Investigating Singapore's Altmetric Landscape

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ABSTRACT

Altmetrics is an emerging measure for academic impact and it is gaining in global importance. In this paper, we analyse the altmetric landscape of Singapore, a young nation with a fast growing international research sector. We aim to find out if the coverage of altmetrics across the different disciplines is increasing along with the fast increase in the amount of research publications in recent years. We also look into how altmetrics relate to traditional citation counts as a measure of research impact. From our results, we see that there is overall an 18% coverage of altmetrics of Singapore publications from 2009 to 2013. The number of publications with available altmetric data has also been increasing over the years for most disciplines. Correlation results between citation counts and altmetrics show medium to low correlations with distinct differences amongst the various disciplines. A high coverage of altmetrics however does not seem to lead to larger correlations with citation counts. Singapore thus remains an intriguing case study to watch in the coming years.

Keywords

Altmetrics, Singapore, research, impact.

INTRODUCTION

Research in Singapore is still very young but has been progressing at a fast rate. In 2006, there were 6,794 articles published mentioning Singapore as an affiliation and in 2015 the amount of publications has doubled to 12, 645. Figure 1 shows the rise in the number of publications in the last ten years according to the database Scopus[1]. This makes Singapore an interesting case study to investigate, as it is interesting to find out if the coverage of publications with available altmetric data is keeping up with the increase in number of publications. It is also intriguing, as a measure of research impact, to analyse how altmetrics relate to the established traditional citation counts.

Research Landscape in Singapore

In Singapore, science and innovation are given high priority by both the government and industry, with science and technology being a key pillar of Singapore's national strategy for growth (Singapore National Academy of Science, n.d.). Recognising the importance of scientific research to Singapore's well-being and future sustainability, the National Science and Technology Board was formed in 1991. It framed the first five-year national technology plan for 1991 to 1995 to help Singapore to advance its economy and thrive in the knowledge era. This organisation was renamed the Agency for Science, Technology and Research (A*STAR) in 2002 and is a major driving force behind scientific research in the biomedical sciences, and the physical sciences and engineering (National Research Foundation, 2016b). In 2006, the National Research Foundation (NRF) was established to guide the nation's scientific research by developing policies, plans and strategies for research, innovation and enterprise. It also funds strategic initiatives and helps nurture research talent (National Research Foundation, 2016a).

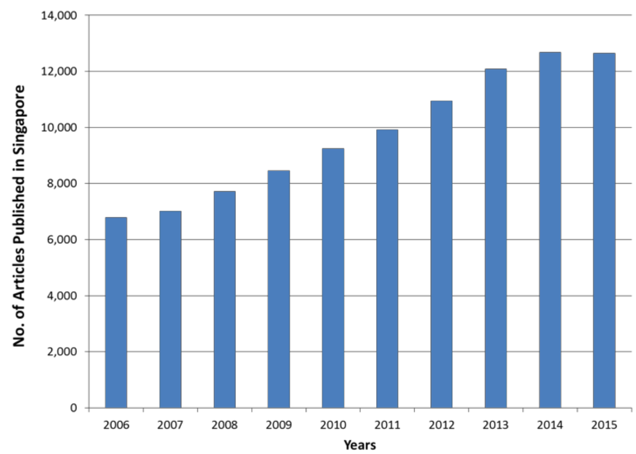

Figure 1. Singapore Publications over the last 10 years

According to the Nature Index Asia-Pacific 2015, Singapore is among the world's top-20 performers in the research world (May & Brody, 2015). Nanyang Technological University (NTU) and National University of Singapore (NUS) ranked 8 and 10 respectively in the index's top institutional contributors (Nature Publishing Group, 2015). In the QS World University Rankings, NUS and NTU ranked 12 and 13 respectively in 2015/16. Evidently, research-intensive universities have played key roles in developing Singapore's research landscape. The success of these two institutions

ASIST 2016, October 14-18, 2016, Copenhagen, Denmark.

[1] http://www.scopus.com, retrieved July 15, 2016

shows that although it is a small nation, Singapore is renowned internationally for its pursuit of scientific knowledge (Singapore National Academy of Science, n.d.).

Altmetrics

Altmetrics refers to web-based metrics used to measure the impact of scholarly materials, emphasising on social media outlets as data sources (Shema, Bar-Ilan, & Thelwall, 2014). They are seen as a good alternative for evaluating the societal impact of research as they enable the measurement of public engagement (Piwowar, 2013). Article-level metrics measure their events (e.g., views, shares, tweets) on various social media platforms and the frequency of "use" of research outputs can be seen as evidence of impact (Fenner, 2013; Neylon, Willmers, & King, 2014).

Within the scholarly community, the importance of altmetrics is gaining recognition with the establishment of various altmetric aggregators such as ImpactStory[2] and Plum Analytics[3]. Elsevier has also partnered with Altmetric.com[4], an altmetric aggregator, and Mendeley[5], a social bookmarking tool (Roemer & Borchardt, 2013). Research on altmetrics has also been growing rapidly at a steady increase since 2011 (Erdt et al., forthcoming). This increasing interest has also led to the initialisation of events such as the Altmetrics Workshops hosted at the ACM Web Science conferences and sessions organised at prominent scientometrics conferences such as the International Society of Scientometrics and Informetrics conference (ISSI) (Weller, 2015).

Research Questions

The following research questions are investigated in this study:

RQ1: What is the coverage of altmetrics in Singapore across the different disciplines?

RQ2: How do citation counts correlate with altmetrics in Singapore across the different disciplines?

In the following sections, we present related work, followed with a description of methodology applied, explaining how the data was collected and giving descriptive statistics of the dataset. We then present the results and conclude with a discussion and future work planned.

RELATED WORK

The increasing interest and use of altmetrics have prompted the comparison of citation counts and altmetrics. Many studies have found weak or no correlations between citation counts and various altmetrics. This suggests that altmetrics measure a different kind of impact compared to citations (Haustein et al., 2014; Costas et al., 2015). According to a study by Peters et al. (2015), the number of cited research outputs with altmetrics is low at 4% to 9% but the coverage of research outputs from the last decade is higher. Likewise, their study found no observable correlation between the number of citations and the total number of altmetrics although certain data types like survey, aggregate data and sequence data are cited more often and receive higher altmetrics (Peters et al., 2015).

Studies on individual social media platforms also yielded similar results. A correlation analysis between tweets and citations in the biomedical literature found a weak relationship between the two metrics (Haustein et al., 2014). A study on F1000, a commercial online post-publication peer review service for biological and medical research, was also conducted and a clear but weak correlation was also found between F1000 recommendations and citations (Waltman & Costas, 2014). There is also a positive, though weak, correlation between Library and Information Science authors' mean citations and their mean bookmarks on CiteULike (Sotudeh et al., 2015).

Comparisons between different disciplines have also been of interest. Costas et al. (2015) discovered that publications from the social sciences, humanities, and the medical and life sciences have the largest altmetrics presence, hence demonstrating their potential value and interest for these fields. A comparison of Twitter usage of selected researchers across ten different disciplines revealed that researchers in biochemistry, astrophysics, cheminformatics and digital humanities seemed to use Twitter for scholarly communication while those in economics, sociology and history of science appeared to use Twitter for scientific purposes a lot less (Holmberg & Thelwall, 2014). According to a study on social science and humanities publications, the highest correlations between Mendeley readership and citation counts were found in information and library science and linguistics. On the other hand, other social science subjects and literature had the lowest correlations (Mohammadi & Thelwall, 2014).

In Singapore, studies on the evaluation of research outputs began as early as 1985. An analysis of 285 publications from 1979 to 1980 indexed in the Science Citation Index (SCI) was conducted. Results show that a large amount of research in Singapore was in the medical field. Of all the publications, almost all of them were published in English language periodicals and nearly two-thirds were from the University of Singapore. These publications were also rarely cited, even those published in journals with high impact factor (Arunachalam & Garg, 1985). More recently, 83,439 science and technology publications from Singapore that were published in different ISI-listed periodicals between 2000 and 2009 were analysed. A cross-disciplinary comparison shows that Engineering, Medicine, Physics and Information & Computer Science were the top 4 science disciplines with the highest percentage of publications. In terms of citation rate, Singapore exceeded the world average in most fields,

[2] https://impactstory.org, retrieved July 15, 2016

[3] http://plumanalytics.com, retrieved July 15, 2016

[4] https://www.altmetric.com, retrieved July 15, 2016

[5] https://www.mendeley.com, retrieved July 15, 2016

with Chemistry having the strongest perception and impact (Rana, 2012). In addition, a case study of biomedical research structure in Singapore involving bibliometrics and network analysis found that institutes in Singapore have higher centrality, especially betweeness centrality and a high ratio of international researchers (Hayashima et al., 2014).

METHODOLOGY

The overall aim of the study is to investigate the altmetric landscape of Singapore's publications. We therefore collected all publications stating Singapore as one of the affiliations of an author of the article. Spearman correlation was used to investigate the correlation between citation counts and altmetric data, provided by Altmetric.com. In this study, not only the correlation between citation counts and overall Altmetric Scores was analyzed but also between citation counts and individual metrics such as the number of readers on CiteULike or Mendeley, the number of mentions on Facebook or Twitter, and the number of blog posts. The interpretation of results followed Cohen (1988) guidelines, regardless of positive or negative, where r=.10 to .29, .30 to .49 and .50 to 1.0 were considered to be small, medium and large correlations respectively.

Data Collection

We collected all research articles stating Singapore as one of the affiliations of an author and extracted citation and altmetrics data for each of them. In total, 50,667 research articles were found in Scopus between the years 2009 to 2013. However, in order to address the research questions, we extracted the publications according to the Scopus subject areas. Thus, the articles are categorized according to 27 subject areas provided by Scopus. There are overlaps in the disciplines as an article can belong to several disciplines. As a result of this, 94,597 publications across 27 subject areas were analysed. Table 1 shows the distribution of articles indexed by Scopus from 2009 to 2013, categorized by subject area. Some disciplines have very few articles such as Dentistry with 131 and Veterinary with 75 articles, whereas other disciplines have much higher numbers such as Engineering with 11,468 and Medicine with 11,492 articles. The percentage of articles having DOIs is also shown, as Altmetric.com only provides altmetric data for articles having DOIs. Overall, 95% of the articles had DOIs.

Data from Scopus

We used this search query in Scopus: AFFILCOUNTRY (Singapore) AND DOCTYPE (ar) AND PUBYEAR > 2008 AND PUBYEAR < 2014. The results were limited to only research articles published from 2009 to 2013. As Scopus only allows the downloading of citation and bibliographic data for 2000 articles, we downloaded the data for each subject area separately. For subject areas with more than 2000 articles, we then downloaded by year. We extracted

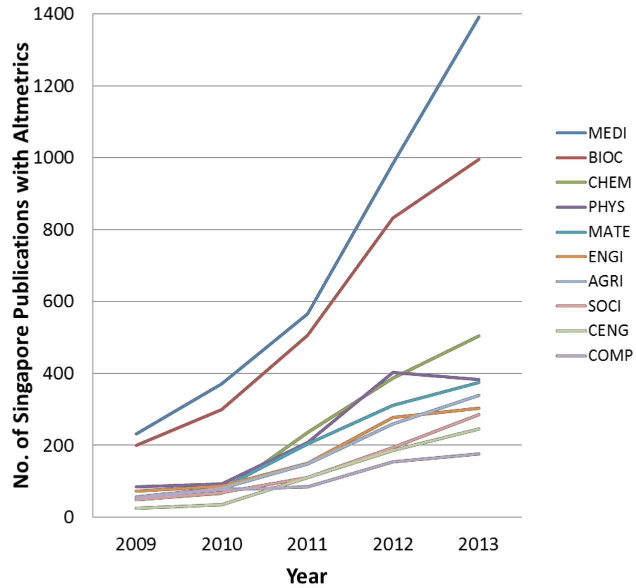

Figure 2. Coverage of Altmetrics for Top 10 Disciplines in Singapore from 2009 - 2013

citation counts for each article based on the Scopus data at the time of data collection (April 6 - 10, 2016).

Data from Altmetric.com

We collected altmetric data for all publications having a DOI from Altmetric.com using the API rAltmetric[6]. The data was collected per subject area based on the DOIs available from the data extracted previously from Scopus. The altmetric data available at the time of data collection (April 10 - 12, 2016) was used for the analysis. The percentage coverage of articles having altmetric data (and thus an Altmetric Score aggregated by Altmetric.com) is shown in Table 1.

RESULTS

The results answering research questions RQ1 and RQ2 are presented in the following sections.

RQ1: Coverage of Altmetrics in Singapore

The overall altmetric coverage of Singapore publications indexed in Scopus across disciplines from 2009 - 2013 is shown in Table 1. Overall, the altmetric coverage across all disciplines is 18% for the years 2009 - 2013. There has been a steady rise in the number of publications over the years, from 15,633 in 2009 to 22,718 in 2013. There has also been an increase in altmetric coverage over the years with 7% coverage in 2009, 9% in 2010, 16% in 2011, 25% in 2012, and 28% in 2013. Across the individual disciplines, this trend is also noticeable in most of the disciplines. Figure 2 shows the distribution of articles with altmetrics for the top 10 disciplines, according to the number of articles in the dataset.

[6] https://github.com/ropensci/rAltmetric, retrieved July 15, 2016

Scopus Subject Area	Articles indexed by Scopus	Articles indexed by Scopus with DOIs	Articles with Altmetric Data 2009 - 2013	Articles with Altmetric Data				
				2009	2010	2011	2012	2013
Agri. & Bio. Sci. (AGRI)	2,573	2,197 (85%)	886 (34%)	57	81	149	259	340
Arts & Humanities (ARTS)	808	695 (86%)	208 (26%)	3	6	29	72	98
Biochemistry Genetics & Molecular Biology (BIOC)	8,766	8,600 (98%)	2,833 (32%)	199	300	506	833	995
Business, Management & Accounting (BUSI)	1,681	1,538 (91%)	264 (16%)	26	30	44	67	97
Chemical Eng. (CENG)	4,141	4,056 (98%)	601 (15%)	25	34	111	186	245
Chemistry (CHEM)	8,290	8,192 (99%)	1,242 (15%)	49	66	235	387	505
Computer Sci. (COMP)	5,842	5,483 (94%)	547 (9%)	55	77	85	154	176
Decision Sci. (DECI)	927	878 (95%)	93 (10%)	15	12	10	26	30
Dentistry (DENT)	131	129 (98%)	25 (19%)	2	2	1	6	14
Earth & Planetary Sci. (EART)	822	737 (90%)	108 (13%)	2	3	16	31	56
Economics, Econometrics & Finance (ECON)	1,172	1,077 (92%)	168 (14%)	13	14	24	48	69
Energy (ENER)	1,480	1,433 (97%)	129 (9%)	3	8	27	42	49
Engineering (ENGI)	11,468	10,963(96%)	892 (8%)	73	87	150	278	304
Environ. Sci. (ENVI)	1,974	1,894 (96%)	293 (15%)	18	28	49	89	109
Health Professions (HEAL)	364	324 (89%)	92 (25%)	4	12	11	21	44
Immunology & Microbiology (IMMU)	1,523	1,457 (96%)	504 (33%)	43	61	84	152	164
Materials Sci. (MATE)	9,544	9,371 (98%)	1,024 (11%)	53	80	204	312	375
Mathematics (MATH)	3,421	3,220 (94%)	320 (9%)	34	35	56	93	102
Medicine (MEDI)	11,492	10,244(89%)	3,540 (31%)	231	370	565	983	1391
Multidisciplinary (MULT)	470	454 (97%)	325 (69%)	28	30	41	84	142
Neuroscience (NEUR)	1,251	1,218 (97%)	382 (31%)	31	44	61	109	137
Nursing (NURS)	559	523 (94%)	223 (40%)	14	14	35	69	91
Pharmacology, Toxicology & Pharmaceutics (PHAR)	1,328	1,265 (95%)	256 (19%)	24	18	41	72	101
Physics & Astro. (PHYS)	9,748	9,511 (98%)	1,171 (12%)	85	93	208	402	383
Psych. (PSYC)	985	951 (97%)	356 (36%)	24	33	54	112	133
Social Sci. (SOCI)	3,762	3,231 (86%)	707 (19%)	49	69	110	194	285
Veterinary (VETE)	75	72 (96%)	21 (28%)	1	3	7	7	3
Total	94,597	89,713 (95%)	17,210 (18%)	1,161 (7%)	1,610 (9%)	2,913 (16%)	5,088 (25%)	6,438 (28%)

Table 1. Altmetric Coverage of Singapore Publications indexed in Scopus from 2009 – 2013, N=94,597 (n_{2009}=15,633, n_{2010}=17,393, n_{2011}=18,474, n_{2012}=20,379, n_{2013}=22,718).

Scopus Subject	N Non-Zero/ All	Citation Median	Altmetric Score Median	Corr.
AGRI	782 886	11 11	1.50 1.25	.274** .229**
ARTS	170 208	6 4	1.50 1.00	.182* .248**
BIOC	2358 2833	17 17	1.25 1.00	.319** .242**
BUSI	212 264	8 7	1.00 1.00	.156* .169**
CENG	534 601	25 24	1.10 1.00	.181** .200**
CHEM	1098 1242	19 18	1.00 0.75	.214** .233**
COMP	364 547	10 10	1.00 0.50	.168** -.001
DECI	69 93	9 9	1.00 1.00	.129 .099
DENT	22 25	3.5 3	0.50 0.50	-.468* -.411*
EART	89 108	9 7	1.00 1.00	.358** .415**
ECON	139 168	7 6	1.25 1.00	.299** .320**
ENER	117 129	21 20	1.35 1.00	-.019 .103
ENGI	652 892	17 15	1.25 0.75	.307** .261**
ENVI	252 293	14 13	2.00 1.25	.213** .195**
HEAL	78 92	6 6	1.50 1.00	.369** .306**
IMMU	443 504	19 20	1.25 1.00	.307** .195**
MATE	817 1024	21 19	1.50 1.00	.242** .245**
MATH	232 320	7 6	1.00 0.63	.266** .161**
MEDI	2862 3540	12 11	1.25 1.00	.295** .193**
MULT	302 325	41.5 39	6.22 4.50	.497** .468**
NEUR	307 382	12 12	1.50 1.00	.302** .243**
NURS	179 223	9 9	1.75 1.00	.408** .302**
PHAR	214 256	15 14	1.00 0.75	.180** .207**
PHYS	903 1171	13 12	1.50 1.00	.331** .252**
PSYC	310 356	8 8	1.50 1.25	.350** .295**
SOCI	576 707	6 5	1.35 1.00	.283** .196**
VETE	20 21	13 12	0.75 0.50	-.184 -.053

Table 2. Spearman Correlations between Scopus Citations and Altmetric Scores.

Medicine (MEDI) and Biochemistry, Genetics and Molecular Biology (BIOC), have the highest rate of increase in altmetric coverage over the years.

RQ2: Correlation between Citation and Altmetrics

Spearman correlations between Scopus citation counts and Altmetric Score, number of CiteULike readers, number of Mendeley readers, number of Facebook mentions, number of blog posts and number of Twitter mentions are investigated. We calculate the correlation for both non-zero and all (both zero and non-zero) values. Non-zero means the zero and NA values are not considered for the calculations, n is usually lower than when all values (both zero and non-zero) are considered. In the cases where no value is available (NA), this is taken as 0. The statistical significance levels are taken at $^{**}p<.01$ and $^{*}p<0.5$.

As shown in Table 2, there are small to medium significant correlations measured between citation counts and Altmetric Score for most of the disciplines. The Multidisciplinary category (MULT) has the largest correlation (r=.497/.468, p<.01). Nursing (NURS) (r=.408/.302, p<.01), Earth and Planetary Science (EART) (r=.358/.415, p<.01), and Health (HEAL) (r=.369/.306, p<.01) also have larger correlations than the other disciplines.

Small to medium significant correlations between citation counts and the number of CiteULike readers were measured across most disciplines as shown in Table 3. Here again, the Multidisciplinary category (MULT) has the largest correlation (r=.540/.628, p<.01) followed by Mathematics (MATH) (r=.519/.347, p<.01). Veterinary (VETE) (N=0/21) and Dentistry (DENT) (N=0/25) could not be conclusively measured due to the small amount of available publications with CiteULike readers.

Scopus Subject	N Non-Zero/ All	Citation Median	CiteULike Median	Corr.
AGRI	195 886	21 11	2.00 0.00	.342** .310**
ARTS	22 208	10.5 4	1.00 0.00	.475* .194**
BIOC	715 2833	31 17	1.00 0.00	.321** .306**
BUSI	28 264	11 7	1.00 0.00	.415* .190**
CENG	72 601	50 24	1.00 0.00	.272* .201**
CHEM	115 1242	29 18	1.00 0.00	.066 .127**
COMP	123 547	19 10	2.00 0.00	.329** .218**
DECI	15 93	9 9	1.00 0.00	-.100 .021
DENT	0 25	 3	 0.00	
EART	8 108	16 7	1.00 0.00	.335 .147
ECON	8 168	17.5 6	1.00 0.00	.620 .171*

ENER	12 129	24 20	1.00 0.00	-.014 0
ENGI	152 892	20 15	1.00 0.00	.339** .080*
ENVI	29 293	25 13	1.00 1.01	.069 .150*
HEAL	11 92	14 6	1.00 0.00	-.176 .226*
IMMU	121 504	44 20	1.00 0.00	.311** .394**
MATE	95 1024	34 19	1.00 0.00	.006 .170**
MATH	79 320	18 6	2.00 0.00	.519** .347**
MEDI	539 3540	28 11	1.00 0.00	.260** .260**
MULT	153 325	90 39	2.00 0.00	.540** .628**
NEUR	89 382	25 12	1.00 0.00	.354** .354**
NURS	17 223	24 9	1.00 0.00	.505* .211**
PHAR	21 256	26 14	1.00 0.00	.426 .173**
PHYS	135 1171	24 12	1.00 0.00	.147 .170**
PSYC	52 356	14 8	1.00 0.00	.225 .257**
SOCI	78 707	13 5	1.00 0.00	.311** .266**
VETE	0 21	 12	 0.00	

Table 3. Spearman Correlations between Scopus Citations and CiteULike.

From the analysis, large significant correlations between citation counts and number of Mendeley readers were measured across nearly all disciplines. These results are shown in Table 4. The correlations across the disciplines were in this analysis rather comparable but the largest correlation was again found in Multidisciplinary (MULT) (r=.822/.829, p<.01). The lowest correlations were for Decision Sciences (DECI) (r=.374/406, p<.01).

Scopus Subject	N Non-Zero/ All	Citation Median	Mendeley Median	Corr.
AGRI	847 886	11 11	26 24.5	.700** .719**
ARTS	178 208	6 4	20.50 17	.540** .632**
BIOC	2773 2833	17 17	25 24	.660** .668**
BUSI	246 264	7 7	37.5 36	.649** .682**
CENG	585 601	25 24	25 25	.623** .637**
CHEM	1211 1242	18 18	18 17	.614** .631**
COMP	508 547	11 10	19 16	.512** .544**
DECI	91 93	9 9	23 22	.374** .406**
DENT	23 25	4 3	15 14	.679** .665**
EART	99 108	8 7	17 15.5	.747** .706**
ECON	151 168	7 6	27 22	.691** .735**
ENER	129 129	20 20	22 22	.578** .578**
ENGI	851 892	16 15	18 16	.686** .694**
ENVI	282 293	14 13	29 28	.562** .556**
HEAL	88 92	6 6	21.5 21	.614** .604**
IMMU	497 504	20 20	30 29	.715** .720**
MATE	994 1024	20 19	20 19	.715** .722**
MATH	295 320	7 6	13 12	.580** .588**
MEDI	3376 3540	12 11	18 17	.603** .627**
MULT	319 325	41 39	72 71	.822** .829**
NEUR	372 382	13 12	24 23.5	.573** .589**
NURS	210 223	9 9	17 16	.476** .513**
PHAR	249 256	14 14	15 15	.630** .651**
PHYS	1120 1171	13 12	18 17	.708** .705**
PSYC	339 356	9 8	35 32.5	.722** .732**
SOCI	620 707	6 5	21 17	.699** .728**
VETE	20 21	13 12	23.5 21	.536* .600**

Table 4. Spearman Correlation between Scopus Citations and Mendeley

For the majority of disciplines, there were low to no significant correlations between citation counts and Facebook mentions. The results are shown in Table 5. The best results were measured for the categories Nursing (NURS) (r=.483/.215, p<.01) and for Multidisciplinary (MULT) (r=.289/228, p<.01). Veterinary (VETE) (N=5) and Decision Sciences (DECI) (N=9) could not be conclusively measured due to the small amount of available publications with Facebook mentions.

Scopus Subject	N Non-Zero/ All	Citation Median	Facebook Median	Corr.
AGRI	187 886	12 11	1 0	.277** .074*

ARTS	22 207	11.5 4	1 0	.080 .095
BIOC	498 2833	20 17	1 0	.251** .079**
BUSI	27 264	8 7	1 0	.260 .008
CENG	76 601	23.5 24	1 0	.167 .050
CHEM	138 1242	20.5 18	1 0	.138 .052
COMP	56 547	14.5 10	1 0	.107 .088*
DECI	9 93	7 9	1 0	 -.004
DENT	3 25	3 3	1 0	-.866 -.183
EART	13 108	11 7	1 0	-.316 .026
ECON	14 168	13.5 6	1 0	.096 .032
ENER	24 129	35.5 20	1 0	-.273 .188*
ENGI	120 892	26.5 15	1 0	.117 .136**
ENVI	36 293	17 13	1 0	.277 .013
HEAL	25 92	7 6	1 0	.136 .097
IMMU	92 504	18.5 20	1 0	.274** .060
MATE	147 1024	22 19	1 0	.144 .063*
MATH	31 320	14 6	1 0	.074 .104
MEDI	707 3540	13 11	1 0	.254** .068**
MULT	93 325	66 39	1 0	.289** .228**
NEUR	67 382	13 12	1 0	.316** .078
NURS	55 223	13 9	1 0	.483** .215**
PHAR	52 256	15 14	1 0	.390** .091
PHYS	136 1171	17 12	1 0	.154 .098**
PSYC	40 356	9 8	1 0	.111 .046
SOCI	86 707	4 5	1 0	.024 -.073
VETE	5 21	18 12	1 0	 -.183

Table 5. Spearman Correlations between Scopus Citations and Facebook

Table 6 shows the results for the correlations between citation counts and number of blog posts. The correlations were also small for most disciplines. Multidisciplinary (MULT) (r=.351/.330, p<.01), Nursing (NURS) (r=.291/216, p<.01), and Agricultural Sciences (AGRI) (r=.241/206, p<.01), however have the best results compared to the other disciplines.

Scopus Subject	N Non-Zero/ All	Citation Median	Blog Posts Median	Corr.
AGRI	778 886	11 11	2 2	.241** .206**
ARTS	170 208	6 4	2 2	.245** .298**
BIOC	2353 2833	17 17	2 1	.173** .130**
BUSI	27 264	8 7	1 0	.015 .065
CENG	530 601	25 24	1 1	.131** .163**
CHEM	1092 1242	19 18	1 1	.078** .125**
COMP	362 547	10 10	1 1	.089 -.026
DECI	69 93	9 9	1 0	-.139 -.046
DENT	21 25	3 3	1 1	-.325 -.365
EART	86 108	9 7	1 1	.077 .222*
ECON	135 168	7 6	1 1	.082 .123
ENER	117 129	21 20	1 1	0,007 0,136
ENGI	648 892	17 15	1 1	.211** .194**
ENVI	247 293	14 13	2 1	.103 .102
HEAL	78 92	6 6	2 2	.209 .193
IMMU	443 504	19 20	2 1	.162** .080
MATE	809 1024	21 19	1 1	.117** .159**
MATH	232 320	7 6	1 1	.154* .102
MEDI	2861 3540	12 11	2 1	.157** .089**
MULT	302 325	41.5 39	4 4	.351** .330**
NEUR	307 382	12 12	2 1	.111 .103*
NURS	179 223	9 9	3 2	.291** .216**
PHAR	214 256	15 14	1 1	.066 .141*
PHYS	898 1171	13 12	1 1	.200** .175**
PSYC	309 356	8 8	2 2	.151** .136*
SOCI	574 707	6 5	2 2	.095* .038

VETE	20 21	13 12	1 1	-.495* -.399

Table 6. Spearman Correlations between Scopus Citations and Blog Posts

The results of the correlations between citation counts and Twitter mentions are shown in Table 7. There were overall small correlations measured for the majority of disciplines. However, Nursing (NURS) had medium to small statistically significant correlations (r=.333/184, p<.01). Multidisciplinary (MULT) also had medium statistically significant correlations for Non-Zero values (r=.411, p<.01).

Scopus Subject	N Non-Zero/ All	Citation (Median)	Twitter (Median)	Corr.
AGRI	599 885	11 11	2 1	.256** .112**
ARTS	152 208	6 4	2 1	.233** .254**
BIOC	1770 2833	16 17	2 1	.245** .002
BUSI	161 263	7 7	1 1	.059 -.062
CENG	386 601	27 24	1 1	.114* .108**
CHEM	783 1242	18 18	1 1	.099** .001
COMP	270 547	8 10	1 1	.195** -.118**
DECI	51 92	8 9	1 1	-.117 -.132
DENT	18 25	3 3	1 1	-0.124 -0.157
EART	63 108	8 7	1 1	.323** .054
ECON	96 168	6 6	1 1	.178 -.094
ENER	59 129	21 20	1 0	.104 .041
ENGI	405 892	16 15	1 0	.252** .067*
ENVI	169 293	13 13	1 1	.161* -.033
HEAL	72 92	6 6	2 1	.219 .136
IMMU	313 504	15 20	2 1	.203** -.096*
MATE	481 1024	21 19	1 0	.127** .042
MATH	183 320	6 6	1 1	.226** -.055
MEDI	2328 3540	11 11	2 1	.188** -.019
MULT	249 325	33 39	4 2	.411** .105
NEUR	236 382	10.5 12	2 1	.183** -.028
NURS	158 223	9 9	2 1	.333** .184**
PHAR	160 256	14 14	1 1	.178* .034
PHYS	585 1171	12 12	1 1	.187** .027
PSYC	264 356	7 8	2 1	.196** .022
SOCI	464 707	6 5	2 1	.097* -.037
VETE	13 21	12 12	2 1	-.575* -.294

Table 7. Spearman Correlations between Scopus Citations and Twitter

Overall, the results from Tables 3 – 7 are comparable to results from other studies in the literature. Small to medium correlations were measured across most disciplines for Altmetric Score, CiteULike, and Twitter. Large correlations for Mendeley, and small to no correlations for Facebook, and blog posts.

There were distinct differences between the results for the different disciplines. Interesting is that the high coverage of altmetrics in some disciplines, for example in Medicine (MEDI), or Biochemistry, Genetics and Molecular Biology (BIOC), did not automatically lead to large correlations with citation counts. Amongst the disciplines, particularly interesting is that the subject area Multidisciplinary (MULT) seems to achieve larger correlations across all metrics compared to the other disciplines. Further investigations into the content of these articles would give deeper insights into the reasons for the differences.

CONCLUSION AND OUTLOOK

In this paper, we analyse the altmetric landscape of Singapore, aiming to find out how the coverage of altmetrics across the different disciplines has progressed in recent years. We also look into how altmetrics relate to traditional citation counts as a measure of research impact. Results show that there has been an increase in altmetrics coverage across most disciplines between 2009 and 2013, with an overall 18% coverage of altmetrics. Correlation results between citation counts and altmetrics show medium to small correlations for most disciplines, with distinct differences amongst the various disciplines. This supports findings by Haustein et al. (2014) that altmetrics do not necessarily reflect citation impact and that they probably measure different types of impact. A high altmetric coverage in some disciplines however did not seem to lead to large correlations with citation counts. Singapore thus remains an interesting case study to continue investigating in the coming years.

There however remain many unanswered questions and these investigations are part of an ongoing project aiming to research into the potential altmetrics offer as a new metric to measure research impact. As part of this project, we have started a world-wide survey to investigate the awareness and familiarity of traditional metrics and altmetrics, examine their usage of traditional metrics and altmetrics, as well as hindrances for not using them, to investigate the researchers' strategies to promote their research and to find out the influential factors affecting the usage of altmetrics among researchers.

Furthermore, we plan to interview key players at the NTU Singapore to gain a deeper insight into how they evaluate research outputs and the value they place on traditional metrics and altmetrics in the evaluation process. Thus the analysis of the Singapore altmetrics landscape forms a basis for these further investigations. The ultimate goal of the project is to create a cross-metric validation framework and tool to help researchers and institutions better analyse and compare the impact of altmetrics with traditional metrics.

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