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E-Learning Research in Asia during 1996-2018 and the Four Country Indicators

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Abstract

This study views the Asian research performance in e-learning during 1996-2018 from the number of documents, citable documents, citations, and self-citations along with the citations per document and Hirsch index. It also measures the correlation between the six research indicators and the four country indicators commonly associated with research performance of some countries, i.e. the Gross Domestic Product per capita, Research and Development expenditure along with the numbers of university and internationally indexed journals. The data on the six research indicators and journals were obtained from the SCImago Journal and Country Rank. Whereas those on the first two country indicators were downloaded from the Word Bank, those on the third one were from the World Higher Education Database. Asia ranked third among the eight regions in the first four research indicators, fourth in the citations per document, and second in the Hirsch index. The 28 Asian countries were responsible for around 20% of over 60 thousand global e-learning publications. All of the research indicators were significantly correlated with all of the country indicators but the citations per document. This work could describe the pattern of research performance and its relationship with the four country indicators in the knowledge area of e-learning.
Keywords: e-learning, research, Asia, metrics, country indicators.

As never before, e-learning has gained its momentum globally from the COVID-19 pandemic. Both teachers and learners were rushed into the e-learning. The rushed shift from face-to-face/ offline to face-to-screen/online learning was commonly ill prepared and designed under the emergency considerations, not the pedagogic ones. It undoubtedly posed some problems such as poor teaching results and unsatisfactory autonomous learning (Zhou et al., 2020). However, the emergency e-learning is the only key unlocking the educational activities for over 1,7 billion students around the globe when most of the educational institutions from pre-primary to tertiary levels were temporarily closed (UNESCO, 2020). The pandemic has made e-learning neither peripheral nor supplemental as it used to be. E-learning thus could direct many more researchers' attentions to its important attributes than ever.

In fact, e-learning has widely been investigated. Defined as the teaching learning model from face-to-face to blended to face-to-screen modes through the use of electronic media, especially the internet, and tools to widen educational access along with promote education and training (Sangrà et al., 2011), e-learning is inter- and multidisciplinary in nature, i.e., technology, accessibility, communication, and education. E-learning research therefore dealt with the use of varied research methods such as the case study for a vast array of topics from the educators' roles to the e-learning design and adoption in educational and professional contexts (Molas-Castells & Fuertes-Alpiste, 2018).

Since the first scientific paper on e-learning was published in 1967 (Chiang et al., 2010), e-learning has grown as an emerging scientific domain of the Social Sciences in the SCImago

Journal and Country Rank/ SJR (SCImago, n.d.; Tibaná-Herrera, Fernández-Bajón, & De Moya-Anegón, 2018), a reputable database of journal citation metrics. Research on e-learning has demonstrated its huge social growth and scientific production (Tibaná-Herrera, Fernández-Bajón, & de Moya-Anegón, 2018). It offers a noteworthy contribution to the quality e-learning with its enormous potentials for social and educational transformation by widening educational access, enriching educational experiences, and reduce educational cost around the globe (Tibaná-Herrera, Fernández-Bajón, & de Moya-Anegón, 2018). The quantity and quality of research and development in the e-learning area undoubtedly greatly important in order to enable the e-learning keep its promises of affordability, accessibility, and flexibility.

The dynamics of research efforts in e-learning have been mapped in a large body of literature over the last decades. The assessment of research productivity and performance could provide some theoretical and practical insights into the developing trends and future directions of e-learning across institution, country, region, and the world. The research metrics were used to analyze the scientific performance on the basis of some databases such as Web of Science (Chiang et al., 2010; Hung, 2012; Surulinathi, 2015) and Scopus (Tibaná-Herrera, Fernández-Bajón, & de Moya-Anegón, 2018) for varying timespans from five (Maurer & Khan, 2010) to 42 years (Chiang et al., 2010). The productivity was also viewed from the global to individual author levels.

Interestingly, one of the salient points of the earlier analyses was that Asia contributed greatly to the research production of e-learning. Some Asian countries, i.e. Taiwan, Japan, and China, ranked among, at least the top ten, if not the big five prolific countries in the e-learning research. At the institutional level from 2003 to 2016 four out of the top five universities contributing to the worldwide e-learning research were Asian universities (Tibaná-Herrera, Fernández-Bajón, & De-Moya-Anegón, 2018). At the individual author level between 1989 and 2018 seven out of ten most productive authors in the e-learning domain were also from Asian countries, i.e., Israel (1), South Korea (1), Taiwan (4), and Turkey (1) (Fatima & K.S, 2019).

Consisting of 48 countries and three dependent territories or Areas of Special Sovereignty (Worldometer, 2020), Asia as whole offering its techno, socio, economy, and cultural diversity relevant to the huge growth of e-learning in the region (Belawati, 2016) cannot be ignored in the worldwide landscape of e-learning research. For example, Asia is the home to not only over half of the global population (55,1%) but also the global internet users (50.3%) (Miniwatts Marketing Group, 2020). While the national population was in the range of around 400 thousand people in Brunei Darussalam to over 1,4 billion people in China, the national internet penetration ranged from less than 1% in North Korea to approximately 96% in South Korea (Miniwatts Marketing Group, 2020). The Asian countries also scattered from the low human development countries such as Afghanistan to the very high human development one such as Singapore (Human Development Report 2019 Team, 2019). Finally, the largest and most diverse continent, Asia with its five sub regions (Worldometer, 2020) is the home to not only researchers and institutions highly productive in the e-learning but also the highest e-learning growth rates in the world (ReportLinker, 2020). In fact, paying more attention to Asia in the big enterprise of e-learning research has been voiced since 2010 (Maurer & Khan, 2010). Investigating the e-learning research ambience in Asia could thus fulfill one of the lacunas.

Moreover, the previous work on the e-learning research have tended to focus on the research metrics per se. The research productivity of any country, on the other hand, does not take place in a vacuum. Several published studies on cross-national research productivity (Jamjoom & Jamjoom, 2016; Meo, Al Masri, et al., 2013; Meo, Usmani, et al., 2013; Meo & Usmani, 2014; Rahman & Fukui, 2003) in such different subject areas as medicine and social sciences spanning over at least 15 years show some factors commonly found behind the research productivity, i.e., Gross Domestic Product (GDP) per capita, Research and

Development (R & D) expenditure (% of GDP) along with the number of universities and internationally indexed scientific journals. Examining the relationship between the four country-specific factors and the Asian scientific performance in the e-learning domain would enliven the portrait of e-learning research productivity in Asia.

The scientific performance in the field of e-learning across Asian countries has relatively been neglected. Moreover, the factors related to the regional variation in the e-learning research productivity remain unclear. This study therefore examines the Asian research performance in the e-learning domain between 1996 to 2018 from the total documents, citable documents, citations, self-citations along with the average citations per document (CPD) and H index. Besides, it measures the correlation between the six research performance indicators and the four country specific factors.

Method

To examine the research performance in the e-learning domain, this study obtained the data from the SJR on the subject categories of e-learning in the Asiatic region from 1996 to 2018, the earliest and latest years available in the database. The data included six research performance indicators, i.e. total documents, citable documents, citations, self-citations along with the average CPD and H index (SCImago, n.d.). Whereas the data on the GDP per capita and R & D expenditure for the same timespan were obtained from the World Bank (https://www.worldbank.org/), those on the number of universities in Asian countries were accessed from the World Higher Education Database (https://www.whed.net/). The data on the number of academic journals in Asian countries were also downloaded from the Journal Rankings of the SJR for all subject areas and categories in the Asiatic region limited to journals in 2018 (SCImago, n.d.). All of the data were downloaded in the first week of April 2020.

Microsoft Excel 2016 (http://office.microsoft.com/excel) was used to describe statistically the research productivity and the four country-specific factors along with to provide their figures. As some of the data in Table 2 and 3 violated the normality assumption and many scores had the same rank, the relationship between the four national factors and the six scientific research performance indicators were non-parametrically analyzed by running Kendall's tau (Akoglu, 2018) in IBM SPSS Statistics Version 22.

Results

Research Performance

Table 1 shows the global and regional scientific performance in the e-learning domain from 1996 to 2018 by using the six indicators of the SJR. Out of the eight regions, the Asiatic one ranked third behind the Western Europe and Northern America in terms of total documents, citable documents along with citations and so did it below the Northern America and Western Europe in terms of total self-citation. Other than the three regions, only the Pacific one got a place in the top ten productive countries of e-learning research.

As regards to the CPD, the Asiatic region sat in the fourth place after the Northern America, Pacific region, and Western Europe. With the H index ranged from 2 to 95, the Asiatic region could be placed in the second position after the Northern America having the H index between 1 to 141 and before the Western Europe with the H index ranging from 0 to 93.

During the study period, the Western Europe and Northern America contributed over one-third and roughly a quarter of the worldwide e-learning documents, respectively. Around 20% of over 60 thousand e-learning documents in the world was published by the 28 Asian countries. The three regions could total over 78% of the world's e-learning documents. The remaining five regions had documents in the range of 2%-6%.

Table 2 shows the top ten countries in e-learning research ranked by the total documents with the data on the six research indicators. The top ten countries contributed 36,752 documents

Table 1
Global and Regional Scientific Performance in E-learning from 1996 to 2018

Indicators	Africa	America		Asia	Europe		Middle	Pacific	World
	(*n = 37)*	Latin (*n = 32)*	Northern (*n = 2)*	(*n = 28)*	Eastern (*n = 23)*	Western (*n = 24)*	East (*n = 16)*	(*n = 8)*	(*N* = 170)
World Rank									
Highest	16	20	1	4	30	2	12	3	1
Lowest	169	167	7	168	153	147	142	170	170
Top 10	0	0	2	3	0	4	0	1	10
Documents	2,294	1,594	15,177	12,348	2,106	20,817	3,319	3,668	61,323
Minimum	1	1	2,308	1	1	2	3	1	1
Maximum	947	676	12,869	2,543	481	5,278	1,404	3,073	12,869
M	62.00	49.81	7,588.50	441.00	91.57	867.38	207.44	458.50	360.72
SD	160.97	126.63	7467.75	747.59	116.09	1162.62	341.49	1074.83	1,173.79
Citable documents	2,230	1,550	14,411	12,057	2,043	19,969	3,246	3,466	58,972
Minimum	1	1	2,200	1	1	2	3	1	1
Maximum	913	663	12,211	2,471	474	4,981	1,383	2,891	12,211
M	60.27	48.44	7205.50	430.61	88.83	832.04	202.88	433.25	346.89
SD	155.11	123.80	7,078.85	731.15	113.87	1,102.47	336.45	1,011.30	1,116.64
Citations	10,046	11,655	190,031	112,778	8,444	202,124	25,012	39,275	599,365
Minimum	0	0	34091	2	1	0	13	0	0
Maximum	5,372	3,106	155,940	47,531	1,579	65,563	11,619	32,363	155940
M	271.51	364.22	95,015.50	4,027.79	367.13	8,421.83	1,563.25	4,909.38	3,525.68
SD	884.80	831.44	86,160.25	9,347.38	412.51	13,737.80	2,965.25	11,346.33	14,089.95
Self-citations	2,113	1,603	66,223	28,838	2,172	42,086	3,722	7,993	154,750
Minimum	0.00	0.00	5186.00	0.00	0.00	0.00	2.00	0.00	0.00
Maximum	1,200	664	61,037	14,612	483	15,140	1,989	7,251	61,037
M	57.11	50.09	33,111.50	1,029.93	94.43	1,753.58	232.63	999.13	910.29
SD	200.17	142.28	39,492.62	2,861.21	126.77	3,213.48	500.34	2,538.99	5,005.41
Citation per document	4.38	7.31	12.52	9.13	4.01	9.71	7.54	10.71	9.77
Minimum	0.00	0.00	12.12	0.40	0.17	0.00	3.08	0.00	0.00
Maximum	9.73	50.00	14.77	19.40	16.83	24.67	18.75	11.98	50.00

Indicators	Africa	America		Asia	Europe		Middle	Pacific	World
	(*n* = 37)	Latin (*n* = 32)	Northern (*n* = 2)	(*n* = 28)	Eastern (*n* = 23)	Western (*n* = 24)	East (*n* = 16)	(*n* = 8)	(*N* = 170)
Md	2.98	4.25	13.45	4.55	3.49	8.19	5.22	2.84	4.37
H index									
Minimum	0	0	80	1	1	0	2	0	0
Maximum	33	28	141	95	21	93	49	72	141

Table 2

E-learning Documents by the Top Ten Countries from 1996 to 2018

Country	Region	Documents		Citations			H index
		n	Citable	*n*	Self-	per document	
United States	Northern America	12,869	12,211	155,940	61,037	12.12	141
United Kingdom	Western Europe	5,278	4,981	65,563	15,140	12.42	93
Australia	Pacific	3,073	2,891	32,363	7,251	10.53	72
Taiwan	Asiatic	2,543	2,471	47,531	14,612	18.69	95
China	Asiatic	2,418	2,367	10,724	2,857	4.44	40
Spain	Western Europe	2,343	2,250	20,396	5,564	8.71	62
Canada	Northern America	2,308	2,200	34,091	5,186	14.77	80
Germany	Western Europe	2,180	2,099	17,760	4,344	8.15	51
Japan	Asiatic	2,147	2,119	11,181	4,686	5.21	35
Italy	Western Europe	1,593	1,532	10,338	2,447	6.49	44

(*M* = 3,675.20, *SD* = 3,380.84) of which 35,121 (*M* = 3,512.10, *SD* = 3,193.44) were citable. They received 405,887 citations (*M* = 40,588.70, *SD* = 44,332.62) of which 123,124 (*M* = 12,312.40, *SD* = 17,694.01) were self-citations. Overall, the CPD by the top ten countries was 11.04, higher than the world's one but lower than the Northern America's one as demonstrated in Table 1. The range (median) for the last indicator was 35-141 (67).

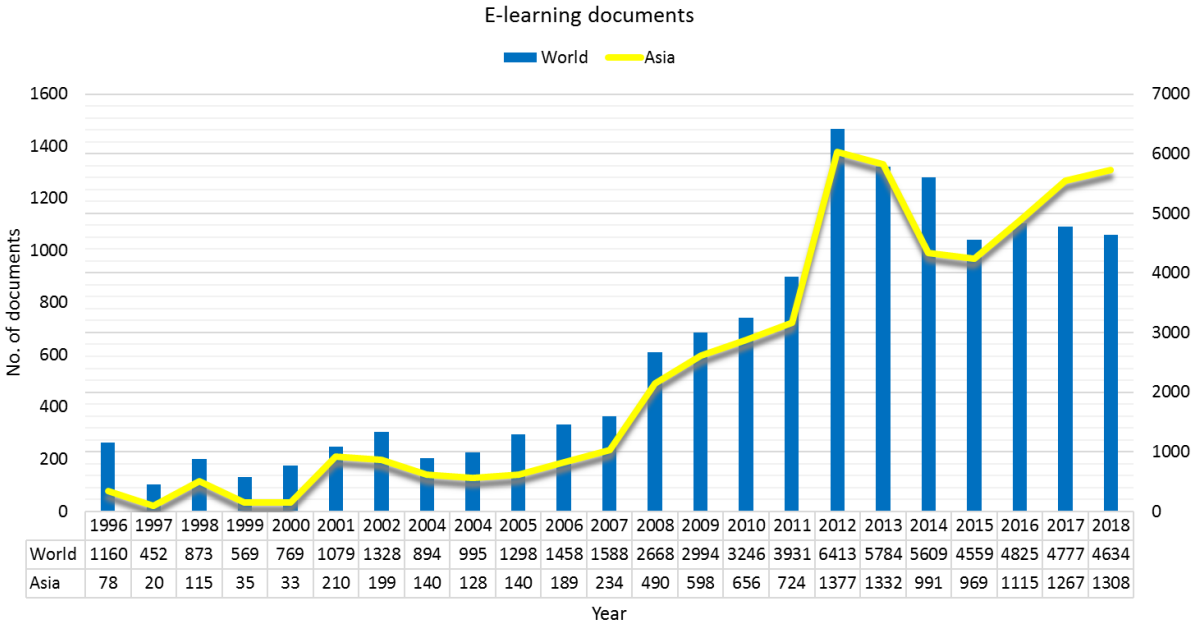
Table 2 highlights the dominance of the United States in the universe of e-learning research with an over twofold productivity compared to the United Kingdom as the second rank. Nearly 60% of the total e-learning documents in the world were published by the top ten countries. Interestingly, three Asian countries could rank among them, i.e., Taiwan, China, and Japan.

Table 3 lists the Asian countries ranked by their total e-learning documents with the data on the six scientific performance indicators. The description of the Asian research performance as a whole could be seen Table 1. The total papers published by the top three Asian countries represent over half of the regional productivity and over 11% of the global one. The other eight countries could contribute about 39% regionally and approximately 8% globally in the range of 1% to 9%. The regional and global shares of the remaining 17 countries with less than 1% contribution were about 3% and less than 1%, respectively.

Table 3
E-learning Documents in the Asiatic Region in the SJR from 1996-2018

Country	Documents		Citations			H index
	n	Citable	*n*	Self-	per document	
Taiwan	2,543	2,471	47,531	14,612	18.69	95
China	2,418	2,367	10,724	2,857	4.44	40
Japan	2,147	2,119	11,181	4,686	5.21	35
India	1,096	1,071	4,324	1,214	3.95	26
Malaysia	905	892	6,219	1,492	6.87	35
South Korea	723	700	8,373	744	11.58	42
Hong Kong	676	642	8,305	976	12.29	43
Singapore	565	546	10,622	1,300	18.80	53
Thailand	403	399	1,638	268	4.06	19
Indonesia	271	266	877	313	3.24	16
Pakistan	193	188	926	180	4.80	16
Philippines	75	73	272	22	3.63	9
Bangladesh	63	58	293	50	4.65	10
Kazakhstan	54	53	191	19	3.54	3
Viet Nam	49	49	302	32	6.16	8
Sri Lanka	46	45	176	4	3.83	8
Macao	39	36	322	8	8.26	8
Brunei Darussalam	34	34	304	54	8.94	8
Mongolia	11	11	36	-	3.27	3
Bhutan	9	9	23	4	2.56	3
Nepal	7	7	7	1	1.00	2
Uzbekistan	5	5	2	-	0.40	1
Kyrgyzstan	5	5	3	-	0.60	1
Cambodia	5	5	97	2	19.40	5
Myanmar	3	3	5	-	1.67	2
Laos	1	1	8	-	8.00	1
North Korea	1	1	2	-	2.00	1
Afghanistan	1	1	15	-	15.00	1

As shown in Figure 1, the world and Asia's scientific productivity in the e-learning domain was at its peak in 2012. During the analyzed timespan, the e-learning research grew more rapidly in the Asiatic region than in the world. The average annual and compound annual growth rates in Asia were 51.32% and 13.67% whereas those in the world were just 12.24% and 6.50%.



	1996	1997	1998	1999	2000	2001	2002	2004	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
World	1160	452	873	569	769	1079	1328	894	995	1298	1458	1588	2668	2994	3246	3931	6413	5784	5609	4559	4825	4777	4634
Asia	78	20	115	35	33	210	199	140	128	140	189	234	490	598	656	724	1377	1332	991	969	1115	1267	1308

Figure 1. Annual Growth of E-learning Documents in the World and Asia

Country Indicators

Table 4 shows the 28 Asian countries involved in the e-learning domain, ranked in accordance with Table 1, with the four national factors. The average GDP per capita (current US$) of the 27 Asian countries during the 23-year time span ranged from 440 to 44,565.37 with a mean of 9843.52 (*SD* = 14,250.28). Between 1996 and 2018 the average percentage of the GDP spent by the 27 countries on R & D ranged 0.02 to 3.11with a mean of 0.72 (*SD* = 1.00). A total of 5,858 universities (*M* = 209.21, *SD* = 326.12) in the 28 countries were registered in the WHED. However, only 17 countries could index 2, 383 journals (*M* = 140.18, *SD* = 197.85) in the SJR.

The Four Country Indicators and the Six Research Performance Indicators

It can be noticed in Table 3 and 4 that the data on documents, $D(16) = .204$, $p = .073$, citable documents, $D(16) = .207$, $p = .065$, and H index, $D(16) = .148$, $p = .200$ did not deviate significantly from normal. However, the Kolmogorov-Smirnov test was significant, $D(16) = .297$, $p = .001$ for citations, $D(16) = .346$, $p < .001$ for self-citations, $D(16) = .266$, $p = .004$ for CPD, $D(16) = .284$, $p = .001$ for GDP per capita, $D(16) = .243$, $p = .012$ for spending on R & D, $D(16) = .290$, $p = .001$ for number of universities, and $D(16) = .307$, $p < .001$ for number of journals. As the data set was non-normal, a non-parametric test was appropriate. Because the data set was small with many scores having the same rank, Kendall's correlation was suitable.

Table 4
Four National Indicators of Asian Countries from 1996 to 2018

Country	Sub region	Income Group	GDP/capita (current US$)*	R& D expenditure (% of GDP)*	Universities in WHED	Journals in SJR
Taiwan	Eastern	High	23,516.00	2.75	148	87
China	Eastern	Upper middle	3,862.09	1.4	736	628
Japan	Eastern	High	38,150.35	3.11	765	460
India	Southern	Lower middle	1,020.47	0.75	809	499
Malaysia	South-Eastern	Upper middle	7,238.39	0.85	80	90
South Korea	Eastern	High	19,622.36	3.09	248	249
Hong Kong	Eastern	High	32,152.07	0.69	11	22
Singapore	South-Eastern	High	39,384.27	2.01	9	119
Thailand	South-Eastern	Upper middle	4,063.33	0.34	146	39
Indonesia	South-Eastern	Lower middle	2,144.45	0.15	549	38
Pakistan	Southern	Lower middle	887.68	0.27	153	96
Philippines	South-Eastern	Lower middle	1,823.29	0.13	1,340	23
Bangladesh	Southern	Lower middle	748.89		120	16
Kazakhstan	Central	Upper middle	6,230.66	0.2	116	4
Viet Nam	South-Eastern	Lower middle	1,134.14	0.34	172	
Sri Lanka	Southern	Upper middle	2,132.25	0.14	26	6
Macao	Eastern	High	44,565.37	0.09	9	
Brunei Darussalam	South-Eastern	High	27,945.31	0.02	4	1
Mongolia	Eastern	Lower middle	2,064.64	0.22	52	
Bhutan	Southern	Lower middle	1,724.42		3	
Nepal	Southern	Low	481.48	0.21	12	6
Uzbekistan	Central	Lower middle	1,223.88	0.22	64	
Kyrgyzstan	Central	Lower middle	747.20	0.17	24	
Cambodia	South-Eastern	Lower middle	700.63	0.08	45	
Myanmar	South-Eastern	Lower middle	729.46	0.07	99	
Laos	South-Eastern	Lower middle	1,041.90	0.04	11	

Country	Sub region	Income Group	GDP/capita (current US$)*	R& D expenditure (% of GDP)*	Universities in WHED	Journals in SJR
North Korea	Eastern	Low			72	
Afghanistan	Southern	Low	440.00		35	

Note. * Data expressed as Mean from 1996 to 2018.

Table 5 summarizes the correlation between the four national indicators and six research performance ones in the Asiatic region during the time span of 23 years. The GDP per capita was the only national indicator significantly correlated with all of research performance ones. The spending on R & D along with the number of universities and internationally indexed journals were not significantly related to the CPD only.

Table 5
The Correlation between the Four National Indicators and Six Research Indicators.

National Indicators	Research performance indicators	T	*p*	Strenth of Relationship[a]
GDP per capita	Documents	.461**	.000	Strong
(*N* = 27)	Citable documents	.461**	.000	Strong
	Citations	.516**	.000	Strong
	Self-citations	.464**	.000	Strong
	CPD	.299*	.014	Weak
	H index	.500**	.000	Strong
R & D expenditure	Documents	.645**	.000	Strong
(*N* = 24)	Citable documents	.645**	.000	Strong
	Citations	.565**	.000	Strong
	Self-citations	.576**	.000	Strong
	CPD	.181	.107	
	H index	.568**	.000	Strong
Universities in the WHED	Documents	.374**	.003	Moderate
(*N* = 28)	Citable documents	.374**	.003	Moderate
	Citations	.274*	.021	Weak
	Self-citations	.306*	.013	Moderate
	CPD	-.058	.332	
	H index	.273*	.023	Weak
Journals in the SJR	Documents	.686**	.000	Strong
(*N* = 17)	Citable documents	.686**	.000	Strong
	Citations	.568**	.001	Strong
	Self-citations	.539**	.001	Strong
	CPD	.214	.116	
	H index	.522**	.002	Strong

Note. T = Kendall's correlation coefficient. GDP = gross domestic product. CPD = citations per document. R & D = research and development. WHED = World Higher Education Database. *ns* = not significant ($p > 0.05$).

[a] Interpretation of correlation coefficients in the research areas of politics (Akoglu, 2018).

* $p < 0.05$ (1-tailed). ** $p < 0.01$ (1-tailed).

Discussion

Viewed from the total documents, citable documents, citations, and self-citations in the e-learning domain, the Asiatic region held 3rd position ahead of the Pacific region, Middle East, Africa, Eastern Europe, and Latin America. The same position was also reported by Maurer and Khan (2010) along with Tibaná-Herrera, Fernández-Bajón, and de Moya-Anegón (2018) each analyzing the scientific development of e-learning in the Web of Science database during 2003-2008 and the Scopus database during 2003–2015. Using the SJR, one of the few databases which acknowledged e-learning as a newly consolidated discipline (Tibaná-Herrera, Fernández-Bajón, & De Moya-Anegón, 2018) and a longer study period, i.e., 23 years, this work could prove that Asia was one of the big players in the e-learning arena.

Viewed from the CPD and H index, the 28 Asian countries as a whole could maintain 4th place behind the Northern America, Pacific region, and Western Europe along with 2nd place behind the Northern America. Contributing to over 20% documents in the e-learning subject category of the SJR, over the last two decades the Asiatic region has demonstrated a huger growth of e-learning research than the world has. The region garnered considerable success in the worldwide e-learning research in terms of quality and quality.

Taiwan, China, and Japan, which held 4th, 5th, and 9th places respectively in the world ranking, have contributed greatly to the success. Together their share was more than 50% at the regional level and about 12% at the global one. Their scientific productivity in the e-learning area has wholly or partially been acknowledged by several researchers (Chiang et al., 2010; Hung, 2012; Surulinathi, 2015; Tibaná-Herrera, Fernández-Bajón, & De-Moya-Anegón, 2018).

For example, Chiang et al. (2010) placed Taiwan, the only Asian country in their list, the third among the top ten countries in their investigation into the trends of e-learning publications in the Web of Science database during 1967-2009. That Taiwan is “the only country that consistently ranks among the first places of production and impact on e-learning” (p. 1087) and “a point of reference and focus on e-learning, ahead of the United States and Western Europe” (p. 1092) could be tracked from the national and international programs to develop e-learning and digital education in the Taiwanese national policy since 2003 (Tibaná-Herrera, Fernández-Bajón, & De-Moya-Anegón, 2018). However, Asia does not consist of Taiwan, China, Japan or other countries/ territories 27 countries listed in this study.

The e-learning research productivity and performance in Asia, unfortunately, has not been equal for all sub regions and countries. Based on the regional division in the Worldometer (2020), there were still 23 Asian countries left in the analysis. All of the eight countries in the Eastern Asia were actively involved in the e-learning knowledge area but no publication could be recorded from all of the 18 countries in the Western Asia. Moreover, two countries in the Central and Southern Asia respectively along with one country in the South-Eastern Asia could index no single e-learning document in the database, either.

However, the invisibility of nearly half of the Asian countries in the scientific development of e-learning by combining the regional division in the Worldometer (Worldometer, 2020) and the SJR (SCImago, n.d.) must be treated with considerable caution. In the SJR database of contributing countries in the e-learning field, one country in the Southern Asia, i.e. Iran, and 14 countries in the Western Asia such as Turkey and Israel are listed in the Middle East. In this study, if over 3,000 research documents by the 15 countries (please refer Table 1 for the research performance in the Middle East) had been added to the existing data, the Asian contribution to the e-learning research enterprise would have been much huger, i.e. 15,662 documents, second only to the Western Europe. The Asian relative standing in this

study thus must be read as the position in the SJR database only. Now it could be argued that the e-learning research productivity and performance in Asia was relatively equal at the sub regional but not national levels.

The gap amongst the Asian countries in terms of e-learning research during the period of study is important to note. The challenging heterogeneity could be used as a starting point to improve the intra- and inter-governmental, institutional, and individual research collaborations in the scientific development of e-learning to improve the scientific quantity, quality, and visibility in the knowledge area of e-learning in the Asiatic region. Another thing to do is to improve some existing initiatives such as an e-literacy development for rural areas (Belawati, 2016) along with the Taiwanese international e-learning programs (Tibaná-Herrera, Fernández-Bajón, & De-Moya-Anegón, 2018). Within this in mind, Asia could also be the region having not only the highest growth of global e-learning market (Belawati, 2016) but also the highest scientific contribution at the global level.

Among the first to pay greater attention to the e-learning publications at the Asian level, this study not only describes the e-learning research in Asia but also measures the correlation between the six research indicators and the four national indicators. With a few exceptions, the Asia's favorable standing in the scientific enterprise of e-learning was shared by all of the four national indicators. As the GDP per capita increased, so did so did the quality (the number of documents, citable documents) and the quality (the citations, self-citations, CPD, and H index) of e-learning research in the Asiatic region. The same pattern could be observed between the other three country indicators and all of the research performance indicators but the CPD.

Regarding the strength of relationship, only three out of 21 positive correlations belong to the weak one. These results offer relatively vital evidence for the four country indicators accounted for the e-learning research in Asia during the investigated timespan. They also suggest that the funding dynamics and related educational policy as reflected in the four country indicators could share the research productivity and performance.

The results differ to some extent from those of Meo, Al Masri, et al. (2013), Meo, Usmani, et al. (2013), Jamjoom and Jamjoom (2016) and Meo et al. (2019). In the first study, the GDP per capita was not significantly correlated with the documents, CPD, and H index in the subject categories of various sciences and social science in the SJR during from 1996 to 2011 but the R & D expenditure along with the number of universities and indexed journals were. The difference could be explained in part by the different subject categories under investigation. Meo, Al Masri, et al. (2013) examined broad subject categories, not only some various sciences but also social sciences. Moreover, they viewed the Asian research performance in many research fields from the three out of six indicators in the SJR. This study, on the other hand, not only concentrated on one of sub level of social sciences in the SJR, i.e. e-learning, but also viewed the research performance from all of the six indicators.

In the second study, no significant correlation could be found between the GDP per capita and all of the four research indicators under investigation, i.e. documents, citable documents, CPD, and H index. The significant correlation could be observed between the spending on R&D and the third along with fourth indicators, between the number of universities and the first, second, along with third indicators, and between the number of journals of pharmacological sciences indexed in the Institute of Scientific Information during 1996-2011 and all of the four research indicators. Involving 16 countries in the Middle East, the study also examined the research performance at the level of subject category including such varied subject areas as pharmacology, toxicology, drug discovery and pharmaceutical science.

In the third study, Jamjoom and Jamjoom (2016) could observed positive associations between the GDP per capita and only three out of six indicators, i.e. the citations, CPD, and H index. The spending on R & D was significantly correlated with four indicators, i.e., the total documents and citable documents along with the CPD and H index. Viewing the research

productivity and performance at the level of subject category in the SJR database, they reported that the number of universities joining the world top 500 and the number of journals indexed in the SJR were significantly correlated with each of the 6 indicators of research on clinical neurology in the top 50 countries in the field from 1996 to 2014.

In the last study, Meo et al. (2019) concentrated on research into medical education in 49 Asian countries. They could find positive associations between the number of medical schools and medical education publications in the Institute of Scientific Information between 1965 to 2015. The number of medical schools was also positively correlated with the number of journals indexed in the same database.

Among the first to investigate the welcoming ambience of e-learning research in Asia, this study combined the strengths of the previous studies. Firstly, the data on the research performance in the knowledge area of e-learning were accessed form the SJR with scientometric indicators of journals indexed in Scopus, one of the most reputable indexing service. The SJR is one of the few citation databases, if not the only one, that establishes e-learning as a distinguishable discipline (Tibaná-Herrera, Fernández-Bajón, & De Moya-Anegón, 2018) among its 313 subject categories under the 27 subject areas (SCImago, n.d.). In other databases, research output in e-learning is possibly indexed under the categories of education and educational research, information science and library science, or computer science/interdisciplinary applications (Chiang et al., 2010). Through a more rigorous viewfinder, this study could portray the scientific development of e-learning, especially in Asia, more convincingly.

Secondly, Kendall's correlation was run because the small data set with many scores having the same rank was not normal and linear. In this study, the use of non-parametric statistics, according to Akoglu (2018), could measure the correlation between the variables more accurately. The findings would thus seem to be defensible, at least in terms of data collection and analysis.

This study captures the bibliometric portrait of e-learning research in Asia before most of the worldwide educational institutions sprung out of e-learning because of the COVID-19 outbreak. It would be of interest to draw a comparison between the productivity and visibility of e-learning research at the global and regional levels before and after the COVID-19 outbreak. The next years is likely to witness a considerable rise in e-learning research. Further studies, which take other indices such as Co-Authorship Index and Relative Research Effort into account, will need to performed.

CONCLUSION

During the 23-year period e-learning research grew faster in the Asiatic region than in the world. Behind the Western Europe and Northern America, Asia with over one-fifth of the global e-learning documents was favorably in the third position followed by the Pacific region, Middle East, Africa, Eastern Europe, and Latin America. The marked tendency for centralization of intellectual efforts into e-learning in Taiwan and China in the Eastern Asia could be the driving force behind higher productivity and visibility of e-learning research in Asia. The relative standing of Asian research into e-learning during the 23-year period could be explained by the GDP per capita, R & D expenditure along with the number of universities and Scopus-indexed journals. Continuing efforts from policy to ground levels must be taken to increase the productivity and visibility of scientific development in the e-learning enterprise across Asian countries. In this view, the transforming potentials of e-learning could widen educational access, enrich educational experiences, and reduce educational barriers not only in Asia but also around the globe especially when the significance of e-learning during the COVID-19 pandemic are undisputed.

References

Akoglu, H. (2018). User's guide to correlation coefficients. *Turkish Journal of Emergency Medicine*, *18*(3), 91–93. https://doi.org/10.1016/j.tjem.2018.08.001

Belawati, T. (2016, November 22). *Open and Distance Education Trend in Asia*. ICDE President Summit, Sydney.

Chiang, J. K., Kuo, C.-W., & Yang, Y.-H. (2010). A bibliometric study of e-learning literature on SSCI database. In X. Zhang, S. Zhong, Z. Pan, K. Wong, & R. Yun (Eds.), *Entertainment for Education. Digital Techniques and Systems* (Vol. 6249, pp. 145–155). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-14533-9_15

Fatima, N., & K.S, A. (2019). E-learning research papers in Web of Science: A bibliometric analysis. *Library Philosophy and Practice (e-Journal)*, *2144*, 1–14.

Human Development Report 2019 Team. (2019). *Human Development Report 2019*. United Nations Development Programme.

Hung, J. (2012). Trends of e-learning research from 2000 to 2008: Use of text mining and bibliometrics: Research trends of e-learning. *British Journal of Educational Technology*, *43*(1), 5–16. https://doi.org/10.1111/j.1467-8535.2010.01144.x

Jamjoom, B. A., & Jamjoom, A. B. (2016). Impact of country-specific characteristics on scientific productivity in clinical neurology research. *ENeurologicalSci*, *4*, 1–3. https://doi.org/10.1016/j.ensci.2016.03.002

Maurer, H., & Khan, M. S. (2010). Research trends in the field of e-learning from 2003 to 2008: A scientometric and content analysis for selected journals and conferences using visualization. *Interactive Technology and Smart Education*, *7*(1), 5–18. https://doi.org/10.1108/17415651011031617

Maurya, S. K., & Shukla, A. (2018). OPEC countries: Research performance across nations in Library and Information Science. *International Journal of Information Science and Management*, *16*(2), 101–110.

Meo, S. A., Al Masri, A. A., Usmani, A. M., Memon, A. N., & Zaidi, S. Z. (2013). Impact of GDP, spending on R&D, number of universities and scientific journals on research publications among Asian countries. *PLoS ONE*, *8*(6), e66449. https://doi.org/10.1371/journal.pone.0066449

Meo, S. A., Sattar, K., Habib ullah, C., Alnassar, S., Hajjar, W., Hajjar, W., & Usmani, A. M. (2019). Progress and prospects of medical education research in Asian Countries. *Pakistan Journal of Medical Sciences*, *35*(6). https://doi.org/10.12669/pjms.35.6.1147

Meo, S. A., & Usmani, A. M. (2014). Impact of R&D expenditures on research publications, patents and high-tech exports among European countries. *European Review for Medical and Pharmacological Sciences*, *18*(1), 1–9.

Meo, S. A., Usmani, A. M., Vohra, M. S., & Bukhari, I. A. (2013). Impact of GDP, spending on R&D, number of universities and scientific journals on research publications in Pharmacological sciences in Middle East. *European Review for Medical and Pharmacological Sciences*, *17*(20), 2697–2705.

Miniwatts Marketing Group. (2020, March 26). *Internet Usage in Asia*. Internet World Stats. https://www.internetworldstats.com/stats3.htm

Molas-Castells, N., & Fuertes-Alpiste, M. (2018). *E-Learning Research Report 2017: Analysis of the main topics in research indexed articles*. eLearn Center, Universitat Oberta de Catalunya (UOC). https://doi.org/10.7238/elc.report.2018

Rahman, M., & Fukui, T. (2003). Biomedical research productivity: Factors across the countries. *International Journal of Technology Assessment in Health Care*, *19*(1), 249–252. https://doi.org/10.1017/S0266462303000229

ReportLinker. (2020, April 2). *Global E-Learning Industry*. ReportLinker. http://www.globenewswire.com/news-release/2020/04/02/2011040/0/en/Global-E-Learning-Industry.html

Sangrà, A., Vlachopoulos, D., Lanzo, N. C., & Gallart, S. B. (2011). *Towards an inclusive definition of e-learning*. eLearn Center. UOC.

SCImago. (n.d.). *SJR - SCImago Journal & Country Rank [Portal]*. https://www.scimagojr.com

Surulinathi, M. (2015). Mapping of digital learning research output: A scientometric analysis. *Research Journal of Information Science and Technology*, *103*, 18.

Tibaná-Herrera, G., Fernández-Bajón, M. T., & de Moya-Anegón, F. (2018). Global analysis of the E-learning scientific domain: A declining category? *Scientometrics*, *114*(2), 675–685. https://doi.org/10.1007/s11192-017-2592-7

Tibaná-Herrera, G., Fernández-Bajón, M. T., & De Moya-Anegón, F. (2018). Categorization of E-learning as an emerging discipline in the world publication system: A bibliometric study in SCOPUS. *International Journal of Educational Technology in Higher Education*, *15*(1), 21. https://doi.org/10.1186/s41239-018-0103-4

Tibaná-Herrera, G., Fernández-Bajón, M.-T., & De-Moya-Anegón, F. (2018). Output, collaboration and impact of e-learning research: Bibliometric analysis and visualizations at the country and institutional level (Scopus 2003-2016). *El Profesional de La Información*, *27*(5), 1082. https://doi.org/10.3145/epi.2018.sep.12

UNESCO. (2020, March 4). *COVID-19 Educational Disruption and Response*. UNESCO. https://en.unesco.org/covid19/educationresponse

Worldometer. (2020). *Countries in Asia*. Worldometer. https://www.worldometers.info/geography/how-many-countries-in-asia/

Zhou, L., Li, F., Wu, S., & Zhou, M. (2020). “School’s Out, But Class’s On”, the largest online education in the world today: Taking China’s practical exploration during the Covid-19 epidemic prevention and control as an example. *Best Evidence of Chinese Education*, *4*(2), 501–519. https://doi.org/10.15354/bece.20.ar023