia	62.5
13	Sweden	62.4
14	Israel	62.2
15	Australia	61.7
16	Slovenia	61.4
17	Finland	61.3
18	Germany	61.1
19	Canada	60.7
20	Croatia	59.5
21	Latvia	59.3
22	Czechia	59.1
23	Iceland	59.1
24	Bulgaria	58.6
25	Montenegro	58.4
26	Slovakia	58.3
27	Malta	58.0
28	Qatar	57.4
29	New Zealand	57.2
30	Lithuania	56.9
31	Singapore	55.8
32	Brunei Darussalam	55.7
33	Paraguay	55.5
34	Spain	55.4
35	Ireland	55.3
36	Romania	55.0
37	Poland	54.8
38	France	53.5
39	Armenia	53.0
40	Italy	52.4
41	Bolivia (Plurinational State of)	52.2
42	Albania	51.8
43	Georgia	51.7
44	Panama	51.6
45	Hong Kong, China (SAR)	51.4
46	Trinidad and Tobago	51.1
47	United Arab Emirates	51.0
48	Peru	50.4
49	Argentina	50.0
50	North Macedonia	49.8

RANK	COUNTRY	VALUE
51	Belarus	49.4
52	Bosnia and Herzegovina	48.9
53	Colombia	48.5
54	Serbia	48.3
55	Suriname	48.2
56	Seychelles	48.2
57	Philippines	48.1
58	Malaysia	48.0
59	Uruguay	47.8
60	Hungary	47.8
61	Kyrgyzstan	47.5
62	Korea (Republic of)	47.3
63	Greece	47.2
64	Chile	47.1
65	Dominican Republic	46.3
66	Mauritius	46.1
67	Mexico	45.3
68	Indonesia	45.2
69	Costa Rica	45.0
70	Saudi Arabia	44.7
71	Kuwait	44.7
72	Botswana	44.7
73	Kazakhstan	44.7
74	Cabo Verde	43.7
75	Ukraine	43.7
76	Namibia	43.5
77	Nepal	43.4
78	Honduras	42.5
79	Ecuador	42.3
80	Azerbaijan	42.1
81	Moldova (Republic of)	42.0
82	Bhutan	41.3
83	Russian Federation	41.1
84	Madagascar	40.9
85	Uzbekistan	39.9
86	Oman	39.6
87	Tunisia	39.1
88	Burundi	38.9
89	South Africa	38.9
90	Mongolia	38.8
91	Brazil	38.7
92	Lao People's Democratic Republic	38.1
93	Eswatini (Kingdom of)	37.9
94	Egypt	37.7
95	Thailand	37.5
96	Sri Lanka	37.1
97	Uganda	37.0
98	Guatemala	36.8
99	Tajikistan	36.8

RANK	COUNTRY	VALUE
100	Palestine, State of	36.1
101	Côte d'Ivoire	35.8
102	Bahrain	35.7
103	Ghana	35.6
104	El Salvador	35.5
105	Jordan	35.3
106	India	35.0
107	Zimbabwe	35.0
108	Lesotho	34.9
109	Viet Nam	34.6
110	Mozambique	34.5
111	Cambodia	34.5
112	Bangladesh	33.7
113	Pakistan	33.6
114	Morocco	33.1
115	Guinea	32.9
116	Türkiye	32.8
117	Kenya	32.2
118	Togo	31.7
119	Iran (Islamic Republic of)	31.3
120	Rwanda	31.3
121	Senegal	30.9
122	Mali	30.1
123	Burkina Faso	29.8
124	Gambia	29.1
125	Cameroon	29.0
126	Ethiopia	28.4
127	Chad	26.9
128	Tanzania (United Republic of)	26.5
129	Niger	25.3
130	Benin	25.3
131	Myanmar	23.1
132	Mauritania	22.1
133	Congo (Democratic Republic of the)	20.1

Research, development and innovation

RANK		COUNTRY	VALUE
1	●	Israel	55.0
2	●	Sweden	54.7
3	●	Switzerland	54.3
4	●	United Kingdom	54.0
5	●	United States	51.5
6	●	Korea (Republic of)	51.4
7	●	Finland	50.7
8	●	Denmark	50.3
9	●	Netherlands	48.8
10	●	Germany	47.3
11	●	Malta	46.7
12	●	Singapore	46.2
13	●	Luxembourg	45.9
14	●	France	45.7
15	●	Belgium	43.7
16	●	Austria	43.5
17	●	Estonia	43.3
18	●	Hong Kong, China (SAR)	43.0
19	●	Ireland	42.9
20	●	Italy	42.3
21	●	Australia	42.0
22	●	Cyprus	41.7
23	●	New Zealand	40.5
24	●	Slovenia	39.8
25	●	Norway	39.6
26	●	Czechia	39.1
27	●	Iceland	38.4
28	●	Saudi Arabia	37.9
29	●	United Arab Emirates	37.9
30	●	Gambia	37.6
31	●	Spain	37.4
32	●	Canada	37.2
33	●	Zimbabwe	37.1
34	●	Malaysia	36.3
35	●	Hungary	34.9
36	●	Portugal	34.9
37	●	Greece	34.8
38	●	Bulgaria	34.1
39	●	Colombia	34.0
40	●	Türkiye	33.5
41	●	Lithuania	32.6
42	●	Latvia	32.6
43	●	Croatia	32.1
44	●	Romania	32.0
45	●	Poland	31.6
46	●	Botswana	31.5
47	●	Qatar	30.8
48	●	Peru	30.7
49	●	Chile	30.7
50	●	Thailand	30.6

RANK		COUNTRY	VALUE
51	●	South Africa	30.5
52	●	Slovakia	30.5
53	●	Albania	30.5
54	●	India	30.1
55	●	Serbia	29.9
56	●	Mongolia	29.9
57	●	Cabo Verde	28.7
58	●	Palestine, State of	28.5
59	●	North Macedonia	28.3
60	●	Kenya	28.3
61	●	Belarus	28.2
62	●	Armenia	27.7
63	●	Iran (Islamic Republic of)	27.7
64	●	Russian Federation	27.4
65	●	Bolivia (Plurinational State of)	27.2
66	●	Suriname	27.1
67	●	Ukraine	27.0
68	●	Dominican Republic	26.8
69	●	Nepal	26.6
70	●	Georgia	26.5
71	●	Seychelles	26.3
72	●	Morocco	26.0
73	●	Tunisia	26.0
74	●	Brazil	26.0
75	●	Montenegro	25.8
76	●	Ecuador	25.7
77	●	Argentina	25.7
78	●	Panama	25.6
79	●	Viet Nam	25.6
80	●	Eswatini (Kingdom of)	25.5
81	●	Moldova (Republic of)	25.4
82	●	Jordan	25.3
83	●	Bosnia and Herzegovina	25.2
84	●	Uruguay	25.1
85	●	Rwanda	25.1
86	●	Tanzania (United Republic of)	24.8
87	●	Ghana	24.5
88	●	Kuwait	24.4
89	●	Benin	24.0
90	●	Egypt	24.0
91	●	Uzbekistan	23.9
92	●	Oman	23.7
93	●	Cameroon	23.7
94	●	Uganda	23.6
95	●	Sri Lanka	23.3
96	●	Kyrgyzstan	23.3
97	●	Azerbaijan	23.2
98	●	Philippines	23.2
99	●	Bhutan	22.3
100	●	Namibia	22.2

RANK		COUNTRY	VALUE
101	●	Bahrain	22.1
102	●	Mauritania	21.9
103	●	Kazakhstan	21.9
104	●	Lao People's Democratic Republic	21.7
105	●	Indonesia	21.4
106	●	Brunei Darussalam	21.4
107	●	Burundi	21.3
108	●	Honduras	21.1
109	●	Mauritius	21.0
110	●	Paraguay	20.9
111	●	Myanmar	20.6
112	●	Cambodia	20.4
113	●	Madagascar	20.2
114	●	Congo (Democratic Republic of the)	19.9
115	●	Lesotho	19.7
116	●	Guatemala	19.6
117	●	Costa Rica	19.3
118	●	Mali	19.2
119	●	El Salvador	19.1
120	●	Mexico	18.5
121	●	Chad	18.3
122	●	Tajikistan	18.2
123	●	Mozambique	18.2
124	●	Trinidad and Tobago	18.0
125	●	Bangladesh	17.4
126	●	Senegal	17.3
127	●	Burkina Faso	16.4
128	●	Guinea	16.4
129	●	Togo	16.3
130	●	Côte d'Ivoire	15.9
131	●	Niger	15.4
132	●	Pakistan	15.3
133	●	Ethiopia	15.0

Information and communications technology

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RANK	COUNTRY	VALUE
1	Singapore	77.5
2	United States	75.1
3	Luxembourg	72.6
4	Korea (Republic of)	72.5
5	Sweden	72.4
6	Finland	71.8
7	Netherlands	71.6
8	Malta	71.5
9	Norway	71.5
10	Estonia	71.1
11	Denmark	70.8
12	United Kingdom	70.4
13	Switzerland	70.2
14	United Arab Emirates	70.0
15	Israel	69.8
16	Hong Kong, China (SAR)	69.2
17	Iceland	68.7
18	Austria	66.1
19	Saudi Arabia	65.4
20	France	65.2
21	Cyprus	65.1
22	New Zealand	64.2
23	Australia	63.8
24	Slovenia	63.7
25	Latvia	63.1
26	Kuwait	62.4
27	Ireland	62.4
28	Lithuania	62.2
29	Canada	62.0
30	Spain	62.0
31	Germany	61.9
32	Belgium	59.8
33	Bahrain	59.3
34	Serbia	59.2
35	Montenegro	58.1
36	Poland	57.9
37	Croatia	57.6
38	Portugal	57.3
39	Malaysia	56.8
40	Chile	56.8
41	Hungary	56.7
42	Bulgaria	56.5
43	Czechia	55.8
44	Italy	55.5
45	Slovakia	54.2
46	Romania	54.2
47	Uruguay	53.3
48	Greece	53.0
49	Oman	53.0
50	Belarus	52.8

RANK	COUNTRY	VALUE
51	Thailand	52.4
52	Seychelles	52.4
53	Brunei Darussalam	52.2
54	Mauritius	52.1
55	Moldova (Republic of)	51.1
56	Russian Federation	51.0
57	North Macedonia	50.9
58	Qatar	50.8
59	Trinidad and Tobago	50.7
60	Ukraine	50.5
61	Armenia	49.8
62	Kazakhstan	49.6
63	Georgia	49.4
64	Türkiye	49.3
65	Brazil	49.0
66	Albania	48.9
67	Costa Rica	48.8
68	Argentina	47.6
69	Bosnia and Herzegovina	47.5
70	Indonesia	47.2
71	Panama	45.7
72	Morocco	45.4
73	Suriname	45.3
74	Paraguay	45.3
75	Mongolia	45.1
76	Viet Nam	44.7
77	Mexico	44.7
78	Colombia	44.5
79	South Africa	43.7
80	Peru	43.4
81	Tunisia	43.1
82	Uzbekistan	42.5
83	India	41.3
84	Azerbaijan	40.7
85	Egypt	39.8
86	Dominican Republic	39.4
87	Sri Lanka	39.0
88	Bolivia (Plurinational State of)	38.7
89	Iran (Islamic Republic of)	38.5
90	Kyrgyzstan	38.4
91	Bhutan	38.4
92	Jordan	38.1
93	Philippines	37.8
94	Cambodia	37.5
95	Ecuador	37.0
96	Ghana	35.5
97	Cabo Verde	35.4
98	El Salvador	35.3
99	Rwanda	35.2

RANK	COUNTRY	VALUE
100	Palestine, State of	35.1
101	Botswana	34.8
102	Guatemala	33.7
103	Kenya	33.3
104	Bangladesh	31.9
105	Côte d'Ivoire	31.3
106	Tajikistan	30.5
107	Namibia	30.4
108	Lao People's Democratic Republic	30.3
109	Pakistan	29.7
110	Eswatini (Kingdom of)	29.6
111	Senegal	29.6
112	Benin	29.2
113	Myanmar	28.9
114	Guinea	28.3
115	Zimbabwe	28.2
116	Mauritania	28.0
117	Honduras	27.1
118	Nepal	26.5
119	Lesotho	26.1
120	Togo	25.3
121	Congo (Democratic Republic of the)	24.1
122	Uganda	24.0
123	Mali	23.2
124	Tanzania (United Republic of)	22.7
125	Burkina Faso	22.2
126	Madagascar	20.8
127	Niger	20.7
128	Cameroon	20.7
129	Gambia	20.4
130	Chad	19.1
131	Burundi	17.7
132	Mozambique	16.7
133	Ethiopia	15.7

Economy

RANK	COUNTRY	VALUE
1	Hong Kong, China (SAR)	79.2
2	Singapore	78.2
3	Denmark	73.6
4	Ireland	72.3
5	Korea (Republic of)	71.0
6	United States	70.5
7	Canada	69.8
8	Switzerland	69.0
9	Malta	68.5
10	Sweden	68.1
11	Austria	67.8
12	Belgium	67.6
13	United Arab Emirates	66.9
14	Israel	66.9
15	Finland	66.7
16	Germany	66.5
17	Hungary	66.2
18	Australia	66.2
19	United Kingdom	66.0
20	New Zealand	65.8
21	Czechia	65.7
22	Netherlands	65.6
23	France	65.5
24	Luxembourg	65.4
25	Kuwait	65.0
26	Qatar	65.0
27	Norway	65.0
28	Iceland	63.5
29	Estonia	63.4
30	Latvia	63.3
31	Slovenia	62.6
32	Lithuania	62.4
33	Thailand	62.3
34	Malaysia	62.3
35	Spain	60.4
36	Italy	59.7
37	Portugal	59.5
38	Romania	58.9
39	Saudi Arabia	58.8
40	Bahrain	58.6
41	Croatia	58.3
42	Mauritius	58.1
43	Poland	57.8
44	Chile	57.5
45	Viet Nam	56.7
46	Slovakia	56.6
47	Bulgaria	55.8
48	Cyprus	55.3
49	Panama	55.3
50	Trinidad and Tobago	54.8

RANK	COUNTRY	VALUE
51	Indonesia	54.6
52	Peru	53.9
53	Mexico	53.7
54	Oman	53.4
55	Seychelles	53.2
56	Georgia	53.0
57	India	52.9
58	Serbia	52.8
59	North Macedonia	52.8
60	Greece	52.5
61	Türkiye	52.5
62	Kazakhstan	51.9
63	Botswana	51.4
64	Moldova (Republic of)	50.7
65	Uruguay	50.5
66	Mongolia	50.3
67	Philippines	50.0
68	Montenegro	49.8
69	Russian Federation	49.7
70	Jordan	49.7
71	Uzbekistan	49.7
72	Brunei Darussalam	49.1
73	Cambodia	48.6
74	Colombia	48.5
75	Guatemala	48.2
76	Bhutan	48.2
77	Costa Rica	47.9
78	El Salvador	47.2
79	Dominican Republic	47.1
80	South Africa	46.9
81	Belarus	46.7
82	Cabo Verde	46.5
83	Bosnia and Herzegovina	46.2
84	Brazil	46.1
85	Egypt	45.9
86	Tunisia	45.8
87	Morocco	45.3
88	Armenia	45.2
89	Kenya	44.8
90	Uganda	44.8
91	Paraguay	44.4
92	Bangladesh	44.4
93	Gambia	44.3
94	Pakistan	43.7
95	Ecuador	43.6
96	Kyrgyzstan	43.2
97	Palestine, State of	43.1
98	Côte d'Ivoire	42.8
99	Azerbaijan	42.4
100	Myanmar	42.0

RANK	COUNTRY	VALUE
101	Tanzania (United Republic of)	42.0
102	Sri Lanka	41.9
103	Senegal	41.8
104	Albania	41.7
105	Namibia	41.6
106	Bolivia (Plurinational State of)	41.5
107	Rwanda	41.4
108	Togo	41.4
109	Argentina	40.9
110	Ukraine	40.8
111	Nepal	40.5
112	Ethiopia	40.1
113	Lesotho	40.0
114	Honduras	39.8
115	Mozambique	39.7
116	Lao People's Democratic Republic	39.1
117	Iran (Islamic Republic of)	38.8
118	Congo (Democratic Republic of the)	38.2
119	Mauritania	37.2
120	Tajikistan	36.8
121	Benin	36.2
122	Zimbabwe	36.0
123	Mali	35.5
124	Ghana	35.2
125	Suriname	35.1
126	Niger	34.5
127	Madagascar	34.5
128	Eswatini (Kingdom of)	34.1
129	Burkina Faso	34.1
130	Cameroon	32.8
131	Guinea	32.2
132	Burundi	29.3
133	Chad	28.7

Enabling environment

RANK	COUNTRY	VALUE
1	Iceland	89.1
2	Norway	87.7
3	Finland	85.8
4	Sweden	85.7
5	Switzerland	85.0
6	Denmark	83.4
7	Luxembourg	82.4
8	Ireland	81.8
9	Singapore	81.4
10	Netherlands	80.6
11	New Zealand	79.7
12	Uruguay	79.6
13	Austria	79.4
14	Germany	79.4
15	Belgium	78.0
16	Portugal	77.2
17	United Kingdom	76.6
18	Estonia	76.5
19	Australia	76.4
20	Slovenia	75.5
21	France	75.3
22	Czechia	73.9
23	Lithuania	73.9
24	Canada	73.8
25	Malta	73.8
26	Spain	73.1
27	Latvia	71.7
28	Costa Rica	70.0
29	Poland	69.3
30	Chile	69.0
31	Slovakia	69.0
32	Cyprus	68.9
33	Italy	68.7
34	Croatia	68.4
35	Korea (Republic of)	68.1
36	Hungary	67.0
37	United States	66.5
38	Cabo Verde	65.9
39	Mauritius	65.6
40	Bhutan	65.3
41	Romania	64.6
42	Brunei Darussalam	64.5
43	Greece	63.9
44	Qatar	63.1
45	United Arab Emirates	62.9
46	Israel	62.3
47	Seychelles	62.0
48	Bulgaria	61.6
49	Georgia	60.8
50	Albania	60.4

RANK	COUNTRY	VALUE
51	Montenegro	59.6
52	Malaysia	59.3
53	Panama	59.2
54	Botswana	59.2
55	Namibia	58.3
56	North Macedonia	58.1
57	Serbia	58.1
58	Kazakhstan	58.0
59	Thailand	57.8
60	Argentina	57.0
61	Dominican Republic	56.1
62	Rwanda	55.9
63	Armenia	55.4
64	Paraguay	55.3
65	Trinidad and Tobago	55.0
66	Moldova (Republic of)	54.9
67	Mongolia	54.9
68	Viet Nam	54.5
69	Ecuador	54.4
70	Brazil	54.3
71	Kuwait	54.1
72	Colombia	54.0
73	Saudi Arabia	53.6
74	Ghana	53.3
75	Bahrain	53.1
76	Ukraine	52.9
77	Sri Lanka	52.6
78	Peru	52.5
79	Indonesia	52.4
80	Bosnia and Herzegovina	51.9
81	Belarus	51.6
82	Jordan	51.5
83	Mexico	51.3
84	Morocco	51.3
85	Türkiye	50.8
86	Tunisia	50.6
87	Bolivia (Plurinational State of)	50.5
88	Suriname	50.1
89	Tanzania (United Republic of)	49.8
90	Oman	49.6
91	South Africa	49.5
92	El Salvador	49.2
93	Uzbekistan	48.7
94	Philippines	48.3
95	Russian Federation	48.1
96	Hong Kong, China (SAR)	47.7
97	Uganda	47.7
98	Kenya	47.5
99	Senegal	47.4

RANK	COUNTRY	VALUE
100	Lao People's Democratic Republic	46.8
101	Palestine, State of	46.6
102	Côte d'Ivoire	46.4
103	Kyrgyzstan	46.2
104	Ethiopia	44.8
105	Honduras	44.5
106	Nepal	44.0
107	Gambia	43.6
108	India	43.6
109	Azerbaijan	43.6
110	Cambodia	43.4
111	Madagascar	43.1
112	Zimbabwe	42.4
113	Togo	42.3
114	Lesotho	42.1
115	Egypt	42.1
116	Benin	41.3
117	Guatemala	41.2
118	Bangladesh	40.7
119	Cameroon	40.6
120	Eswatini (Kingdom of)	40.5
121	Burundi	40.4
122	Mozambique	39.9
123	Myanmar	37.9
124	Niger	36.9
125	Tajikistan	36.6
126	Mauritania	36.4
127	Burkina Faso	36.0
128	Pakistan	35.1
129	Iran (Islamic Republic of)	34.9
130	Guinea	32.9
131	Congo (Democratic Republic of the)	32.6
132	Mali	31.7
133	Chad	27.2
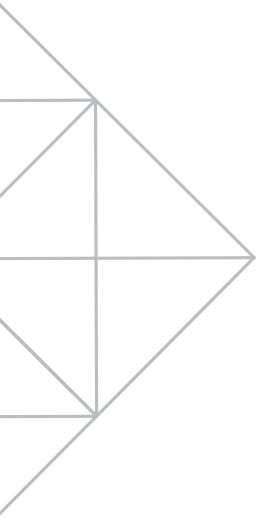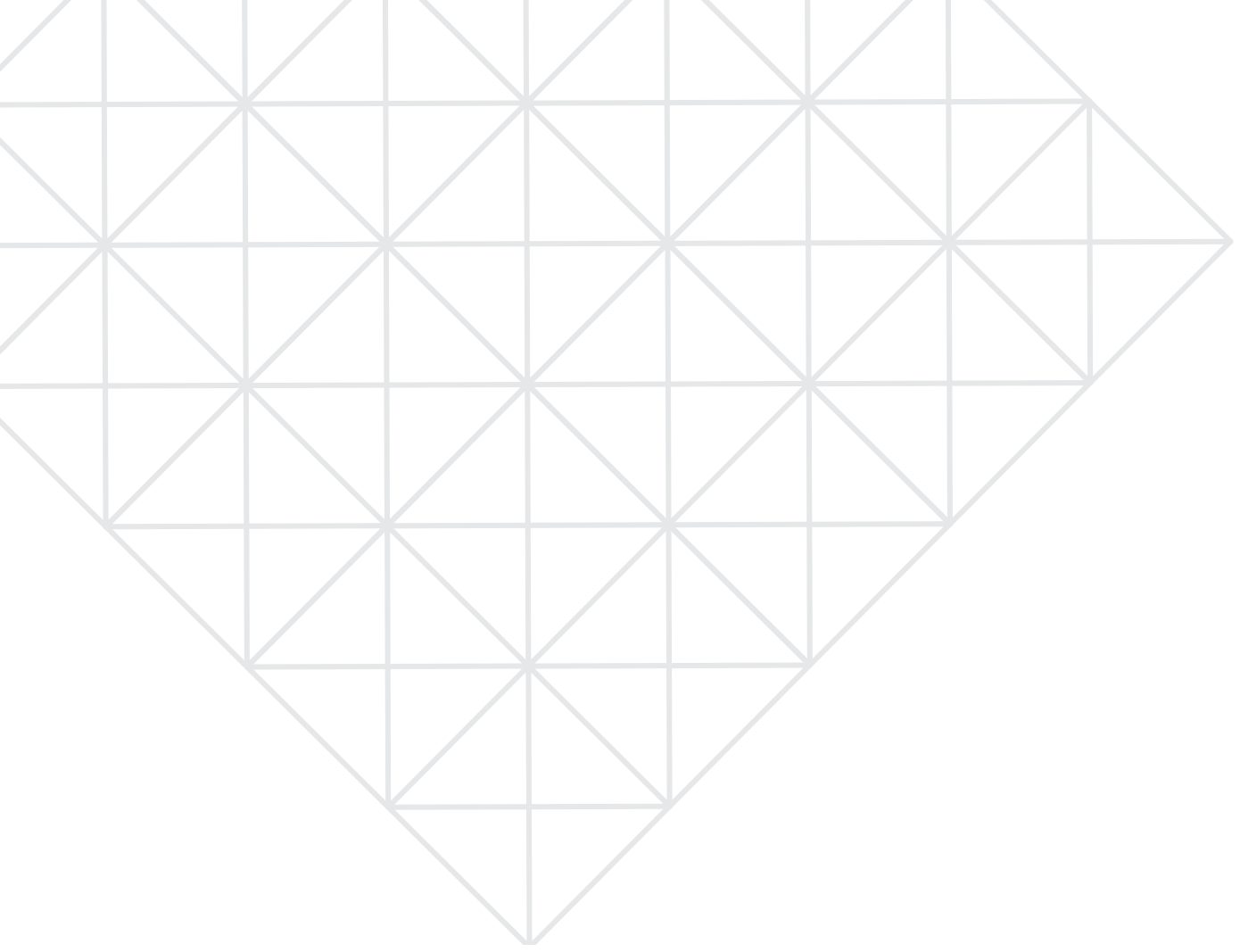
Executive summary

Statistical methodology

The Global Knowledge Index (GKI) consists of seven sub-indices – pre-university education; technical and vocational education and training; higher education; research, development and innovation (RDI); information and communications technology (ICT); economy; and enabling environment – each of which is constructed in accordance with standard international methodologies for the design of composite indicators.[1]

The structure of the Index features a hierarchy comprising sectoral indices (referred to as sub-indices), pillars, sub-pillars and variables. Each of the sub-indices has a weight of 15 percent, except for enabling environment, which is assigned a weight of 10 percent (Figure 1).

Figure 1: GKI structure
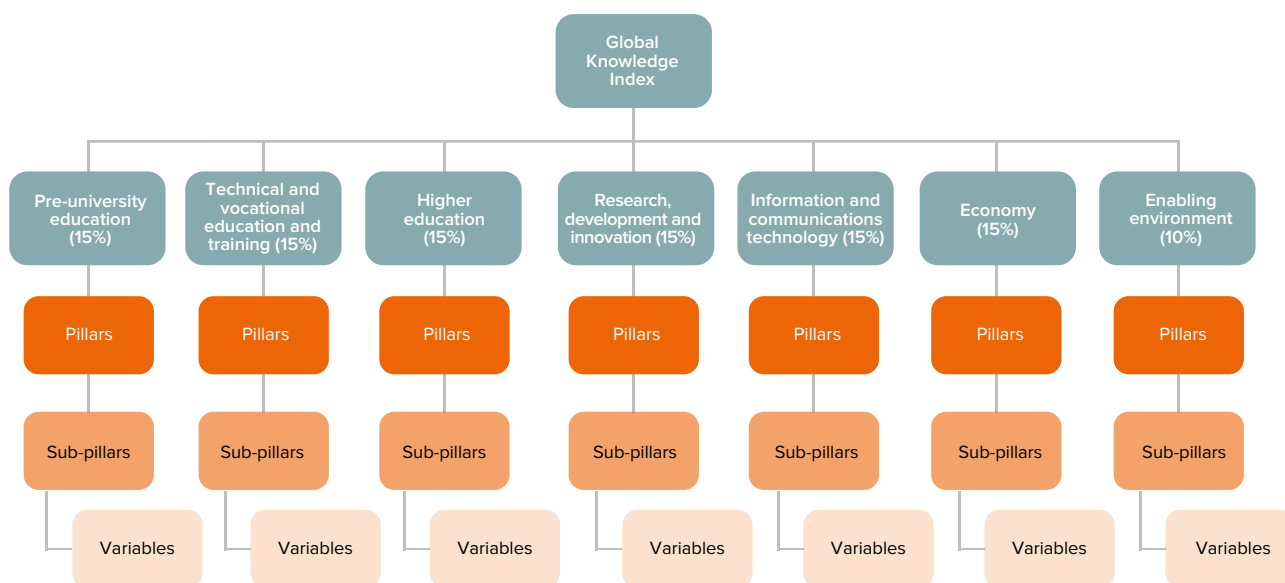
SELECTION OF VARIABLES

The selection of variables included in the construction of each of the seven sub-indices is based on a clearly defined scientific methodology drawn from an extensive review of relevant local and international literature, as well as the experiences of, and concepts employed by, international organizations and agencies such as the European Commission's Competence Centre on Composite Indicators and Scoreboards.[2] It also relies on an intensive consultation process that took place in 2021 and engages high-level advisory board members from different countries with a variety of different backgrounds and affiliations, all specialized in fields related to the sectors of the GKI. This process began with a mapping of the proposed variables (i.e. whether the variable is still reported or has been discontinued) while also assessing their methodologies and limitations. A complementary mapping exercise was undertaken to list variables capturing emerging trends that could potentially be included within the new structure of the Index. Focus group meetings were also held to discuss the propositions and feedback from the advisory board, chaired by the core team members who prepared the report. Based on these discussions and focused workshops, final structures – including pillars, sub-pillars and variables – were produced.

A factor analysis is used to confirm the consistency of the selected variables and the structure of their classification within the various sub-indices, further supporting the consistency of the broader conceptual context across the variables and sub-groups – for which the explained variance ratio in most cases exceeded 65 percent.[3]

The results of the in-depth correlation analysis and Cronbach's Alpha coefficient (exceeding 0.70 in most cases) confirmed the validity of the selection and classification of the variables. Furthermore, the correlation matrix for normalized variables was analysed to ensure that they followed the same direction as the composite index.

DATA COLLECTION

The 155 variables employed in the 2023 GKI are drawn from over 40 international sources and databases, including those of the United Nations Educational, Scientific and Cultural Organization (UNESCO); the World Bank; the International Telecommunication Union (ITU); the World Economic Forum (WEF); the International Monetary Fund (IMF); the Organisation for Economic Co-

operation and Development (OECD); the International Labour Organization (ILO) and other United Nations agencies and international organizations. The collected data are reviewed multiple times to ensure no errors had occurred during data entry; consequently, data are processed on the assumption that it is error-free. Also, all variables are taken in relative terms, and for those not linked to other size-dependent variables – such as population or GDP – results are recalculated after adjusting for the effect of size. Variables included are in the form of either hard data, composite indicators or survey questions/responses.

The most recent data for each variable within the period 2013–2023 are used.[4] As a prerequisite, data employed in the construction of the sub-indices had to meet certain statistical criteria. This applies to all sub-indices and for all countries. Where no data for a variable were available for at least half of the countries, such variable was excluded from the structure.

Missing data are not estimated or imputed; instead, they are left blank and excluded from the sub-pillar aggregation. This means that missing variables do not count as zero for a country; rather, they are excluded from the calculation of sub-pillars.

DATA TREATMENT

Outliers are identified using the skewness and kurtosis measures, which are considered less invasive compared to the interquartile range and z-score measures. Outliers were treated, as they often lead to biased rankings and misinterpretations of results. Given that the min-max normalization technique is adopted, outliers' identification is required whereby as few observations as possible will be treated.

It was deemed necessary to treat variables when the absolute skewness coefficient is above 2.25, and absolute kurtosis coefficient above 3.5.[5] Variables with skewness lower than the threshold defined but with absolute kurtosis above 10 are also treated.

By applying the rules for identifying outliers through severe skewness and severe kurtosis in the data, the team found 30 variables with outliers that required treatment. The methods adopted follow the COINr tool package, an R-based and Excel-based software tool to help develop and analyse composite indicators and scoreboards.[6]

Variables with identified outliers are then treated to be prepared for normalization and aggregation with the goal of treating as few observations as possible. Variables with fewer than five outliers are treated using the Winsorization technique – treating only few potentially problematic observations by capping values so they fall at the edge of the main distribution. In cases of positive skewness, these values are assigned the second-highest value, while in cases of negative skewness, they are assigned the second-lowest value until skewness or kurtosis fell within the desired ranges.

If applying Winsorization to at most five observations did not sufficiently correct skewness or kurtosis, the logarithmic transformation[7] is employed for variables with positive skewness and the second or third power was applied for variables with negative skewness. These two methods transform all the values in the indicator.

In some instances where logarithmic transformation alone could not bring skewness and kurtosis into the desired ranges, logarithmic median transformation and normalization[8] are applied. Table 1 displays the frequency distribution of these outlying variables according to their respective sub-indices and the treatment methods used.

Table 1: Frequency distribution of GKI variables with outliers, by treatment method

SUB-INDEX	TREATMENT		TOTAL COUNT
	WINSORIZATION	LOGARITHMIC TRANSFORMATION OR SECOND/THIRD POWER	
Pre-university education	2	-	2
Technical and vocational education and training	2	1	3
Higher education	5	-	5
Research, development and innovation	9	2	11
Information and communications technology	3	3	6
Economy	3	-	3
Enabling environment	-	-	-
Total	**24**	**6**	**30**

For example, in the pre-university education sub-index, within the variable 'pupil-trained teacher ratio in primary education', outliers were identified and were treated, using the Winsorization technique, whereas in the information and communications technology sub-index, within the variable 'fixed-broadband basket (% GNI per capita)', outliers were identified and treated using logarithmic transformation. A detailed list of the outlying GKI 2023 variables with the sector they belong to and the treatment method applied is presented in Table 2.

NORMALIZATION

A rescaling of variables onto a common scale to permit comparability among variables with different units of measurement and ranges of variation is performed. The min-max method is used for normalization, prior to aggregation, where the values of variables are normalized into the [0,100] range, in which higher values indicated better results. The normalization criterion depends on whether the variable has a positive or a negative relationship with the overall Index.

Variables with a positive relationship are normalized using the following formula:

$$\text{Normalized value} = \frac{Country\ value - Minimum\ sample\ value}{Maximum\ sample\ value - Minimum\ sample\ value} \times 100$$

In the case of variables with an inverse relationship, the formula is adjusted as follows:

$$\text{Normalized value} = \frac{Maximum\ sample\ value - Country\ sample\ value}{Maximum\ sample\ value - Minimum\ sample\ value} \times 100$$

For survey data or composite indices, the theoretical ranges of values are retained in the form of minimum and maximum values; for instance, in the case of the [1,7] range for the World Economic Forum Executive Opinion Survey variables, the minimum and maximum are kept as 1 and 7, respectively, regardless of the observed minimum and maximum.

INDEX WEIGHTING

Weighting across the different components of the Index (sub-indices, pillars and sub-pillars) is not unified; rather, it varies according to the nature of the components and their relative importance. Weightings identified for the seven constituent sub-indices ranges from equal weighting and budget allocation to factor analysis. Equal weights are used in the absence of any clear evidence of a diversity of significance among variables, as well as in the absence of sound and complete information concerning the existence of causal relationships, or where a lack of consensus exists on a classical method for estimating weights. The budget allocation process method is also used for weighting. A group of specialists and experienced experts were each given a budget consisting of 100 points to award to the variables. If the variable was believed to have greater relative importance, it was allocated a greater number of points. Subsequently, the

weights were calculated according to the average of the total points allocated to each variable.[9]

The weights are also assessed using factor analysis, which is based on aggregating the linked sub-indicators to form a single factor containing as much information as possible that is shared between the linked indicators. The weights produced by using both the budget allocation and factor analysis methods are consistent with each other and with the initial weight estimates, based on the intellectual and conceptual framework.

All sub-indices have equal weights across all hierarchies except for the research, development and innovation (RDI) sub-index, due to theoretical reasons outlined under the section on the RDI sub-index.

INDEX CALCULATION

The 2023 GKI is calculated for 133 countries, using the most recent and reliable available data to calculate the variables for each country, with 2013 as a cut-off year.

Owing to the lack of availability of data covering all the components for each country, and in view of the need to maintain a sufficient level of accuracy, the composite index is calculated in a bottom-up approach by applying a series of successive aggregations. Consequently, pillars are calculated using at least half of their sub-pillars, whereas sub-pillars require at least one variable. The availability of at least two-thirds of the pillars is required to calculate the sub-index. The overall GKI is calculated only if data for all seven sub-indices are available.

The arithmetic aggregation formula is used to calculate all sub-indices, pillars and sub-pillars of the Index. The composite indicator (CI) is calculated by aggregating its sub-components (SCj) as follows:

$$CI = \sum_{j=1}^{n} w_j \times SC_j$$

CI is the proposed composite indicator to be computed (sub-index, pillar or sub-pillar); wj is the relative weight of the sub-component SC (pillar, sub-pillar, or variable); and n is the number of sub-components aggregated to form the composite indicator.

The geometric mean was used to compute the overall Global Knowledge Index, given that no perfect substitutability exists among the seven sectoral indices. Looking into the ranking differences between the arithmetic and geometric aggregation of the overall Index, only 3 countries differed by 5 ranks; 3 countries by 6 ranks, namely Bhutan, Canada and Oman; and 2 countries by 7 ranks, namely Colombia and Mexico; and 2 countries, by 8 ranks (Peru) and 11 ranks (Costa Rica).

Table 2: Data treatment

	DATA TREATMENT	OUTLIERS
PRE-UNIVERSITY EDUCATION		
Pupil-trained teacher ratio in primary education	Winsorization	1
Pupil-trained teacher ratio in pre-primary education	Winsorization	1
TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING		
Share of students enrolled in post-secondary vocational programmes	Third power (negatively skewed)	-
Average monthly earnings for high-skill TVET occupations relative to total average wage	Winsorization	2
Average monthly earnings for medium-skill TVET occupations relative to total average wage	Winsorization	1
HIGHER EDUCATION		
Teaching staff compensation (% tertiary expenditure)	Winsorization	1
Pupil-teacher ratio in tertiary education	Winsorization	1
Inbound mobility rate	Winsorization	3
Educational attainment rate, doctoral or equivalent	Winsorization	2
Citable documents per R&D personnel in higher education	Winsorization	2
RESEARCH, DEVELOPMENT AND INNOVATION		
Intellectual property payments (% total trade)	Winsorization	5
Average documents per researcher	Winsorization	2
Resident patent applications (per 100 billion GDP)	Logarithmic transformation	-
Intellectual property receipts (% total trade)	Winsorization	4
Industrial design applications (per 100 billion GDP)	Winsorization	4
PCT applications (per 100 billion GDP)	Winsorization	4
Trademark applications (per 100 billion GDP)	Winsorization	2
Cultural goods exports (% exports)	Winsorization	5
Printing and publishing output (% manufactured output)	Winsorization	2
Joint ventures per strategic alliance deals (per billion GDP)	Winsorization	1
Research institutions prominence	Logarithmic median transformation and normalization	-
INFORMATION AND COMMUNICATIONS TECHNOLOGY		
Secure Internet servers per 1 million population	Logarithmic transformation	-
Fixed broadband basket (% GNI per capita)	Logarithmic transformation	-
Mobile broadband basket (% GNI per capita)	Winsorization	3
International Internet bandwidth per user	Logarithmic median transformation and normalization	-
Mobile broadband Internet traffic per subscription	Winsorization	2
ICT PCT patent applications (per 100 billion GDP)	Winsorization	5
ECONOMY		
High-technology trade (% total trade)	Winsorization	4
Foreign direct investment, net inflows (% GDP)	Winsorization	3
Bank non-performing loans (%)	Winsorization	2

Pre-university education sub-index

INTRODUCTION

The pre-university education sub-index, covering the stage of pre-primary education through the end of secondary education, was established as one of the branches of the Global Knowledge Index to serve as a systematic tool for measuring the performance of the pre-university education system at various stages. Various consultations with experts have confirmed the significance of this achievement. Statistical procedures have revealed encouraging indicators regarding the soundness of the sub-index structure and the consistency and stability of its components.

The structure of the pre-university education sub-index

The sub-index comprises two interactive pillars: knowledge capital and educational enabling environment, with each containing several sub-pillars.

The first pillar: Knowledge capital

The sub-index measures knowledge capital as one of the main goals of educational systems, with the necessity to highlight the contextual variables that are directly related and influential in the value and quality of the educational output; i.e., the set of inputs and processes that enable the student to achieve the desired objectives.

The knowledge capital pillar consists of three sub-pillars: enrolment, completion and outcomes:

- The enrolment sub-pillar: employs rates of the extent to which countries are able to provide access to education institutions at all levels, from pre-school education to the end of secondary education. This sub-pillar includes three variables:
  - Net enrolment rate in primary education;
  - Net enrolment rate in lower secondary education; and
  - Net enrolment rate in upper secondary education.

The second pillar: Educational enabling environment

This pillar encompasses sub-pillars of expenditure, resources (which include variables that relate more closely to the learning environment), early learning, and a fourth sub-pillar recognizing the increasing significance of equity and inclusiveness in international charters, and their close connection with the right to education. Below is a detailed description of the sub-pillars and their rationale:

- Regarding the expenditure sub-pillar, higher rates of enrolment in education entail increased expenditure on education, as this requires the construction of school buildings, the preparation of teachers, the provision of educational devices and aids, and other necessary services. As such, countries must spend on education to ensure its continuity and improve its internal and external efficiencies.

- Completion sub-pillar: Two important aspects are taken into consideration when selecting the variables for this sub-pillar: a legislative aspect related to compulsory education, and a realistic aspect related to actual completion. The variables in this sub-pillar are as follows:
  - Number of years of compulsory primary and secondary education guaranteed in legal frameworks;
  - Completion rate in upper secondary education; and
  - Gross intake ratio to the last grade of lower secondary education.

- As for the outcomes sub-pillar, the variables employed are the 'assessment of 15-year-old students in mathematics, science and reading', as well as another variable that relates to student learning: learning-adjusted years of schooling.

Expenditure on education is often measured as a percentage of a country's budget or GDP. Accordingly, the expenditure sub-pillar includes four variables relating to different integrated aspects of government spending, as follows:
- Government expenditure on primary education (% GDP);
- Government expenditure on secondary education (% GDP);
- Government funding per primary student (% GDP per capita); and
- Government funding per secondary student (% GDP per capita).

- Concerning the resources sub-pillar, the human capital entrusted with the task of teaching is a key factor that is no less important than expenditure on education. Without highly qualified and well-trained education cadres,

education goals and curricula cannot be effectively translated into reality and will remain largely theoretical. While we are certain that a proper approach to measuring this factor requires a number of variables in relation to teachers' preparation, continuous training and professional self-development, given the scarcity of data, two variables were included in relation to the availability of trained teachers:
- Pupil–trained teacher ratio in primary education (headcount basis); and
- Pupil–trained teacher ratio in secondary education (headcount basis).

Additionally, based on the high correlation revealed between the availability of computers and the availability of Internet connections, two variables were included:
- Proportion of primary schools with access to computers for pedagogical purposes (%); and
- Proportion of secondary schools with access to computers for pedagogical purposes (%).

The early learning sub-pillar highlights the role of learning in building children's personalities and preparing them cognitively, emotionally and socially for learning in the subsequent stages of education. This sub-pillar includes four variables:
- Gross enrolment ratio in early childhood education;
- Proportion of children aged 24–59 months who are developmentally on track in terms of health, learning and psychosocial well-being;
- Proportion of children under five years experiencing positive and stimulating home learning environments; and
- Pupil-trained teacher ratio in pre-primary education (headcount basis).

- The equity and inclusiveness sub-pillar was determined in line with the principle of the sustainable development agenda of 'leaving no one behind', where equity and inclusiveness should be given special attention. A number of significant variables were suggested in relation to the differences between students in reading, mathematics and science scores by gender, location, immigration, disability, and guaranteed level of inclusion in primary and secondary education for students with disabilities.

However, in view of the scarcity of such data and the difficulty of measuring aspects of equity in education beyond the issue of parity, three main dimensions were taken into account: gender, location and wealth:
- Completion rate in upper secondary education, gender parity;
- Completion rate in upper secondary education, wealth parity; and
- Completion rate of upper secondary education, location parity.

Figure 2: Structure of the pre-university education sub-index
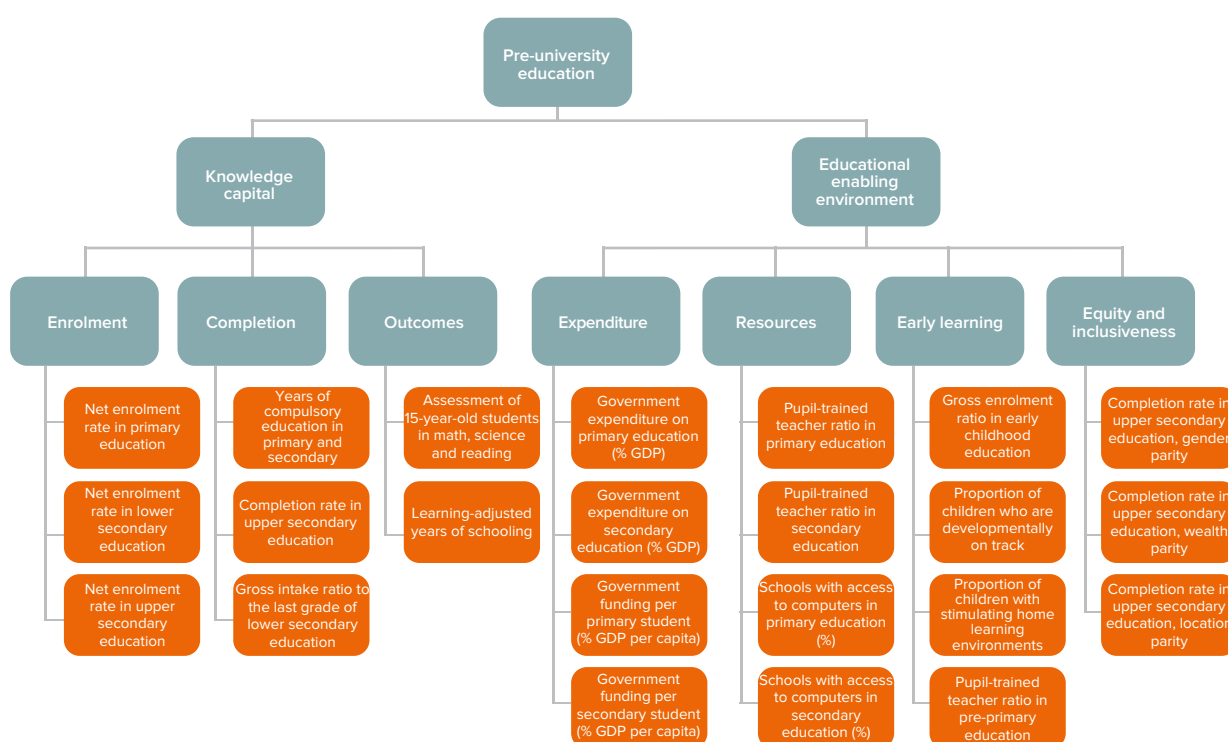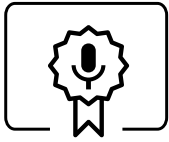
Technical and vocational education and training (TVET) sub-index

INTRODUCTION

The GKI considers TVET to be an essential sector that combines training and qualifications of the human capital at the professional level and one of the most critical sectors linked to the labour market. Meeting labour market requirements and integrating them into academic courses and curricula is a complex process that is subject to the fluctuations of the economy, competitiveness and international conditions. Professions come and go rapidly, making it difficult to respond quickly to changing requirements. Proactive policy adoption is therefore required based on a long-term vision, rather than economic fluctuations.

The structure of the TVET sub-index

The structure of the sub-index is based on a methodological foundation built on numerous relevant international studies. These studies focus on creating a balanced view of the sector, built on fundamental rights in education and training as one of the pillars of the Sustainable Development Goals established by the United Nations' 2030 Sustainable Development Agenda. Therefore, quantitative variables such as enrolment and completion were linked to qualitative variables, as is the case for extent of staff training and quality of vocational training.

The economic structure, especially in terms of its relation to contemporary and knowledge transformations, has an essential role in this approach. Therefore, the sub-index measures the extent to which national economies are able to diversify their offerings and modernize their structures to ensure both their positive interaction with education and training systems, and their positive contribution to the development of human capital. There are three main factors that affect the structure of the economy and the dynamics of social systems today: the environment of the economy, the structure of the labour market, and qualifications. These factors are all interconnected and enable societies to respond to challenges, including most notably the integration of young people into their economies.[10]

The sub-index also focuses on the element of training efficiency and the principles of fairness and inclusivity. It underscores the role of education and training integration in combating poverty and social exclusion, especially within productive environments.

It emphasizes the importance of certain indicators that delineate the dynamic equation between the training structure and the labour market. These indicators are key to evaluating the training and development system's ability to interact positively with labour market constraints and determinants, such as unemployment and qualifications.

Data availability and source quality represented determining factors in the adoption of new variables. Hence, the structure of the TVET sub-index remains both realistic and credible.

Thus, the structure of the TVET sub-index comprises two pillars:

The first pillar: TVET components

This pillar monitors the structures of TVET institutions, the qualifications they provide, and their ability to diversify their educational offerings and make them available to various segments of society—especially females. This relates primarily to factors including enrolment and graduation ratios at all levels, as well as the nature and size of the human resources working in the sector—especially trainers and teachers—and the ability to leverage continuous training programmes to achieve improvements in quality. This pillar is divided into three sub-pillars:

- The first sub-pillar focuses on TVET structure. It is measured through the following three variables: government expenditure on secondary, post-secondary and non-tertiary vocational education (%); share of all students in secondary education enrolled vocational programmes; and share of all students in post-secondary non-tertiary education enrolled in vocational programmes.

- The second sub-pillar focuses on TVET quality and qualifications and is measured through the following variables: extent of staff training; quality of vocational training; average monthly earnings for high-skill TVET occupations relative to total average wage; and average monthly earnings for medium-skill TVET occupations relative to total average wage.

- The third and final sub-pillar is continuous training and skilling. It is measured through the following variables: percentage of firms offering formal training; labour force participation rate with short-cycle tertiary education; and participation rate of youth and adults in formal and non-formal education and training.

The second pillar: TVET labour market

The labour market pillar monitors the realities of the employment system in relation to TVET as an integral part of the economy. It is measured through three sub-pillars and offers a picture of conditions in the labour market and the extent to which the principles of efficiency, equity and inclusiveness are respected.

- The first sub-pillar, efficiency of the labour market, comprises four variables: percent of firms identifying an inadequately educated workforce as a major constraint; proportion of employees who are over or undereducated; proportion of skilled workers (out of all production workers); and unemployment rate among individuals with upper secondary, post-secondary non-tertiary, and short-cycle tertiary education.

- The second sub-pillar, post-TVET employment, is measured through the following variables: share of TVET occupations as a percentage of total employment; and manufacturing employment as a proportion of total employment.

- The last sub-pillar is equity and inclusiveness. It is measured through two variables: 15- to 24-year-olds enrolled in vocational education, adjusted gender parity; and vulnerable employment as a percentage of total employment.

Figure 3: Structure of the TVET sub-index
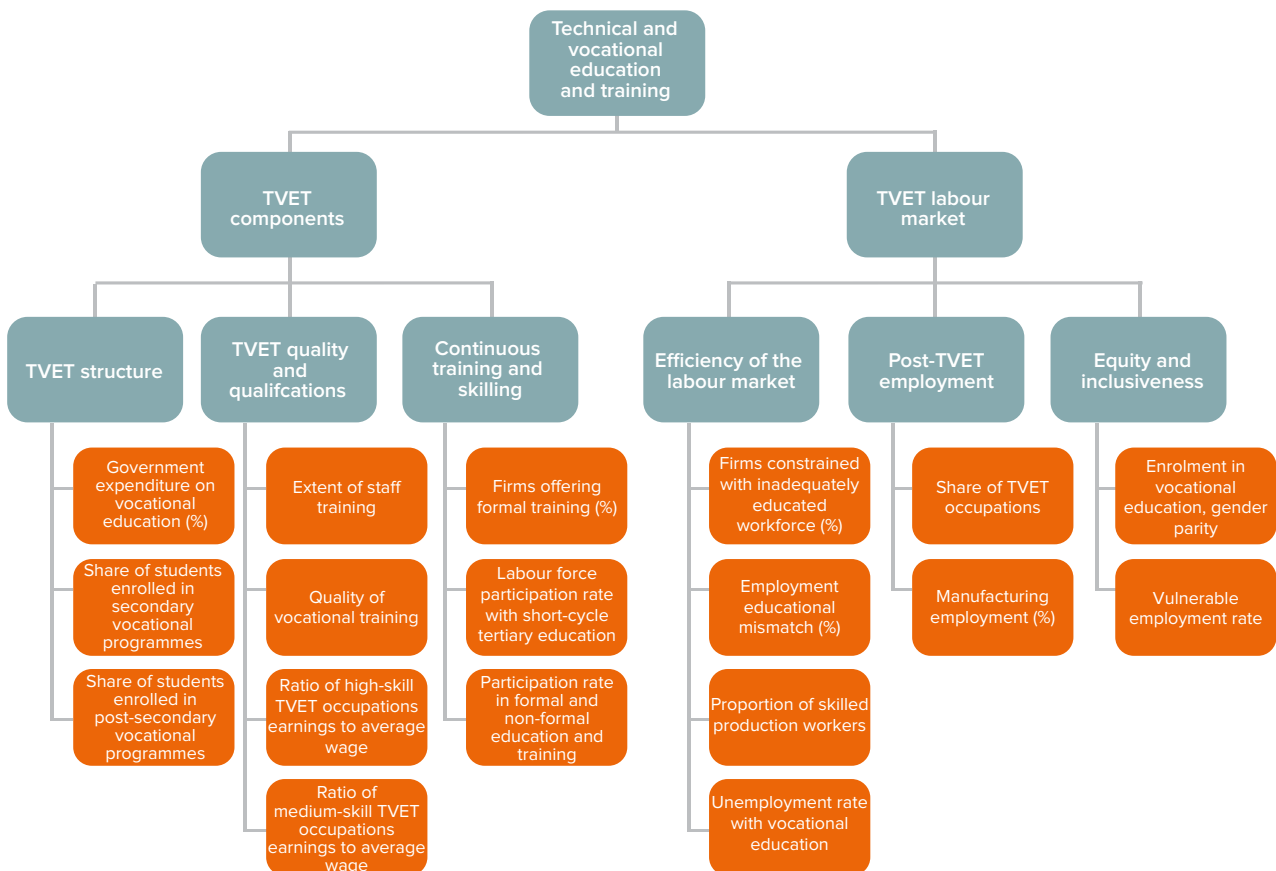
Higher education sub-index

INTRODUCTION

Higher education plays a key role in driving knowledge and innovation by producing human capital with the qualifications and skills necessary to meet the needs of industries that drive the global knowledge economy. Hence, it was imperative that higher education be included as a core sub-index under the GKI. For the purpose of this index, higher education includes short-term programmes, bachelor's or equivalent degree levels, master's or equivalent degree levels, and doctoral or equivalent degrees offered by public and private higher education institutions, falling within levels 5 to 8 according to the International Standard Classification of Education (ISCED 2011) by the United Nations Educational, Scientific, and Cultural Organization (UNESCO).

The structure of the higher education sub-index

The higher education sub-index comprises three main pillars: inputs, which includes three sub-pillars: expenditure, enrolment, and resources; learning environment, which consists of two sub-pillars: diversity and academic freedom, and equity and inclusiveness; and outputs, which includes three sub-pillars: attainment, employment, and impact.

The first pillar: Inputs

The inputs of higher education are those factors that enable systems to achieve their objectives. They come from different sources including fiscal and human.

- With regard to the expenditure sub-pillar, it includes two variables; government expenditure per student in tertiary education, and teaching staff compensation as a percentage of total expenditure in tertiary public institutions.

- For the second sub-pillar on enrolment, two variables are considered relating to share of population enrolled in

bachelor's or equivalent level, and the share of population enrolled in master's, doctoral or equivalent level, to measure enrolment rates for all groups covered by the higher education sub-index.

- In the resources sub-pillar, two variables are adopted: pupil-teacher ratio in tertiary education, and percentage of researchers (FTE) in higher education. While the second variable could also be considered an output of the system, it is nonetheless a resource available to higher education institutions and is considered an input for the index.

The second pillar: Learning environment

The aim of the learning environment pillar is to provide an indication of the learning and teaching climate that students and instructors experience in higher education institutions. Therefore, four themes were suggested: diversity, academic freedom, equity and inclusiveness—where diversity and academic freedom are grouped in one sub-pillar and equity and inclusiveness grouped in another.

- In the diversity and academic freedom sub-pillar, the first theme on diversity was measured through two variables: female-to-male ratio of teachers in tertiary education, and inbound mobility rate. The second theme, on academic freedom, reflects issues of freedom and openness. A higher education sector is responsive to issues of diversity

and freedom if it considers a balanced representation of male and female teachers, opens its doors to both sexes from abroad, and maintains an atmosphere of freedom of expression, freedom in teaching and research, institutional autonomy, academic exchange and campus integrity.

- For the equity and inclusiveness sub-pillar, three variables were adopted: gross attendance ratio for tertiary education, gender parity; gross attendance ratio for tertiary education, wealth parity; and gross attendance ratio for tertiary education, location parity. Taken together, these three variables relate to the composition of students in higher education institutions by their gender, location and wealth and provide a good indicator for equity in the sector.

The third pillar: Outputs

The outputs pillar aims to provide an assessment of the outcomes and impact of the system and its contribution to the economic and social development of its graduates. The outputs pillar consists of three sub-pillars: attainment, employment and impact.

- The attainment sub-pillar comprises three variables: educational attainment rate, bachelor's or equivalent; educational attainment rate, master's or equivalent; and educational attainment rate, doctoral or equivalent.

- The employment sub-pillar includes two variables: the labour force participation rate with advanced education as a percentage of the total labour force (15+); and

unemployment rate with advanced education as a percentage of total labour force (15+).

- The impact sub-pillar features two variables: university-industry collaboration in R&D, which indicates economic and business impact; and citable documents normalized by total R&D personnel in higher education (FTE), which indicates research and knowledge creation impact.

Figure 4: Structure of the higher education sub-index
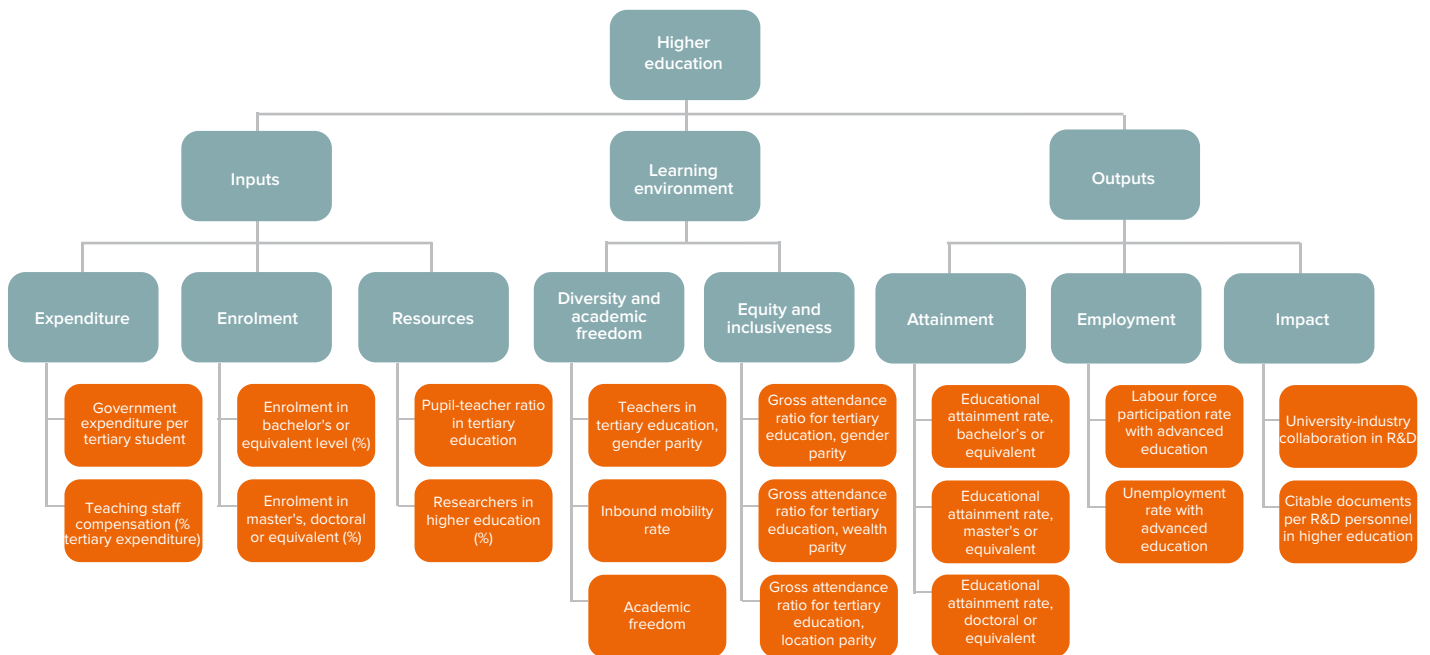
Research, development and innovation (RDI) sub-index

INTRODUCTION

Research and development (R&D) "comprise creative and systematic work undertaken in order to increase the stock of knowledge—including knowledge of humankind, culture and society—and to devise new applications of available knowledge".[11] Innovation, on the other hand, is viewed as creative activity leading to the development of new products or processes that differ significantly from the product previously delivered to consumers, or the process previously used by the company or the industry.[12,13] Based on these definitions and rationale, scientific research, development and innovation (RDI) represent a central aspect of knowledge generation, dissemination and application processes in support of development.

The structure of the RDI sub-index

The first pillar: Inputs

The inputs pillar is composed of three sub-pillars: inputs of R&D institutions; inputs of RDI in business enterprises; and inputs of societal innovation.

- The constituent variables of the inputs of R&D institutions sub-pillar are gross expenditure on R&D (GERD) as a percentage of GDP; GERD per researcher (computed as full time equivalent [FTE]); and the share of researchers per thousand labour force. Furthermore, the percentage of graduates from science, technology, engineering and mathematics (STEM) programmes in tertiary education is included here, given its relevance to R&D processes.

- In the sub-pillar related to the inputs of RDI in business enterprises, two types of gross expenditure are considered. The first estimates the total amount of spending allocated to RDI in business enterprises (GERD performed by business enterprises [%]), whereas the second type of spending concentrates on the business sector own financing (GERD financed by business enterprises [%]). Based on this definition, the first spending variable reflects the interest of a country in enhancing R&D in the business sector; while the second variable estimates the internal policy of enterprises

to finance R&D needs. The percentage of researchers in business enterprises represents RDI inputs that determine research capacity and resources in an enterprise. Finally, the percentage of firms that spend on R&D in a given country is included to show the dissemination of a research culture in business sector.

- Inputs of societal innovation, as a third sub-pillar, is composed of three variables. The first variable reflects the importance of having knowledgeable and skilled labour to achieve societal innovation, with the variable high-skilled employment share as a percentage of the total number of unemployed people. High-skilled labour is generally required in the knowledge-intensive industries that characterize developed economies. In order to produce innovative or creative goods and services, civil societies need to acquire intellectual property rights. This represents the second variable of societal innovation, namely intellectual property payments as a percentage of total trade. Finally, the state of cluster development is another measure that reflects the capacity of a country to have well-established cluster industrial and services units that are geographically distributed in support of innovation.

The second pillar: Outputs

- The sub-pillar, outputs of R&D institutions, concentrates mainly on publications (average documents per FTE researcher), citations (citations per document) and resident patent applications.

- The sub-pillar, outputs of RDI in business enterprises, is based on four variables. Two relate to the number of receipts the business sector collects against the utilization by other national institutions of their intellectual property

rights and industrial design applications. The increase in this type of income means that the business enterprises of a country are more productive and innovative. A third variable measures the number of patents under the Patent Cooperation Treaty (PCT)—administrated by the World International Property Organization (WIPO) to provide patent protection in a number of countries simultaneously—which reflects the level of advanced innovation products. Finally, the percentage of firms producing new goods and services

constitutes a direct measure of the innovative capacity of a business sector in a country.

- The third sub-pillar is concerned with outputs of societal innovation which is generally broken down into the acquisition of intangible assets, outputs of creative and culture products, and online creativity. Investment in

intangible assets is represented in the output of societal innovation sub-pillar by trademark applications per GDP. Creative and cultural products are measured within the structure of the sub-pillar by two variables: share of cultural goods exports as a percentage of total goods exports, and printing and publishing output as a percentage of manufactured total output.

The third pillar: Impact

This impact axis incorporates several elements of the impact of research, development, and innovation to the extent permitted by the international scientific and socio-economic database. This pillar comprises three sub-pillars with variables pertaining to the quality of RDI, RDI linkages and how RDI affects the business sector development process—business development.

- The quality of RDI is measured using both survey questions and hard data. Two survey questions determine the prominence of research institutions, and growth of innovative companies of a country. A third variable estimates the management quality of institutions (ISO 9001) (% GDP), and a fourth variable determines eco-innovation performance measured by ISO 14001 environmental certificates (% GDP).

- GERD financed by the outside world is allocated to the linkages sub-pillar in order to measure the cooperation

between domestic and foreign RDI institutions. Furthermore, joint ventures per strategic alliance deals (% GDP) is another measure of linkages.

Finally, computer software spending (% GDP) is interpreted as a way of ensuring linkages between RDI and information technology (IT).

- A third sub-pillar included under the impact pillar is business development. Since the development ideas of new business enterprises are considered as innovation outcomes, a measure of new business density per thousand population can be viewed as part of the innovation impact on business development. Finally, the variable percent of firms with new products or services that are considered new or significant improvements to the main economic market is viewed as a measure leading to the development of business enterprises.

Figure 5: Structure of the RDI sub-index
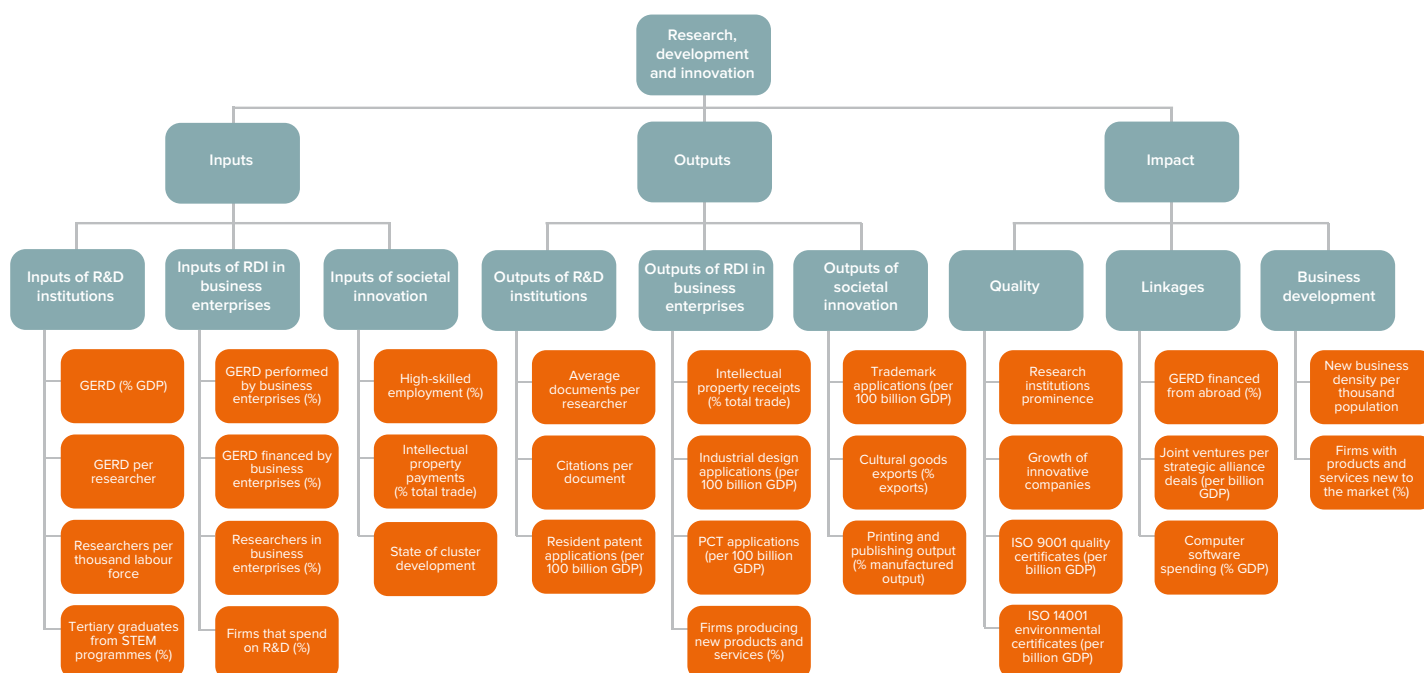
Information and communications technology (ICT) sub-index

INTRODUCTION

As the digital economy grows to constitute an increasingly significant portion of the broader global economy, industries in all sectors are striving to meet the requirements of the Fourth Industrial Revolution,[14] and its demands on information and communications technology (ICT) and other knowledge sectors. For ICT to reach its full potential, knowledge creation should not be restricted to a cluster of countries or regions; rather, it should be localized and shared for the well-being of all societies. Therefore, to gain an insight into how the future will unfold, we must acknowledge the interactions embedded within a number of mutually reinforcing trends in ICT.

The structure of the ICT sub-index

In the framework of the GKI, the ICT sub-index considers variables relating to ICT infrastructure, and access to, and usage of, technologies.

The first pillar: Infrastructure

The infrastructure pillar reflects the importance of infrastructure as a prerequisite for the realization of the gains of technologies, and as an enabler for digital transformation. The deployment of mobile network coverage, and investments in telecommunication networks, tangible and intangible assets, are critical for the development of the sector in any country. Not only should governments invest in their fixed assets, but they should also guarantee that quality services are provided at affordable prices.

Accordingly, the infrastructure pillar is divided into three sub-pillars, coverage, quality and affordability.

- The coverage sub-pillar includes three variables: percentage of population covered by at least 3G/4G mobile networks; secure Internet servers per 1 million people; and annual investment in telecommunication services as a percentage of GDP.

- The quality sub-pillar measures the quality of fixed and mobile-broadband subscriptions provided in terms of speed using three variables: average mobile upload and download speeds; average fixed-broadband upload and download speeds; and fixed-broadband subscriptions by speed per 100 people. It is worth noting that while mobile-broadband technology is advancing at a fast pace, it is not yet an alternative for fixed-broadband, given that businesses to date are highly dependent on fibre-optic communication to conduct business. As such, equal importance is allocated to both fixed- and mobile-broadband in measuring the penetration and quality of telecommunication services in a country.

- While the availability of quality services is essential, ensuring that the services are provided at affordable prices is also indispensable. Hence, a third sub-pillar, affordability, measures the relative prices of ICT services; it encompasses three variables: fixed-broadband basket, 5 GB as a percentage of GNI per capita; data-only mobile-broadband basket, 2 GB as a percentage of GNI per capita; and level of internet and telephony competition.

The second pillar: Access

The development of an advanced and integrated ICT infrastructure alone is not sufficient for the development of a dynamic and inclusive ICT sector. Access and usage of ICTs by citizens, businesses, and governments to drive innovation, maximize the growth potential of technologies and realize development goals, remains at the core of the digital agenda. Accordingly, the access pillar was introduced to measure the penetration of ICT in the country and human capacities in the ICT field. It is divided into two sub-pillars: subscriptions; and skills and employment.

- The sub-pillar, subscriptions, measuring the penetration of ICT services among citizens, includes three variables: active mobile-broadband subscriptions per hundred inhabitants; international Internet bandwidth per Internet user; and estimated proportion of households with Internet access at home.

- This skills and employment sub-pillar assesses the capacity of human capital to integrate the new technologies and to contribute to the growth of the ICT sector. As the demand for digital skills is increasing with the rise in digital-oriented

jobs, and the adoption of technologies in the workplace and by governments, citizens should acquire a set of digital skills to harness these technologies for economic and social development. Furthermore, as global competition is now concentrated over ICT-enabled goods and services, creating a massive number of jobs in the field, the need for self-motivated

and talented ICT specialists that possess programming and analytical skills is paramount. Therefore, this sub-pillar measures the proportion of individuals with standard ICT skills; percentage of graduates from tertiary education graduating from information and communication technology programmes; and ICT employment as a percentage of total employment.

The third pillar: Usage

The technological, societal, and scientific impacts of ICT remain the utmost factors in determining the contribution of this sector to the development of a country. While the infrastructure and access pillars set the digital foundations for a strong ICT sector, the usage of technological services to promote development and create new opportunities is fundamental in measuring the advancement of this sector in an economy. An increase in the use of ICT services promotes the rapid exchange of knowledge—as more people are connected through social networks—and enables the effective development of solutions to pressing challenges via Internet-enabled innovation, creativity and entrepreneurship.[15] Additionally, the availability of online government services and the transition towards digital government is imperative in promoting transparency, accountability and governance in public administrations.

To illustrate the exchange of knowledge and the impact driven by ICT, the usage pillar consists of two sub-pillars: services and outcomes.

- The sub-pillar, services, measures the provision of adequate ICT services, and includes four variables: government online services; fixed-broadband Internet

traffic per subscription; mobile-broadband Internet traffic per subscription; and percentage of Internet users.

- The second sub-pillar, outcomes, reflects the efficacy of the sector and its dynamic effects on other aspects of the economy such as trade, innovation, governance and doing business. It covers four variables: ICT PCT patent applications (per 100 billion GDP); e-participation; percentage of Internet activities by individuals; and international trade in digitally deliverable services as a percentage of total trade.

Finally, the gender digital divide is reflected in the seventh GKI sub-index, enabling environment, as it impacts all sectors presented in the GKI and is considered an important variable in measuring gender equity. The variable, female-to-male Internet users' ratio, measures the usage of Internet and knowledge-enhancing applications and services by females relative to that of males, which is in turn a good measure of female empowerment, as the use of ICTs enables women greater independence and autonomy, providing them with economic and social opportunities.[16]

Figure 6: Structure of the ICT sub-index
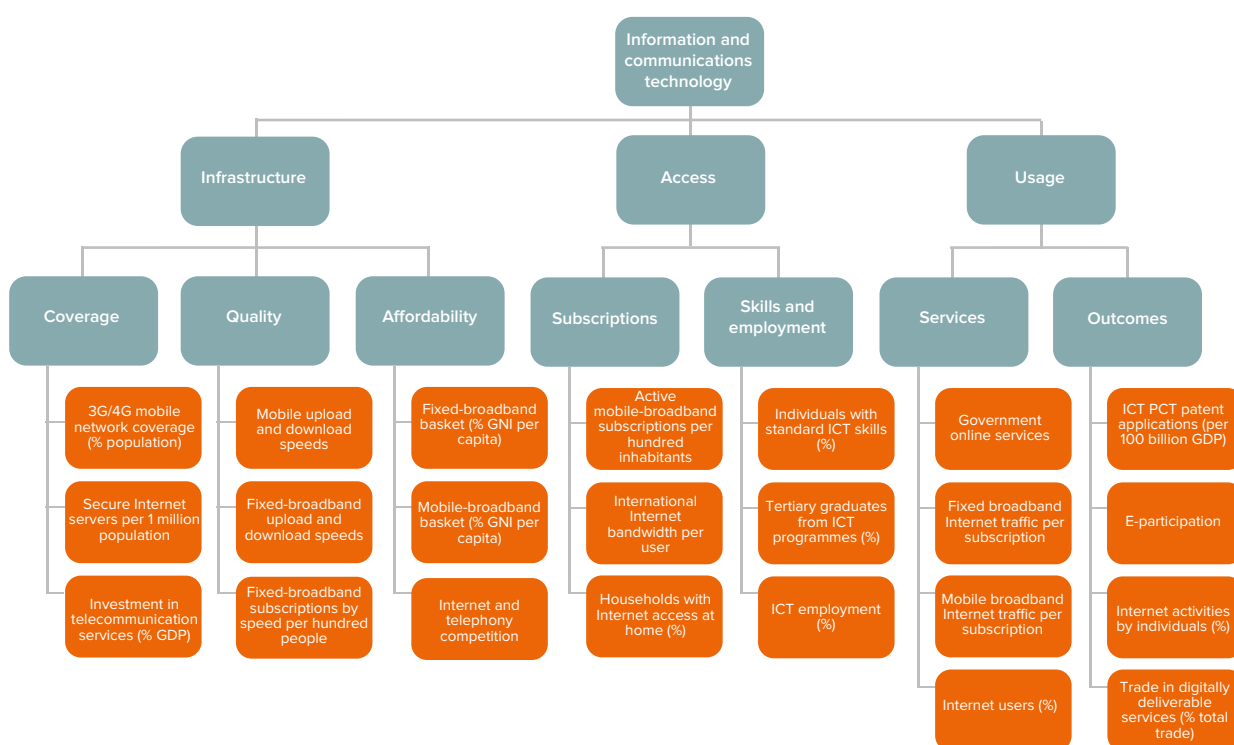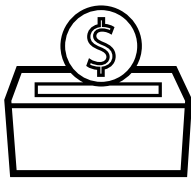
Economy sub-index

INTRODUCTION

The establishment of knowledge economies—characterized by their diversity of production, productivity, labour and human capital—has become the main determinant of the ability of countries to adapt to global transformations and developments. Within GKI, the components of the knowledge economy related to economic competitiveness, economic openness, and financing and domestic value added, represent important indicators of the ability and resilience of economies to face global transformations and developments. This has been illustrated by the COVID-19 pandemic, which has shown that countries with competitive knowledge-based economies are best able to adapt to, and recover from, such crises.

The structure of the economy sub-index

The economy sub-index seeks to reflect the intertwined organic nature of the knowledge economy, taking into consideration two key aspects. First, the overlap between the economy and other knowledge sectors included in the GKI that represent essential components of a knowledge economy. Second, the concept of the knowledge economy in the contemporary world requires clarification, as it complements other sectors; for example, the infrastructure needed to attract investment—which requires knowledge, funding, production, and access to markets. In addition, economic openness, financing and domestic value added play important roles in the localization, adoption and transfer of knowledge both locally and globally. Indeed, the definition of knowledge economy has been much debated among researchers since the 1960s.[17]

The structure of the economy sub-index consists of three main pillars: economic competitiveness, economic openness, financing and domestic value added.

The first pillar: Economic competitiveness

The economic competitiveness pillar consists of two sub-pillars: infrastructure investment and business agility. This pillar is one of the most important determinants of qualifying economies for competitiveness and attracting investments, which together constitute the backbone of the economy.

- Investment in infrastructure facilitates access to resources, which in turn accelerates the pace of innovation and knowledge production. According to the Organisation for Economic Co-operation and Development (OECD), infrastructure investment includes all variables and indicators relating to the infrastructure of the economy, including roads, buildings, transportation and even financial legislation and the availability of capital.[18] This sub-pillar comprises four variables that represent the concept of investment infrastructure in its broad sense, as follows: gross fixed capital formation as a percentage of GDP; logistics performance index; transport productive capacity index; and building quality control index.

- Economics literature today clearly indicates the importance of agility in economic decision-making at the micro and macro levels, among individuals and institutions.[19] Therefore, as part of the development and modernization of the economy sub-index, business agility is introduced as a sub-pillar within the economic competitiveness pillar to reflect data that measure the economy's agility in relation to complex and unprecedented changes and transformations—whether global, regional or local. The business agility sub-pillar includes four variables as follows: ease of starting a business; insolvency recovery rate; entrepreneurial employee activity rate; and extent of corporate transparency index.

The second pillar: Economic openness

Two sub-pillars were employed within this pillar: trade and diversification, and financial openness.

- While developing the structure of the economy sub-index, the components of the trade and diversification sub-pillar were reconsidered to reflect the level of knowledge associated with trade exchange between countries on the one hand, and because diverse markets offer an opportunity to increase knowledge at the level of micro and macroeconomics. This sub-pillar contains the following variables: trade as a percentage of GDP; high-technology trade as a percentage of total trade;

product concentration index; and market concentration index.

- Within the concept of economic openness, financial openness is an essential component that determines the ability of countries to obtain and circulate knowledge. The sub-pillar on financial openness contains the following variables: Chinn-Ito financial openness index; foreign direct investment, net inflows as a percentage of GDP; and debt dynamics.

The third pillar: Financing and domestic value added

This pillar is based on two sub-pillars: financing and taxes, and domestic value added.

- The financing and taxes sub-pillar reflects the positive impact of financing on the dissemination and localization of knowledge in countries. It also clarifies the effects of taxation on the generation and dissemination of knowledge. The latter occurs through the legalization of easy transfers of goods and services between countries, which is considered one of the most important factors in knowledge exchange and transfer. This sub-pillar includes four variables: domestic credit to private sector as a percentage of GDP; MSME financing gap as a percentage of GDP; total tax and contribution rate as a percentage of profit; and bank non-performing loans to total gross loans.

- The term, domestic value added, within the concept of economy, refers to the potential resources of countries in producing knowledge. It necessarily implies the extent to which local human and material resources are used in the production processes of both goods and services. This sub-pillar includes the following variables: share of medium and high-tech activities in total manufacturing value added; industry and services value added as a percentage of GDP; composite rate of labour underutilization; and output per worker.

Figure 7: Structure of the economy sub-index
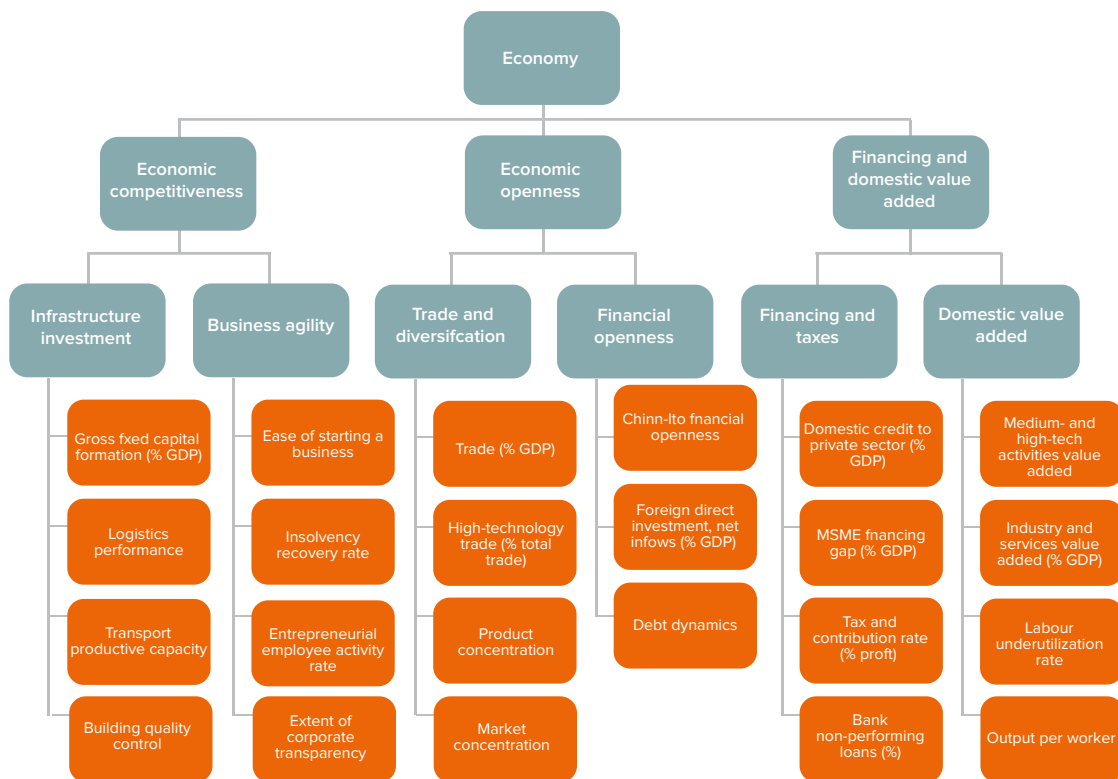
Enabling environment sub-index

INTRODUCTION

The enabling environment represents the necessary conditions for the incubation and support of the production, development, and utilization of knowledge to achieve sustainable development. It is a key determinant for the development of knowledge indicators as it is related to all sectors—institutional, social, economic, and political enabling factors are considered as the main pillars for knowledge empowerment. This sub-index comprises many elements, such as development, education and qualification policies and plans; economic and political reform projects; and legislative frameworks that help support the processes of nurturing new generations, establishing the rule of law and strengthening human rights systems to ensure human safety, welfare, and equality. Health services, quality of life and the environment are also general elements that play a key role in achieving and sustaining human development.

Therefore, the six sectoral sub-indices that make up the GKI are open and dynamic systems that constantly interact with each other on the one hand, and with their surroundings within the general context on the other. They are linked to a number of contextual variables that have been proven to influence the functioning of sectors and their outputs, based on a holistic view of development and its components, placing them in the context of an integrated synthetic system that is dynamically active and interactive, without being closed or confined to one factor or component.

The structure of the enabling environment sub-index

The enabling environment sub-index reflects dimensions that intersect and influence all six sub-indices. The index is based on three-pillars: governance pillar; socio-economic; and health and environment.

The first pillar: Governance

Governance is an issue that transcends all sectors and determines their performance. It is an essential requirement for establishing an incubating environment for development.

The effectiveness of the political environment is an important indicator due to its role in unlocking potentials, setting priorities, working to promote justice and equal opportunities, and controlling corruption. These are the dimensions emphasized by the World Bank in its efforts to monitor and measure governance at the global level by collecting and documenting data on aggregate and individual governance indicators.

Based on the above, the governance pillar was divided into two sub-pillars:

- Political environment, which is measured through two variables: political stability and absence of violence/terrorism; and voice and accountability.

- Quality of institutions, which is measured through three variables: rule of law; control of corruption; and government effectiveness.

The second pillar: Socio-economic

The socio-economic environment falls within the context of concepts adopted by the United Nations, such as human development and sustainable development, or those related to equity, inclusion and integration, among others. The agreed definition focuses on enabling individuals and groups to acquire increased control over their lives, and the variables and factors affecting them, as well as raising their income and standard of living. It also helps individuals to build their capabilities and skills, become full partners in society, and access mechanisms that regulate their influence in society.[20]

Since social, economic and knowledge dimensions necessitate the ability to influence and participate in change, this pillar comprises three sub-pillars:

- Gender equity, which comprises three variables: female-to-male ratio in parliament; female-to-male labour force participation; and female-to-male ratio in Internet usage.

- Social inclusion, which also includes three variables: proportion of population covered by at least one social protection benefit; adult literacy rate, population 15+ years; and share of youth not in employment, education or training.

- Standard of living, which is measured using two variables: poverty headcount ratio at national poverty lines as a percentage of population; and GDP per capita.

The third pillar: Health and environment

Health and environment are among the most prominent current issues in the global agenda that require swift, appropriate solutions that protect the safety of humans and all living creatures, and their right to enjoy a normal life in a healthy environment. This requires the adoption of integrated policies that adhere to fair and equitable standards and can achieve development by combining scientific and technological development with the preservation of physical and mental health, and protection of the natural environment.

Given the significant inherent challenges in achieving these goals, it is clear that responsibility for their realization does not lie solely with professionals and specialists in these fields; rather, it is a shared, collective responsibility. Dealing with health issues is not the responsibility of medical professionals alone, just as dealing with environmental challenges is not the task of environmentalists alone. Hence, any policy that is good for the environment is also good for health. The World Health Organization (WHO) Committee on Health and Environment has stated that human health depends primarily on the ability of society to manage the interaction between human activities and its biological environment in a manner that protects and promotes health without compromising the integrity of the ecosystems that form the basis for the physical and biological environment. This requires the provision of a stable climate and the availability of environmental resources (soil, drinking water and clean air) in a sustainable manner, as well as the proper functioning of the natural systems that receive the waste produced by human societies.[21]

Hence, health and environment were combined in a third independent pillar. This choice was necessitated by the correlative relationship between them, which has been underlined by global health studies,[22] as well as human development reports that link environmental degradation with the resultant change in living conditions. Therefore, greater attention was paid to the expected effects on, and threats to, human health, security and life.[23]

This pillar is divided into two sub-pillars:

- The health sub-pillar comprises three variables: universal health coverage (UHC) service coverage index; healthy life expectancy at birth; and under-five mortality rate (probability of dying by age of 5 per 1,000 live births).

- The environmental performance sub-pillar comprises three variables: renewable energy consumption as a percentage of total final energy consumption; ecological footprint per capita; and natural hazard exposure.

These sub-pillars and their variables are characterized by the interactive relations between them and can be included within a broader concept of human well-being, which is a basic goal of sustainable development. Human well-being can only be achieved through comprehensive health care for all biological, mental, psychological and social aspects of life; and effective policies to eradicate poverty, and reduce the frequency of environmental threats and other threats related to life and society. Perhaps the greatest evidence of the importance of this interactive relationship and its direct impact on economic growth and human development is the paralysis of vital sectors throughout the COVID-19 pandemic, which led to the most severe recession the world has witnessed since World War II. The severity of the effects of these factors varied from country to country, depending on their health, economic and social infrastructure, and the resilience of existing health systems and their ability to respond to the requirements of the crisis. It was not possible to contain the crisis and its repercussions on various aspects of economic, social, health and environmental life without adopting coordinated and comprehensive measures targeting collective health. These required global financial and technical solidarity to help the poorest and most affected countries, providing the basis for the resumption of efforts to achieve safe and equitable development and prosperity for all.

Figure 8: Structure of the enabling environment sub-index
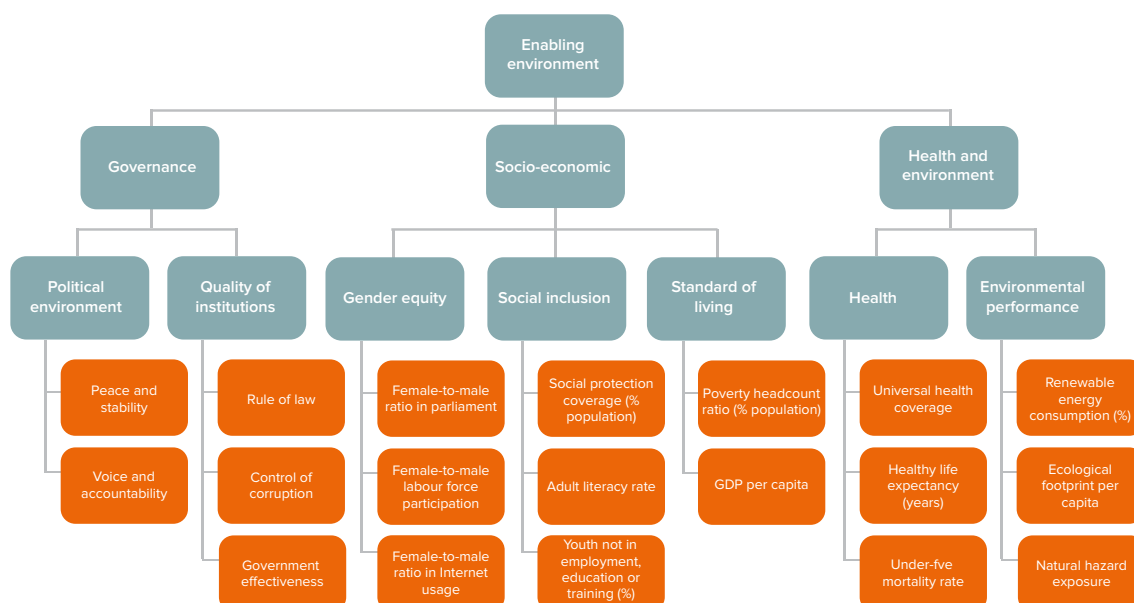
Endnotes

1. Organisation for Economic Co-operation and Development (OECD), 2008.
2. See European Commission, n.d.
3. For more information about Principal Component Analysis, see Hair et al., 2015.
4. Only very few exceptions were made.
5. The condition was relatively relaxed because the qualifying sample size is 133 countries (conditioned by data availability from credible international sources).
6. See European Commission, 2022.
7. The following transformation for all values is applied: new value = ln(value − min + 1).
8. The following transformation and normalization for all values was applied such that the new min = 0, new max = 1 and new median = 0.5: new value = 0.5*ln[1 + (value − min)*(max + min − 2*sample median) / (sample median − min) ^2)] / ln[(max −median) / (median − min)] * direction + 0.5*(1 - direction).
9. For more information about the Budget Allocation Process method, see OECD, 2008.
10. See Biavaschi et al., 2012.
11. OECD, 2015.
12. Ibid.
13. OECD and Eurostat, 2018.
14. See Schwab, 2015.
15. OECD, 2016.
16. International Telecommunication Union (ITU), 2015.
17. Piotrowski, 2015.
18. OECD, 2021.
19. See Su, 2011.
20. Desmons, 2018 [in French].
21. World Health Organization (WHO), 1994.
22. See WHO, 2008.
23. See European Environment Agency, 2020.

References

REFERENCES IN ENGLISH

Biavaschi, C., W. Eichhorst, C. Giulietti, C., M.J. Kendzia, A. Muravyev, J. Pieters; N. Rodríguez-Planas, R. Schmidl, and K.F. Zimmermann (2012). "Youth Unemployment and Vocational Training". Background Paper for the World Development Report 2013. Washington, DC: World Bank. Available from: https://openknowledge.worldbank.org/handle/10986/12150

European Commission (n.d.). Composite indicators. Available from: https://joint-research-centre.ec.europa.eu/scientific-activities-z/composite-indicators_en

European Commission (2022). COINr. Available from: https://knowledge4policy.ec.europa.eu/composite-indicators/coinr_en

European Environment Agency (2020). Environment and Health. Available from: https://www.eea.europa.eu/themes/human/intro

Hair, J., R. Anderson, R. Tatham, and W. Black (2015). Multivariate Data Analysis (7th ed.) (Upper Saddle River, NJ: Prentice-Hall International).

International Telecommunication Union (ITU) (2015). Measuring the Information Society Report 2015. Available from: https://www.itu.int/en/ITU-D/Statistics/Pages/publications/mis2015.aspx

Organisation for Economic Co-operation Development (OECD) (2008). Handbook on Constructing Composite Indicators: Methodology and User Guide, Paris.

OECD (2015). Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development, The Measurement of Scientific, Technological and Innovation Activities. Paris: OECD Publishing. Available from: https://www.oecd-ilibrary.org/docserver/9789264239012-en.pdf?expires=1637649130&id=id&accname=guest&checksum=3BC625D2C82D424E784EB8C863B21F95

OECD (2016). Economic and Social Benefits of Internet Openness, OECD Digital Economy Papers. Available from: https://www.oecd-ilibrary.org/docserver/5jlwqf2r97g5-en.pdf?expires=1638169656&id=id&accname=guest&checksum=8628BB31287DC825C33037A2339FB44B

OECD (2021). Data on infrastructure investment. Available from: https://www.oecd-ilibrary.org/sites/aaa8a6c2-en/index.html?itemId=/content/component/aaa8a6c2-en#section-d1e2504

OECD and Eurostat (2018). Oslo Manual 2018: Guidelines for Collecting, Reporting and using Data on Innovation (4th Ed.), The Measurement of Scientific, Technological and Innovation Activities. Paris: OECD Publishing; Luxembourg: Eurostat. Available from: https://www.oecd-ilibrary.org/docserver/9789264304604-en.pdf?expires=1637649229&id=id&accname=guest&checksum=075070635E43A0FF4EC568A7B100CB30

Piotrowski, J. (2015). What is a knowledge economy? Sci Dev Net. Available from: https://www.scidev.net/global/features/knowledge-economy-ict-developing-nations/

Schwab, K. (2015). "The Fourth Industrial Revolution: What It Means and How to Respond", Foreign Affairs (December 12). Available from: https://www.foreignaffairs.com/articles/2015-12-12/fourth-industrial-revolution

Su, G. (2011). Exploring requirements of agility for knowledge management. Available from: https://www.researchgate.net/publication/330508456_EXPLORING_REQUIREMENTS_OF_AGILITY_FOR_KNOWLEDGE_MANAGEMENT

World Health Organization (WHO) (1994). "The work of WHO: 1992-1993, biennial report of the Director-General to the World Health Assembly and to the United Nations". https://apps.who.int/iris/handle/10665/39102

WHO (2008). Climate change and health: Report by the Secretariat. Available from: https://apps.who.int/gb/archive/pdf_files/A61/A61_14-en.pdf

REFERENCE IN FRENCH

Desmons, P. (2018). Citizenship or empowerment: "Another effort?", L'information psychiatrique, 94. Available from: https://www.cairn-int.info/article-E_INPSY_9410_0797--citizenship-or-empowerment-another.htm