



2016 INDEX REPORT OF SMART LEARNING ENVIRONMENTS



IN CHINESE CITIES

(Executive Summary)



Smart Learning Institute of Beijing Normal University

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1 Introduction

1.1 Purpose and significance of the research

Since 2009, some cities in China have begun to develop the Internet of Things and explored the ways to construct “smart cities”. From 2010, big cities like Beijing, Shanghai, Ningbo, Hangzhou, Wuhan, officially started the construction of smart cities. Since then, more and more cities are beginning to take the construction of smart cities as an important step to implement the “Synchronization of Four Modernizations (i.e. integrating the development of industrialization, IT application, urbanization and agricultural modernization)” and promote city transformation. In 2013, the Ministry of Housing and Urban-Rural Development (short for MOHURD) launched smart city pilot programs in several cities. Since 2014, the state has issued relevant policies and measures for the development of smart cities such as “China’s New Urbanization Plan (2014-2020)”, “Several Opinions of the State Council on Promoting Information Consumption and Boosting Domestic Demand”, “Notification on Promoting Information Engineering Works for the Benefits of the People” and “Guiding Opinions on Promoting the Healthy Development of a Smart City”. These policies and measures state that it is encouraged to promote the construction of smart cities and a batch of smart cities with distinctive features will be constructed by 2020. The support and encouragement of the state policies bring China a new opportunity to develop smart cities and more than 400 cities are engaged in the construction of smart cities.

A city's Smart Learning Environments are important parts of a smart city and high-end forms of the Digital Learning Environments in the city. In the scope of education provided by the government, a smart learning environment is one of the targets of educational informationization in schools. Also, in the scope of family education and social education under social environment, it is one of the targets of construction of urban informationization. In a smart learning environment, learners can learn at Any Time, Any Place, Any Way, and at Any Pace. This kind of learning environment can also support learners with the experience of Easy, Engaged and Effective Learning.

To assist government departments and city administrators to get acquainted with the construction of city smart learning environment and to promote the continuous development of urban innovation, the research group from the Smart Learning Institute of Beijing Normal University built a framework for assessing the development of smart learning environments in cities based on the *White Paper: Smart Learning Environments in China 2015*. The framework puts forward the Index of Smart Learning Environments in Cities (iSLEC), which is used to comprehensively evaluate the state of smart learning environments of different cities.



1.2 Scope of assessment

Multiple factors were taken into consideration for the assessment of smart learning environments in cities, such as areal distribution, economic level, urban population. 68 cities were assessed, including 4 municipalities

directly under the central government, 5 cities enjoying the provincial-level status in the state economic plan, 26 provincial capitals and 33 prefecture-level cities. And 15 sub-provincial cities are included in these 68 cities.

The cities to be assessed (in alphabetical order):

Anqing, Baotou, Beihai, Beijing, Bengbu, Changchun, Changde, Changsha, Chengdu, Chongqing, Dalian, Dandong, Fuzhou, Ganzhou, Guangzhou, Guilin, Guiyang, Harbin, Haikou, Hangzhou, Hefei, Hohhot, Huizhou, Jilin, Jinan, Jining, Jinhua, Jinzhou, Jiujiang, Kunming, Lanzhou, Luzhou, Luoyang, Mudanjiang, Nanchang, Nanchong, Nanjing, Nanning, Ningbo, Pingdingshan, Qinquangdao, Qingdao, Quanzhou, Sanya, Shanghai, Shaoguan, Shenyang, Shenzhen, Shijiazhuang, Taiyuan, Tangshan, Tianjin, Urumchi, Wenzhou, Wuhan, Wuxi, Xi'an, Xining, Xiamen, Xiangyang, Yantai, Yangzhou, Yichang, Yinchuan, Yueyang, Zhanjiang, Zhengzhou, Zunyi

1.3 Data sources

Part of the data used in this assessment is from public issued data such as *China Statistical Yearbook*, *China City Statistical Yearbook*, statistical yearbooks related to the 68 cities; other data has been obtained from a sampling survey by a entrusted third-party research

company through a professional investigation program on residents from the 68 cities. The investigation has collected 13,600 valid samples and the total amount of the survey data is about 700,000.



2 Assessment System



2.1 Assessment framework

The assessment focuses on the city's innovative capacity, different fields for citizens' learning and citizens' smart learning experiences.

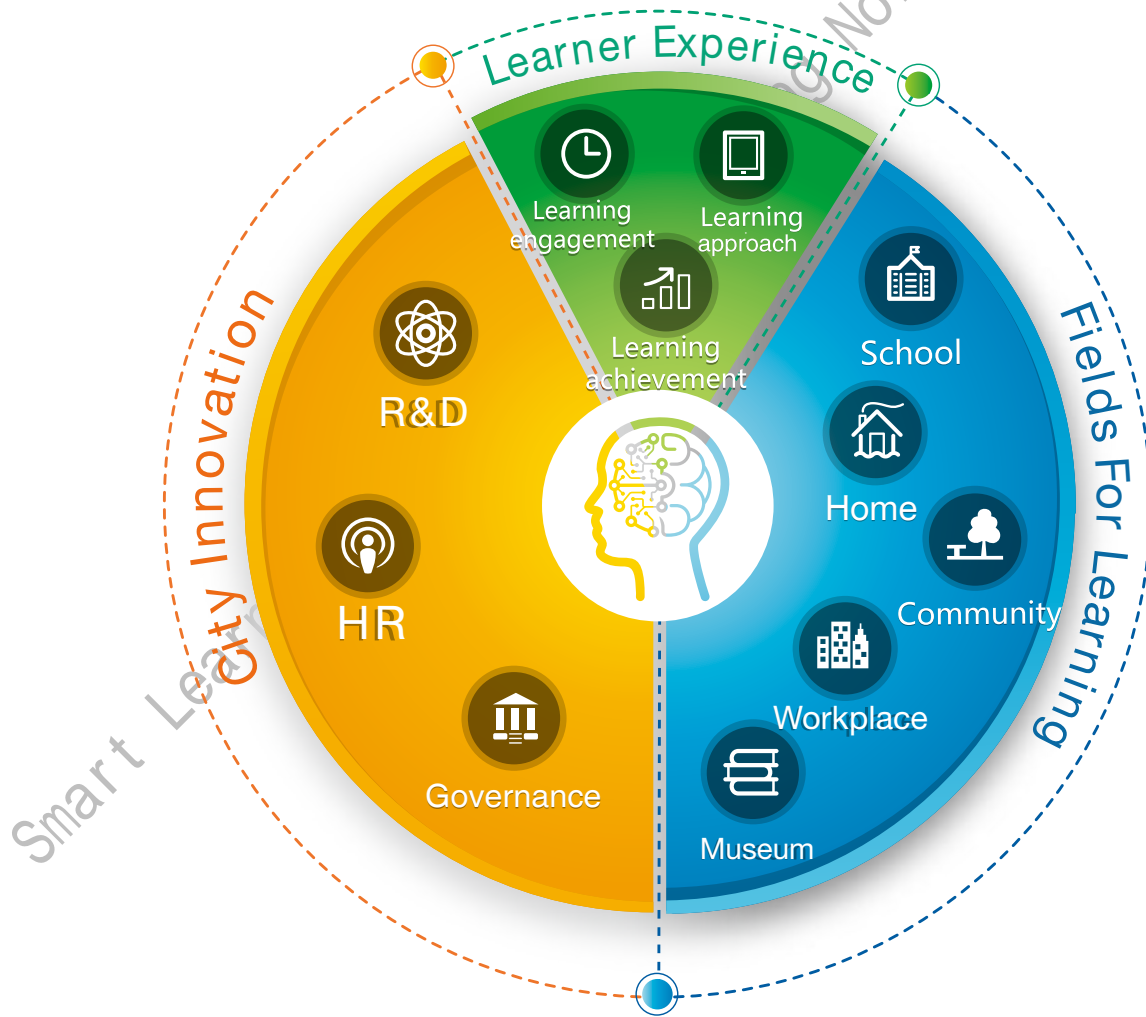


Figure 1 Framework for evaluating smart learning environments in cities



City innovation

“City innovative capacity” and “Citizens' livable experience” are the dual cores to promote the development of a smart city^①. The city innovation is the foundation and component of the smart learning environments in cities. A city's R&D capacity, HR development and government support are selected as the three key indicators to evaluate a city's innovative capacity in this assessment.



Fields for learning

Fields for learning are the main places for youngsters and citizens to participate in the learning activities. In this assessment, school learning environment, home learning environment, community learning environment, workplace learning environment, and museum learning environment are taken as the five key indicators to evaluate the smart learning environments.



Learner experience

Learner experiences contain youngsters' learning experiences in school educational environments and the comprehensive feelings the citizens have on the city's digital learning environments. Learning engagement, learning approach and learning achievement have been selected as the three key indicators to assess the citizens' learning experiences.

^① White Paper: Smart Learning Environments in China 2015 by Huang Ronghuai, Liu Dejian, Fan Lei, etc. (2015). Beijing, Smart Learning Institute of Beijing Normal University.

2.2 Assessment method

The assessment adopts comprehensive index method, and determines the values of indicators by normalization and weighed calculation.



Indicator weight

Based on the significance of the indicators, the reliability of the data sources, etc. it is determined that weights of the City Innovation indicator and the Fields For Learning indicator are respectively 40%, and that of Learner Experience is 20%. For the second and third level indicators, an equal-weight method is adopted within each upper level indicator.



Normalization of data

The data collected at the observation point shall be normalized. The maximum value of the source data of the corresponding observation point is set as the reference value to obtain the normalized value of every datum. The normalized values range from 0 to 1. Greater value means higher rank.



Computation of the iSLEC

The computation of the iSLEC is based on successive aggregations of scores from the third-level indicators all the way up to the overall iSLEC score.




The score of second-level indicator is calculated by an arithmetic mean of third level indicators related to it, and the score of first level indicator is calculated by an arithmetic mean of second level indicators related to it. The overall iSLEC score is obtained by a weighted mean of the first level indicators.

2.3 Indicators system

The assessment conducts comprehensive evaluation of the smart learning environments in cities from three dimensions, namely, City Innovation, Fields For Learning, and Learner Experience, forming

a measurement indicator system with 3 first level indicators, 11 second level indicators and 30 third level indicators.

Table 1 The Indicators System of Smart Learning Environments in Chinese Cities (2016)

First level indicator		Second level indicator		Third level indicator	
indicator	weight	indicator	weight against the upper indicator	indicator	weight against the upper indicator
 City Innovation indicator	2/5	1.1 City R&D capacity indicator	1/3	1.1.1 Indicator of research and development	1/2
				1.1.2 Indicator of patent application	1/2
		1.2 City HR development indicator	1/3	1.2.1 Indicator of college students	1/2
				1.2.2 Indicator of higher education institutes	1/2
		1.3 Government support indicator	1/3	1.3.1 Indicator of government support of smart city construction	1/2
				1.3.2 Indicator of city innovation and entrepreneurship	1/2
 Fields for Learning indicator	2/5	2.1 School learning environment indicator	1/5	2.1.1 Indicator of computer resource allocation	1/3
				2.1.2 Indicator of multimedia classrooms	1/3
				2.1.3 Indicator of digital resource	1/3
		2.2 Home learning environment indicator	1/5	2.2.1 Indicator of home electronics	1/3
				2.2.2 Indicator of home reading	1/3
				2.2.3 Indicator of satisfaction with home learning	1/3
		2.3 Community learning environment indicator	1/5	2.3.1 Indicator of community learning places utilization	1/4
				2.3.2 Indicator of community information platform utilization	1/4
				2.3.3 Indicator of community learning activities participation	1/4
				2.3.4 Indicator of community education development	1/4
		2.4 Workplace learning environment indicator	1/5	2.4.1 Indicator of workplace Internet	1/3
				2.4.2 Indicator of workplace learning engagement	1/3
				2.4.3 Indicator of workplace online learning	1/3
		2.5 Museum learning environment indicator	1/5	2.5.1 Indicator of museum resources	1/3
				2.5.2 Indicator of museum utilization	1/3
2.5.3 Indicator of museum informationization	1/3				
 Learner Experience indicator	1/5	3.1 Learning engagement indicator	1/3	3.1.1 Indicator of citizen's participation in learning activities	1/3
				3.1.2 Indicator of citizen reading	1/3
				3.1.3 Indicator of citizen study time	1/3
		3.2 Learning approach indicator	1/3	3.2.1 Indicator of citizen mobile learning	1/3
				3.2.2 Indicator of citizen self-regulated learning	1/3
				3.2.3 Indicator of utilization of city online learning platform	1/3
		3.3 Learning achievement indicator	1/3	3.3.1 Indicator of satisfaction with learning environments	1/2
				3.3.2 Indicator of citizen's learning improvement	1/2



3 Assessment result



3.1 Ranking of cities according to Index of Smart Learning Environments in Cities

The top ten cities include 2 municipalities directly under the Central Government, 3 cities enjoying the provincial-level status in the state economic plan and 5 provincial capitals. Thirty four cities above the average value include 4 municipalities

directly under the Central Government, 5 cities enjoying the provincial-level status in the state economic plan, 20 provincial capitals and 5 prefecture-level cities (Wuxi, Yichang, Xiangyang, Yantai, Wenzhou).

Table 2 Ranking of 68 Cities according to the dimensions of Index of Smart Learning Environments in Cities

City	Combined indicators		City innovation indicator		Fields for learning indicator		Learner experience indicator	
	Rank	Score	Rank	Score	Rank	Score	Rank	Score
Beijing	1	0.8280	1	0.8905	3	0.7733	11	0.8124
Shanghai	2	0.7618	2	0.6739	1	0.8547	25	0.7519
Wuhan	3	0.7045	7	0.5760	6	0.7532	5	0.8639
Hangzhou	4	0.6894	3	0.6090	8	0.7369	21	0.7550
Qingdao	5	0.6779	16	0.4859	4	0.7720	4	0.8737
Jinan	6	0.6624	14	0.5001	7	0.7378	8	0.8361
Shenzhen	7	0.6621	5	0.5874	9	0.7362	61	0.6634
Dalian	8	0.6498	22	0.4611	5	0.7550	10	0.8169
Xi' an	9	0.6463	6	0.5776	23	0.6404	14	0.7954
Guangzhou	10	0.6445	10	0.5474	13	0.6968	32	0.7340
Nanjing	11	0.6407	4	0.6089	20	0.6594	60	0.6668
Wuxi	12	0.6310	12	0.5228	17	0.6669	18	0.7757
Yichang	13	0.6304	45	0.3038	2	0.7892	2	0.9661
Zhengzhou	14	0.6299	15	0.4931	18	0.6668	9	0.8298
Urumchi	15	0.6280	28	0.4161	10	0.7289	6	0.8501
Chengdu	16	0.6227	8	0.5555	22	0.6503	43	0.7019
Tianjin	17	0.6133	11	0.5390	26	0.6218	27	0.7448
Chongqing	18	0.6126	21	0.4660	15	0.6764	17	0.7781
Xiangyang	19	0.6088	44	0.3039	11	0.7275	1	0.9814
Shijiazhuang	20	0.6061	30	0.4059	16	0.6692	3	0.8804
Changsha	21	0.6032	18	0.4765	14	0.6766	42	0.7099
Taiyuan	22	0.6024	17	0.4830	19	0.6648	39	0.7163
Ningbo	23	0.6004	13	0.5152	21	0.6523	59	0.6672
Hefei	24	0.5973	9	0.5499	29	0.5983	49	0.6902
Yantai	25	0.5967	33	0.3702	12	0.7220	13	0.7991

City	Combined indicators		City innovation indicator		Fields for learning indicator		Learner experience indicator	
	Rank	Score	Rank	Score	Rank	Score	Rank	Score
Nanchang	26	0.5600	20	0.4717	45	0.5614	33	0.7336
Xiamen	27	0.5558	24	0.4257	27	0.6199	50	0.6875
Lanzhou	28	0.5507	29	0.4082	38	0.5784	16	0.7801
Fuzhou	29	0.5490	27	0.4177	34	0.5870	31	0.7356
Wenzhou	30	0.5477	35	0.3598	25	0.6249	20	0.7690
Shenyang	31	0.5444	19	0.4754	30	0.5979	68	0.5754
Kunming	32	0.5442	31	0.3861	28	0.6031	28	0.7423
Changchun	33	0.5378	25	0.4225	35	0.5864	58	0.6711
Guiyang	34	0.5371	26	0.4201	50	0.5380	19	0.7694
Baotou	35	0.5312	38	0.3414	36	0.5859	12	0.8013
Guilin	36	0.5281	43	0.3077	33	0.5886	7	0.8480
Harbin	37	0.5261	23	0.4373	49	0.5403	54	0.6751
Hohhot	38	0.5250	32	0.3819	39	0.5725	40	0.7161
Changde	39	0.5232	50	0.2766	24	0.6355	15	0.7917
Nanning	40	0.5181	37	0.3559	41	0.5697	29	0.7395
Yinchuan	41	0.5099	36	0.3588	46	0.5552	38	0.7213
Luoyang	42	0.5067	39	0.3289	44	0.5617	23	0.7525
Yangzhou	43	0.4988	46	0.2917	32	0.5928	37	0.7248
Quanzhou	44	0.4822	41	0.3285	51	0.5370	52	0.6801
Jinhua	45	0.4747	34	0.3624	56	0.5256	67	0.5975
Yueyang	46	0.4744	48	0.2872	43	0.5624	56	0.6730
Tangshan	47	0.4719	47	0.2909	54	0.5317	41	0.7143
Huizhou	48	0.4655	49	0.2843	48	0.5505	62	0.6580
Jining	49	0.4646	40	0.3289	58	0.5157	64	0.6340
Bengbu	50	0.4562	51	0.2561	53	0.5346	45	0.6999
Qinhuangdao	51	0.4514	42	0.3173	66	0.4603	44	0.7017
Dandong	52	0.4509	57	0.1920	40	0.5710	35	0.7284
Haikou	53	0.4481	56	0.2006	47	0.5511	30	0.7372
Shaoguan	54	0.4463	60	0.1433	31	0.5964	24	0.7520
Jiujiang	55	0.4402	61	0.1416	37	0.5832	26	0.7515
Zunyi	56	0.4369	52	0.2547	64	0.4741	36	0.7271
Jilin	57	0.4366	55	0.2154	55	0.5274	47	0.6974
Xining	58	0.4278	54	0.2219	60	0.4998	48	0.6955
Luzhou	59	0.4165	53	0.2543	65	0.4637	63	0.6465
Sanya	60	0.4156	62	0.1338	42	0.5687	55	0.6733
Anqing	61	0.4059	64	0.1128	52	0.5364	34	0.7314
Pingdingshan	62	0.4038	59	0.1620	59	0.5111	57	0.6728
Mudanjiang	63	0.3842	58	0.1626	62	0.4883	65	0.6190
Beihai	64	0.3796	65	0.1127	63	0.4872	46	0.6980
Ganzhou	65	0.3753	66	0.1054	61	0.4911	51	0.6835
Nanchong	66	0.3747	68	0.0341	57	0.5255	22	0.7545
Jinzhou	67	0.3573	63	0.1334	67	0.4546	66	0.6101
Zhanjiang	68	0.3519	67	0.0973	68	0.4446	53	0.6758

3.2 Ranking of city according to each dimension of Index of Smart Learning Environments in Cities

1. City innovation indicator

The city innovation indicator includes 3 second level indicators: city R&D capacity indicator, city HR development indicator and government support indicator. City R&D capacity indicator includes 2 third level indicators of research and development, and patent application. City HR development indicator includes 2 third level indicators of college students and higher

education institutes. Government support indicator include 2 third level indicators of support of smart city construction and city innovation entrepreneurship .

The top ten cities by the rank of city's innovation indicator contains 2 municipalities directly under the Central Government, 1 city enjoying the provincial-level status in the state economic plan and 7 provincial capitals.

Table 3 Ranking of 68 Cities according to the dimension of City Innovation Indicator

City	City innovation indicator		City R&D indicator	City HR development indicator	Government support indicator
	Rank	Score	Score	Score	Score
Beijing	1	0.8905	0.6715	1.0000	1.0000
Shanghai	2	0.6739	0.3975	0.6477	0.9765
Hanzhou	3	0.6090	0.4845	0.4132	0.9294
Nanjing	4	0.6089	0.3794	0.5927	0.8545
Shenzhen	5	0.5874	0.5065	0.2852	0.9706
Xi' an	6	0.5776	0.5881	0.6065	0.5382
Wuhan	7	0.5760	0.2264	0.6614	0.8401
Chengdu	8	0.5555	0.3015	0.4811	0.8840
Hefei	9	0.5499	0.3267	0.5242	0.7989
Guangzhou	10	0.5474	0.1806	0.5324	0.9294
Tianjin	11	0.5390	0.3491	0.4664	0.8016
Wuxi	12	0.5228	0.5674	0.2418	0.7594
Ningbo	13	0.5152	0.6019	0.1930	0.7508
Jinan	14	0.5001	0.2668	0.4640	0.7695
Zhengzhou	15	0.4931	0.1458	0.5073	0.8262
Qindao	16	0.4859	0.3817	0.3016	0.7743
Taiyuan	17	0.4830	0.2549	0.5154	0.6786
Changsha	18	0.4765	0.1254	0.4635	0.8406
Shenyang	19	0.4754	0.2141	0.4719	0.7401
Nanchang	20	0.4717	0.1656	0.4837	0.7658
Chongqin	21	0.4660	0.1719	0.3485	0.8775
Dalian	22	0.4611	0.2365	0.3833	0.7636
Harbin	23	0.4373	0.1390	0.4569	0.7160
Xiamen	24	0.4257	0.3229	0.3540	0.6003

City	City innovation indicator		City R&D indicator	City HR development indicator	Government support indicator
	Rank	Score	Score	Score	Score
Changchun	25	0.4225	0.1648	0.3868	0.7160
Guiyang	26	0.4201	0.2292	0.3301	0.7011
Fuzhou	27	0.4177	0.1418	0.3124	0.7989
Wulumuqi	28	0.4161	0.0758	0.4863	0.6861
Lanzhou	29	0.4082	0.1226	0.4287	0.6733
Shijiazhuang	30	0.4059	0.1013	0.3539	0.7626
Kunming	31	0.3861	0.0620	0.3975	0.6989
Huhot	32	0.3819	0.0863	0.4092	0.6503
Yantai	33	0.3702	0.2641	0.1846	0.6620
Jinhua	34	0.3624	0.2839	0.1317	0.6717
Wenzhou	35	0.3598	0.2404	0.1384	0.7005
Yinchuan	36	0.3588	0.0763	0.3402	0.6599
Nanning	37	0.3559	0.0754	0.2923	0.7000
Baotou	38	0.3414	0.0936	0.2868	0.6439
Luoyang	39	0.3289	0.1429	0.1711	0.6727
Jining	40	0.3289	0.1442	0.1351	0.7075
Quanzhou	41	0.3285	0.1542	0.1539	0.6775
Qinhuangdao	42	0.3173	0.0916	0.2025	0.6578
Guilin	43	0.3077	0.0836	0.1731	0.6663
Xiangyang	44	0.3039	0.1514	0.1238	0.6364
Yichang	45	0.3038	0.1007	0.1617	0.6492
Yangzhou	46	0.2917	0.3124	0.1674	0.3955
Tangshan	47	0.2909	0.0139	0.1651	0.6936
Yueyang	48	0.2872	0.0714	0.1382	0.6519
Huizhou	49	0.2843	0.2524	0.1253	0.4751
Changde	50	0.2766	0.0513	0.1278	0.6508
Bengbu	51	0.2561	0.2417	0.1414	0.3853
Zunyi	52	0.2547	0.0381	0.0998	0.6262
Luzhou	53	0.2543	0.0404	0.0792	0.6433
Xining	54	0.2219	0.0325	0.2537	0.3794
Jilin	55	0.2154	0.0443	0.1870	0.4147
Haikou	56	0.2006	0.0574	0.3311	0.2134
Dandong	57	0.1920	0.0531	0.1418	0.3810
Mudanjiang	58	0.1626	0.0645	0.1732	0.2500
Pingdingshan	59	0.1620	0.1160	0.1202	0.2500
Shaoguan	60	0.1433	0.1099	0.1436	0.1765
Jiujiang	61	0.1416	0.0327	0.1419	0.2500
Sanya	62	0.1338	0.0459	0.2260	0.1294
Jinzhou	63	0.1334	0.0998	0.1588	0.1417
Anqing	64	0.1128	0.0716	0.1357	0.1310
Beihai	65	0.1127	0.0592	0.1345	0.1444
Ganzhou	66	0.1054	0.0554	0.1030	0.1578
Zhanjiang	67	0.0973	0.0280	0.1233	0.1406
Nanchong	68	0.0341	0.0242	0.0780	0.0000

2. Fields for learning indicator

The fields for learning indicator includes 5 second-level indicators: school learning environment indicator, home learning environment indicator, community learning environment indicator, workplace learning environment indicator and museum learning environment indicator. School learning environment indicator contains 3 third level indicators of computer resource allocation, the multimedia classrooms and the digital resource. Home learning environment indicator includes 3 third level indicators of home electronics, home reading and satisfaction with home learning. Community learning environment indicator includes 4 third level indicators of community learning place utilization, community information platform utilization , community learning activities participation and community educational development in. Workplace learning environment

indicator includes 3 third level indicators of workplace Internet, workplace learning engagement, and workplace online learning. Museum learning environment indicator includes 3 third level indicators of museum resources, museum utilization and museum informationization.

The top ten cities by ranking the fields for learning indicator include 2 municipalities directly under the Central Government, 3 cities enjoying the provincial-level status in the state economic plan, 4 provincial capitals and 1 prefecture-level city (namely, Yichang). The fields for learning indicator of Yichang ranks the second. And its indicator of home learning environment and working place learning environment are both higher than 0.9 and in the forefront among the assessed cities.

Table 4 Ranking of 68 Cities according to the dimension of Fileds for Learning Indicator

Cities	Fields for learning indicator		school learning environment indicator	home learning environment indicator	community learning environment indicator	workplace learning environment indicator	museum learning environment indicator
	Rank	Score	Score	Score	Score	Score	Score
Shanghai	1	0.8547	0.9292	0.8340	0.7175	0.8880	0.9047
Yichang	2	0.7892	0.5597	0.9807	0.7500	0.9159	0.7396
Beijing	3	0.7733	0.7869	0.7944	0.7286	0.6890	0.8676
Qingdao	4	0.7720	0.4227	0.9615	0.8551	0.9560	0.6650
Dalian	5	0.7550	0.6587	0.8353	0.8312	0.8343	0.6156
Wuhan	6	0.7532	0.4599	0.9029	0.9140	0.7782	0.7112
Jinan	7	0.7378	0.5648	0.9149	0.7082	0.8494	0.6519
Hangzhou	8	0.7369	0.5911	0.8721	0.7578	0.7761	0.6875
Shenzhen	9	0.7362	0.7084	0.7468	0.6740	0.7034	0.8482
Wulumuqi	10	0.7289	0.7200	0.9602	0.6083	0.7431	0.6126
Xiangyang	11	0.7275	0.3264	1.0000	0.7500	0.8822	0.6790
Yantai	12	0.7220	0.4981	0.9095	0.6629	0.9232	0.6163
Guangzhou	13	0.6968	0.6904	0.7777	0.6916	0.7255	0.5986
Changsha	14	0.6766	0.3613	0.8557	0.8175	0.7309	0.6178
Chongqing	15	0.6764	0.3361	0.7983	0.8180	0.6930	0.7367

Cities	Fields for learning indicator		school learning environment indicator	home learning environment indicator	community learning environment indicator	workplace learning environment indicator	museum learning environment indicator
	Rank	Score	Score	Score	Score	Score	Score
Shijiazhuang	16	0.6692	0.3328	0.8151	0.7822	0.7324	0.6837
Wuxi	17	0.6669	0.5397	0.8290	0.7370	0.6383	0.5902
Zhengzhou	18	0.6668	0.4553	0.8624	0.5227	0.8107	0.6827
Taiyuan	19	0.6648	0.3458	0.9192	0.5301	0.8834	0.6452
Nanjing	20	0.6594	0.6335	0.7108	0.6791	0.6687	0.6050
Ningbo	21	0.6523	0.5689	0.7754	0.6791	0.6619	0.5762
Chengdu	22	0.6503	0.4568	0.8049	0.6773	0.6887	0.6235
Xi' an	23	0.6404	0.3095	0.7955	0.7496	0.7095	0.6376
Changde	24	0.6355	0.2283	0.8872	0.7638	0.7516	0.5465
Wenzhou	25	0.6249	0.5609	0.6900	0.6347	0.6780	0.5608
Tianjin	26	0.6218	0.5541	0.7360	0.4946	0.6974	0.6270
Xiamen	27	0.6199	0.4874	0.7671	0.6100	0.6501	0.5849
Kunming	28	0.6031	0.2981	0.7252	0.6563	0.7686	0.5671
Hefei	29	0.5983	0.3460	0.7687	0.6156	0.6798	0.5815
Shenyang	30	0.5979	0.5042	0.6754	0.5010	0.6948	0.6142
Shaoguan	31	0.5964	0.2641	0.7559	0.7025	0.7415	0.5179
Yangzhou	32	0.5928	0.4227	0.7652	0.5695	0.6457	0.5607
Guilin	33	0.5886	0.2131	0.8316	0.5738	0.7408	0.5838
Fuzhou	34	0.5870	0.3954	0.7204	0.6137	0.6573	0.5481
Changchun	35	0.5864	0.1961	0.8692	0.5692	0.7479	0.5498
Baotou	36	0.5859	0.2949	0.9632	0.2709	0.8269	0.5735
Jiujiang	37	0.5832	0.1519	0.8154	0.6718	0.7671	0.5097
Lanzhou	38	0.5784	0.3209	0.7837	0.4350	0.7711	0.5814
Huhhot	39	0.5725	0.2450	0.9039	0.3126	0.8028	0.5980
Dandong	40	0.5710	0.1764	0.8509	0.5415	0.8333	0.4531
Nanning	41	0.5697	0.1830	0.8725	0.4823	0.7263	0.5841
Sanya	42	0.5687	0.5576	0.7736	0.3312	0.7287	0.4523
Yueyang	43	0.5624	0.1945	0.7498	0.7822	0.5953	0.4901
Luoyang	44	0.5617	0.2270	0.7995	0.5491	0.6898	0.5432
Nanchang	45	0.5614	0.2599	0.7634	0.5661	0.6643	0.5533
Yinchuan	46	0.5552	0.4496	0.7513	0.3218	0.7008	0.5524
Haikou	47	0.5511	0.1930	0.7753	0.5279	0.7027	0.5563
Huizhou	48	0.5505	0.3682	0.6749	0.5577	0.6501	0.5014
Harbin	49	0.5403	0.2171	0.7801	0.3981	0.7637	0.5424
Guiyang	50	0.5380	0.2399	0.7604	0.5101	0.6455	0.5340
Quanzhou	51	0.5370	0.2943	0.6736	0.5254	0.6982	0.4935
Anqing	52	0.5364	0.2021	0.7487	0.5458	0.7060	0.4792
Bengbu	53	0.5346	0.3333	0.7320	0.4796	0.6330	0.4951
Tangshan	54	0.5317	0.2951	0.6435	0.6346	0.6006	0.4845
Jilin	55	0.5274	0.2343	0.7774	0.3931	0.7383	0.4939
Jinhua	56	0.5256	0.5154	0.6502	0.4009	0.5968	0.4649
Nanchong	57	0.5255	0.1483	0.7615	0.5513	0.6521	0.5141
Jining	58	0.5157	0.3067	0.7223	0.3083	0.7266	0.5147

Pingdingshan	59	0.5111	0.1422	0.7622	0.4541	0.6960	0.5009
Xining	60	0.4998	0.2973	0.6999	0.3869	0.5812	0.5337
Ganzhou	61	0.4911	0.1196	0.7522	0.4418	0.5890	0.5529
Mudanjiang	62	0.4883	0.2358	0.7053	0.3325	0.7081	0.4599
Beihai	63	0.4872	0.2066	0.6865	0.4330	0.6331	0.4768
Zunyi	64	0.4741	0.1918	0.6544	0.3604	0.6714	0.4923
Luzhou	65	0.4637	0.1427	0.6219	0.5110	0.5565	0.4865
Qinghuangdao	66	0.4603	0.2824	0.6607	0.4195	0.5031	0.4357
Jinzhou	67	0.4546	0.2390	0.6717	0.3312	0.6243	0.4070
Zhanjiang	68	0.4446	0.1769	0.6582	0.4174	0.5147	0.4557

3. Learner experience indicator

Learner experience indicator includes 3 second level indicators, namely, learning engagement indicator, learning approach indicator and learning achievement indicator. The learning engagement indicator includes 3 third level indicators of citizen learning participation, citizen reading and citizen study time. The learning approach indicator includes 3 third level indicators of citizen mobile learning, citizen self-regulated learning and city online learning platform utilization. The learning achievement indicator includes 2 third level indicators of satisfaction with learning environment and citizens' learning improvement.

The top ten cities by ranking learner experience indicator include 2 cities enjoying the provincial-level status in the state economic plan, 5 provincial capitals and 3 prefecture-level cities. Among the 3 prefecture-level cities in the top ten cities, Xiangyang and Yichang rank first and second. Their learning engagement indicator, learning approach indicator and learning achievement indicator are higher than 0.9 and are in the forefront of the assessed cities. The indicator of learner experience of Guilin ranks seven and its learning approach indicator is higher than 0.9, and also in the forefront of the assessed cities.

Table 5 Ranking of 68 Cities according to dimension of Learner Experience Indicator

Cities	Learner experience indicator		Learning engagement indicator	Learning approach indicator	Learning achievement indicator
	Rank	Score	Score	Score	Score
Xiangyang	1	0.9814	0.9834	1.0000	0.9609
Yichang	2	0.9661	0.9482	0.9873	0.9627
Shijiazhuang	3	0.8804	0.8964	0.8516	0.8931
Qingdao	4	0.8737	0.8398	0.8299	0.9514
Wuhan	5	0.8639	0.8422	0.8874	0.8621
Wulumuqi	6	0.8501	0.8910	0.8010	0.8581
Guilin	7	0.8480	0.7431	0.9147	0.8860
Jinan	8	0.8361	0.8365	0.7947	0.8770
Zhengzhou	9	0.8298	0.8174	0.7949	0.8771
Dalian	10	0.8169	0.8033	0.7488	0.8985
Beijing	11	0.8124	0.8310	0.7690	0.8372

Cities	Learner experience indicator		Learning engagement indicator	Learning approach indicator	Learning achievement indicator
	Rank	Score	Score	Score	Score
Baotou	12	0.8013	0.8770	0.6358	0.8911
Yantai	13	0.7991	0.8170	0.6711	0.9093
Xi' an	14	0.7954	0.7908	0.7713	0.8240
Changde	15	0.7917	0.6708	0.7719	0.9324
Lanzhou	16	0.7801	0.7117	0.7209	0.9076
Chongqing	17	0.7781	0.7559	0.7391	0.8395
Wuxi	18	0.7757	0.7530	0.7047	0.8692
Guiyang	19	0.7694	0.6986	0.7214	0.8883
Wenzhou	20	0.7690	0.6591	0.6573	0.9906
Hangzhou	21	0.7550	0.7340	0.5849	0.9461
Nanchong	22	0.7545	0.7247	0.6274	0.9114
Luoyang	23	0.7525	0.7628	0.6782	0.8163
Shaoguan	24	0.7520	0.7320	0.7275	0.7966
Shanghai	25	0.7519	0.7685	0.5976	0.8895
Jiujiang	26	0.7515	0.6664	0.7477	0.8405
Tianjin	27	0.7448	0.7763	0.5869	0.8711
Kunming	28	0.7423	0.7107	0.6878	0.8285
Nanning	29	0.7395	0.6749	0.7011	0.8425
Haikou	30	0.7372	0.6780	0.7151	0.8185
Fuzhou	31	0.7356	0.6813	0.5821	0.9433
Guangzhou	32	0.7340	0.7317	0.6457	0.8247
Nanchang	33	0.7336	0.7260	0.6479	0.8268
Anqing	34	0.7314	0.7126	0.6644	0.8171
Dandong	35	0.7284	0.6979	0.6174	0.8699
Zunyi	36	0.7271	0.6457	0.6745	0.8612
Yangzhou	37	0.7248	0.6984	0.5947	0.8813
Yinchuan	38	0.7213	0.7166	0.6186	0.8287
Taiyuan	39	0.7163	0.7536	0.6058	0.7896
Huhhot	40	0.7161	0.7400	0.5666	0.8416
Tangshan	41	0.7143	0.6707	0.5979	0.8742
Changsha	42	0.7099	0.6517	0.6381	0.8401
Chengdu	43	0.7019	0.6239	0.6142	0.8676
Qinghuangdao	44	0.7017	0.7032	0.5416	0.8604
Bengbu	45	0.6999	0.6330	0.6200	0.8466
Beihai	46	0.6980	0.5246	0.7098	0.8598
Jilin	47	0.6974	0.7602	0.5252	0.8068
Xining	48	0.6955	0.6631	0.5304	0.8930
Hefei	49	0.6902	0.6320	0.6103	0.8281
Xiamen	50	0.6875	0.6247	0.5521	0.8858
Ganzhou	51	0.6835	0.6140	0.5797	0.8566
Quanzhou	52	0.6801	0.5690	0.5353	0.9361
Zhanjiang	53	0.6758	0.6056	0.6224	0.7994
Harbin	54	0.6751	0.6734	0.4942	0.8579
Sanya	55	0.6733	0.6702	0.5572	0.7924

Cities	Learner experience indicator		Learning engagement indicator	Learning approach indicator	Learning achievement indicator
	Rank	Score	Score	Score	Score
Yueyang	56	0.6730	0.5982	0.5906	0.8302
Pingdingshan	57	0.6728	0.6503	0.5698	0.7982
Changchun	58	0.6711	0.7888	0.4883	0.7361
Ningbo	59	0.6672	0.5719	0.5705	0.8593
Nanjing	60	0.6668	0.5981	0.5469	0.8553
Shenzhen	61	0.6634	0.6374	0.4873	0.8654
Huizhou	62	0.6580	0.5469	0.5969	0.8302
Luzhou	63	0.6465	0.5352	0.4924	0.9119
Jining	64	0.6340	0.5915	0.4511	0.8593
Mudanjiang	65	0.6190	0.6162	0.4594	0.7814
Jinzhou	66	0.6101	0.6521	0.3648	0.8135
Jinhua	67	0.5975	0.5169	0.4676	0.8082
Shenyang	68	0.5754	0.6097	0.3666	0.7500

3.3 Ranking of cities in different regions according to Index of Smart Learning Environments in Cities

Based on partition of the economic areas by the National Bureau of Statistics of China^①, this assessment divides the 68 cities into four groups, namely, eastern cities (27), central cities (16), western cities (17) and northeast cities (8).

Eastern Cities

The top five cities by referring to index of smart learning environments in cities are

Beijing, Shanghai, Hangzhou, Qingdao, Jinan

Central Cities

The top five cities by referring to index of smart learning environments in cities are

Wuhan, Yichang, Zhengzhou, Xiangyang and Changsha

Western Cities

The top five cities by referring to index of smart learning environments in cities are

Xi'an, Urumchi, Chengdu, Chongqing and Lanzhou

Northeast Cities

The top five cities by referring to index of smart learning environments in cities are

Dalian, Changchun, Shenyang, Harbin and Dandong

The value of index of smart learning environments in cities of 59.3% for the eastern cities, 50.0% for the central cities, 41.2% for the western cities and 37.5% for the northeast cities in China that have been assessed are higher than the average value of the 68 assessed cities.

^① National Bureau of Statistics of China: Partition method of China's East, West, Central Area and Northeast regions http://www.stats.gov.cn/ztc/zthd/sjtjr/dejtkfr/tjqp/201106/t20110613_71947.htm (2011-06-13)

3.4 Ranking of provincial cities according to Index of Smart Learning Environments in Cities

This assessment contains 26 provincial cities. Figure 2 is the distribution of indicator value of Index of Smart Learning Environments in provincial cities.

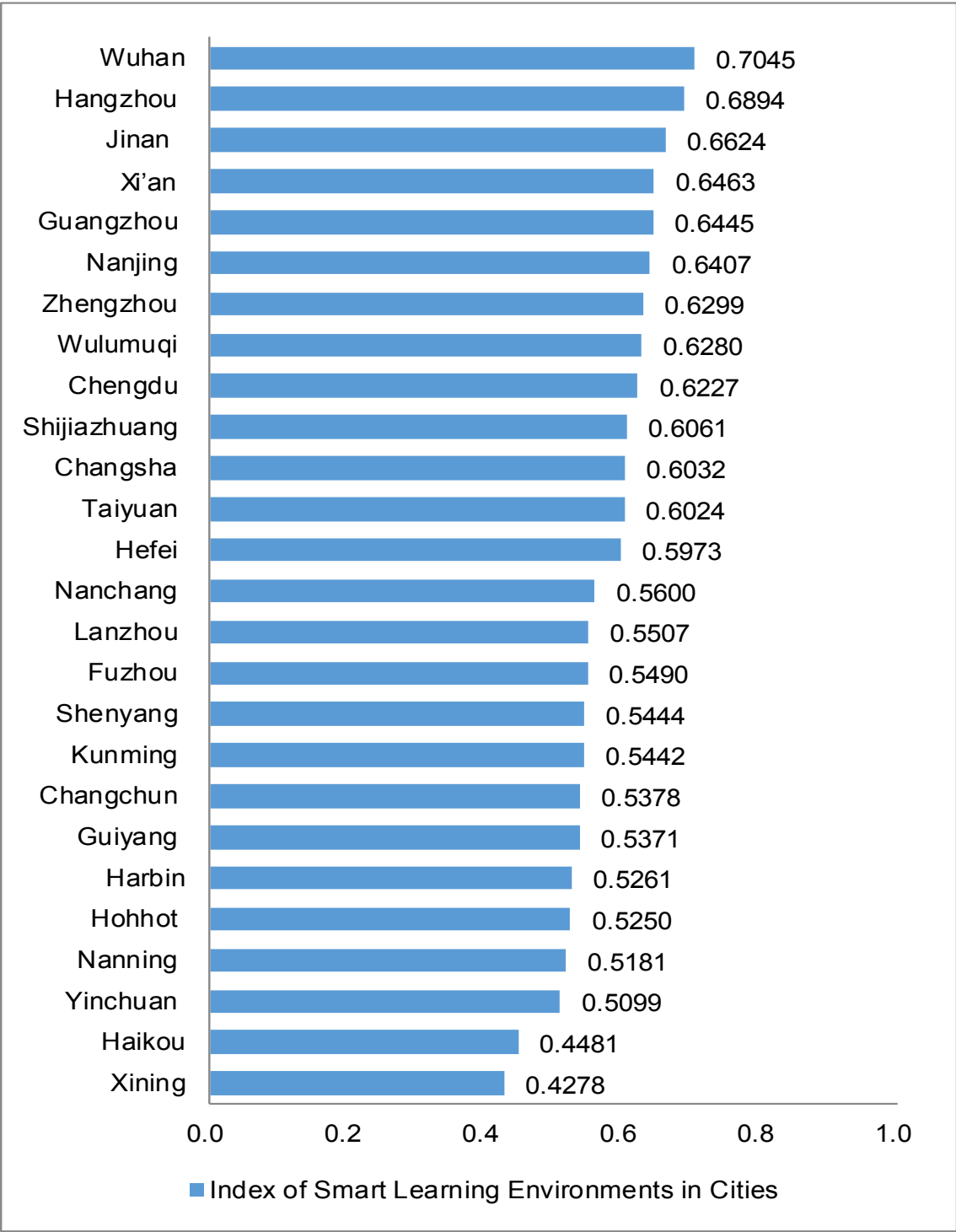


Figure 2 Ranking of Provincial Cities according to Index of City Smart Learning Environments in Cities

3.5 Ranking of sub-provincial and above cities according to Index of Smart Learning Environments in Cities

Cities of the sub-provincial level and above include 4 municipalities directly under the Central Government, 15 sub-provincial cities. 15 sub-provincial cities include 5 cities enjoying the provincial-level status in the state economic plan, 10 provincial capitals. Figure 3 is distribution of indicator value of Index of Smart Learning Environments in cities above the sub-provincial level.

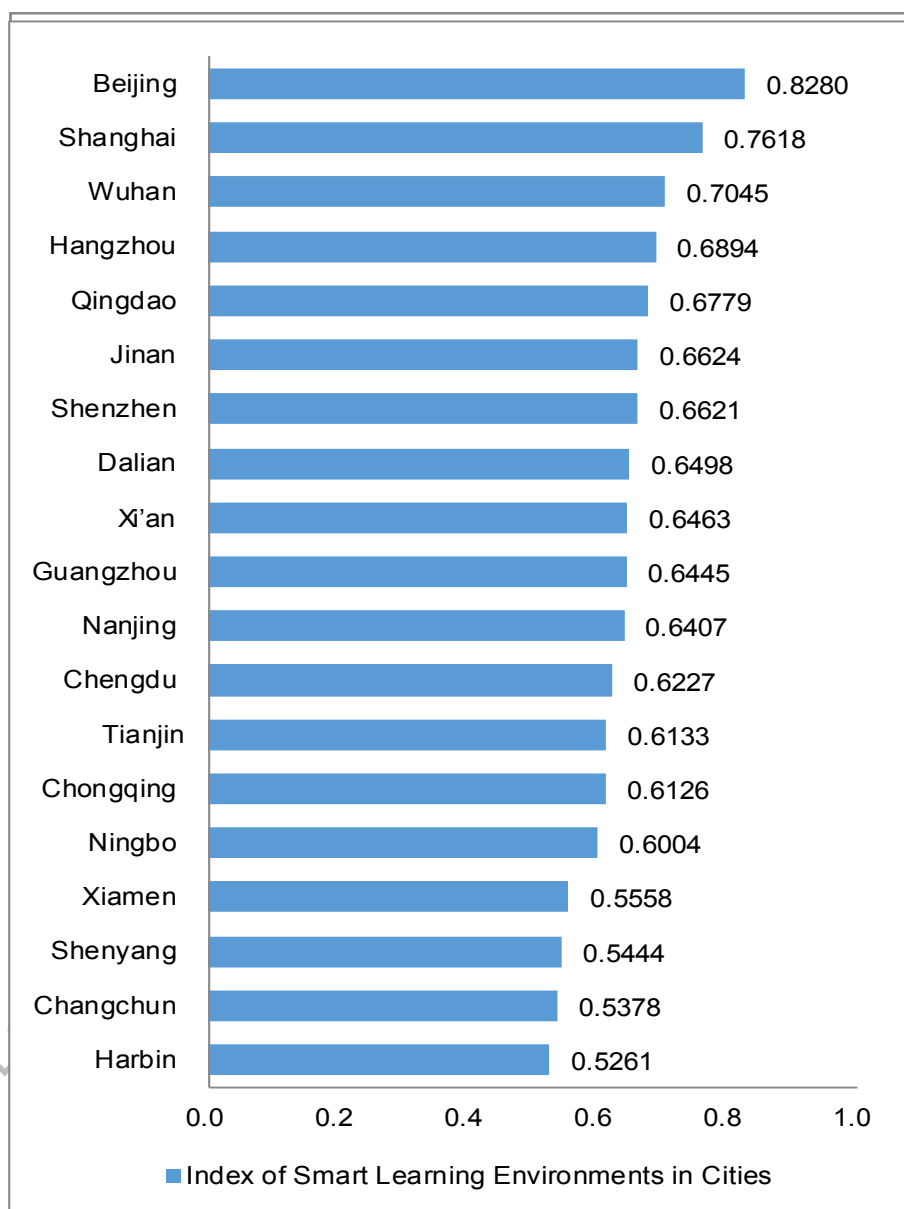


Figure 3 Distribution of index of City Smart Learning Environments in Cities of the Sub-provincial level and above



WeChat official account of the Smart Learning Institute of
Beijing Normal University



Inquiry platform of the assessed indicators of the city smart learning
environment :

<http://sli.bnu.edu.cn/csli2016/>



4 Key points



- 1 A city's smart learning environments represent high-end forms of digital learning environments in the city and are important parts of the construction of a learning society and a smart city. Smart learning environments can be found in schools, homes, communities, workplaces and museums. The construction of a city's smart learning environments is helpful to improve the citizens' scientific and cultural literacy and the city's soft power.
- 2 "City Innovation Capacity" and "Citizens' Livable Experience" are the dual conceptual engines for the construction and development of smart cities. Construction of a city's smart learning environments can contribute to the optimization of an environment that cultivates creative and entrepreneurial talents, as well as to the improvement of innovation and competitiveness of the city.
- 3 The construction of a city's smart learning environments is based on the city's innovative capacity. The goal is to improve the citizens' smart learning experiences, as well as to optimize and upgrade the fields for learning at all levels and at all places in the city. Smart learning environments in the assessment of cities can reflect the status of the construction of a learning society; it also can reflect the development level of the construction of smart cities.
- 4 Although the development of smart learning environments in cities is connected to some objective factors (e.g., economic level, city size, areal of distribution, etc.), some prefecture-level cities are at the forefront of the development as they provide their citizens with good smart learning experiences.
- 5 Cities have distinctive characteristics in the development of their smart learning environments. In the assessed cities, the Index value of Smart Learning Environments in cities is 59.3% for the eastern cities, 50.0% for the central cities, 41.2% for the western cities and 37.5% for the northeast cities, are higher than the average value of the assessed 68 cities. To a certain extent, regional development is unbalanced.
- 6 "Ratio of participation in learning activities" of the citizens is highly connected to ratio of participation in mobile learning, ratio of museum utilization, volumes of books at home, emphasis level on employees' learning in workplaces, popularizing rate of home digital terminal equipment. Strengthened construction of learning environments at home, in community, workplace and museum can effectively promote the overall development of smart learning environments in cities.
- 7 The home learning environment is an important place for citizens to perform reading activities. Volumes of books at home is highly correlated to the rate of family digital equipment, satisfaction with the home learning environment, ratio of museum utilization, ratio of participation in learning activities and ratio of participation in mobile learning.
- 8 Smart learning environments provide important support for the development of online education. The citizens are provided with diversified learning methods, and mobile learning and online learning are becoming increasingly popular. Learning places become more diversified and the utilization rates of communities and museums continuously improve. Learning resources become richer, and the digitalization of school learning resources is greatly improved.
- 9 The construction of city smart learning environments needs top-level design and support by the government. In addition, there is a need for participation of multiple parties including enterprises and a social commitment to gradually build a sound long-term smart learning city environment.
- 10 "Smart Learning" should become an important part of the construction of smart city. It provides strong support for citizens' life-long learning, and also is the key feature of self-evolution of the urban system. Development of smart learning can improve the citizens' livable experiences, enhance the city's innovative capacity, and present the intelligence quality of a city.